RESEARCH ARTICLE



Redescription of Chribellphorura allanae (Christiansen & Bellinger, 1980) (Collembola, Onychiuridae), with comments on the systematic position of the genus

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Abstract

Chribellphorura allanae (Christiansen & Bellinger, 1980), a poorly known Nearctic springtail, is redescribed and important morphological characters are illustrated (Figs 1–7). The genus is characterized by the following characters: postantennal organ with one vesicle divided into five lobes, antennal segment IV with apical vesicle closely flanked by two papillae, sense organ of the third antennal segment with four papilla, four guard setae, two straight sensory clubs and two sensory rods, very similar in shape and length, labial palp of 0-type, abdominal sternum IV divided ventrally into two subsegments, furcal remnant as a finely granulated area with three rows of setae posteriorly, tibiotarsi with clavate setae in distal whorl and anal spines present. The taxonomic status of this *Chribellphorura* is also discussed.

Keywords

Morphology, Nearctic, Oligaphorurini, taxonomy

Introduction

The monotypic genus *Chribellphorura* was established by Weiner (1996) to accommodate *Onychiurus (Archaphorura) allanae* described by Christiansen and Bellinger (1980) from localities in Oregon, USA. Weiner erected the new genus in the tribe Oligaphorurini and emphased as its distinguishing characters the presence of an apical vesicle on the antennal segment IV and clavate dorso-distal setae on the tibiotarsi.

In connection with a phylogenetic analysis of the Oligaphorurini (Paśnik and Weiner 2017) and in order to clarify the status of *Chribellphorura*, its type species has been reexamined. As the original description of *C. allanae* is incomplete and we have found differences between the original description and the specimen examined, the current paper presents a redescription of the *C. allanae*, illustrations of its most important taxonomic features, and notes on its taxonomic position.

Material and methods

Morphological terms

Labial types are named after Fjellberg (1999). Setae on furcal and manubrial areas are notated after Paśnik and Weiner (2017). Setae on anal valves are named following Yosii (1966).

Abbreviations

Ant.	antennal segments,	Ms	s-microsetae (ms) (microsensillum),
Th.	thoracic segments,	Pso	pseudocellus,
Abd.	abdominal segments,	Psx	parapseudocellus,
AIIIO	sensory organ of Ant. III,	VT	ventral tube.
PAO	postantennal organ,		

Taxonomy

Chribellphorura allanae (Christiansen & Bellinger, 1980) Figs 1–7

Onychiurus (Archaphorura) allanae Christiansen & Bellinger, 1980: 406.

Type material. Paratype, female (No. Insect Collection 529.3270): USA, Corvallis, Benton Co., Oregon, under loose bark of fir tree, 1967, leg. Fitzgerald, housed in Il-linois Natural History Survey, Insect Collection.

Diagnosis. Pso formula as 32/122/23343 dorsally and 2/000/00000 ventrally; AIIIO with four papillae, four guard setae, two smooth, straight sensory clubs and two smooth sensory rods in the middle, subequal in length to sensory clubs; Abd. sternum IV divided ventrally into two subsegments; Ant. IV with apical vesicle flanked by two papillae; PAO with one five-lobed vesicle; Labium of type 0; Tibiotarsi I–III with 2,3,3 clavate tenent setae.



Figures 1–6. *Chribellphorura allanae*: **1** Habitus and dorsal chaetotaxy **2** Dorsal side of Ant. III–IV **3** Ant. IV apical vesicle from dorsal (upper) and ventral view (lower) **4** Sensorial elements of AIIIO **5** PAO and anterior cephalic pso **6** Abd. IV, furcal remnant.



Figure 7. Chribellphorura allanae: Tibiotarsi and claws of legs I-III.

Redescription. Length up to 2.0 mm, specimen examined (female) 1.3 mm. Colour in alcohol white (red when alive; Christiansen and Bellinger 1980). Body shape cylindrical, abdomen slightly broadened in the region of Abd. III and IV (Fig. 1). Granulation homogenous.

Antennae thin, shorter than head, not club-like, their base not marked. Ant. I with 10 setae, Ant. II with 16 setae. AIIIO consisting of four papillae, four guard setae, two smooth, straight sensory clubs and two smooth sensory rods in the middle, subequal in length to sensory clubs (Fig. 4), ventro-lateral s-microsetae (ms) present (Fig. 2). Ant. IV with small subapical organite and apical vesicle with two closely flanked papillae (giving the impression of a trilobed vesicle) (Fig. 3) and s-microsetae (ms) located in the middle of the segment (Fig. 2).

PAO with one five-lobed vesicle (5 or 6 lobed; Christiansen and Bellinger 1980), located in a depression with schitinised edges, subequal in length to the nearest pseudocellus (Fig. 5). Seta d0 on the head absent. Labral formula of setae: 4/342. Maxillary palp simple with two sublobal hairs. Labial type 0. Labium with four basal and five basolateral setae.

Dorsal pso formula as 32/122/23343 (Fig. 1), ventrally as 2/000/00000. Abd. terga II–III with pso c located in antero-lateral position (Fig. 1). Psx indistinct. Subcoxa 1 of legs I–III with 1,1,1 pso and 5,5,5/6 setae respectively. Dorsal chaetotaxy asymmetrical, setae relatively short, weakly differentiated into macro- and microsetae. Sensory setae s undifferentiated. Th. tergum I with 4+5 setae. Th. tergum II–III with lateral s-microsetae (ms). Abd. tergum VI with medial setae a0 and p0. Anal spines small and straight, set on small papillae, 0.33 as long as inner edge of claw (Fig. 1). Th. sterna I–III without setae. VT tube with 7+7 distal setae and 2+2 setae at base. Abd. sternum IV elongated, divided ventrally into two subsegments, below this division with four setae in the middle of segment (Fig. 6). Furcal vestige reduced to field of fine granulation. Chaetotaxy of manubrial field with four setae in ma-row, four setae in mm-row and five setae in mp-row (Fig. 6). Anal valves with numerous acuminate setae, each lateral valve with a0 and 2a1; upper valves with setae a0, 2b1, 2b2, c0, 2c1, 2c2.

Tibiotarsi I–III with 22, 22, 21 setae respectively, distal tibiotarsal whorl with 11 setae (Fig. 7). Distal whorl on tibiotarsi I–III with 2,3,3 clavate tenent setae respectively (Fig. 7). Claw without denticle. Empodial appendage without basal lamella and 0.45 as long as inner edge of claw (Fig. 7).

Discussion

Christiansen and Bellinger's description of the *Chribellphorura allanae* is very abbreviated and does not contain features of taxonomic value introduced for this group in later years. In addition, several of the characters in the original description do not match those of the specimen we examined. These differences are shown in Table 1.

Recent phylogenetic studies of Oligaphorurini (Paśnik and Weiner 2017) recover *Chribellphorura* as a monophyletic group. The genus was placed in the basal position on the tree as a sister group to the remaining taxa. This specialised genus has several features which are absent or rare in the subfamily Onychiurinae: antennal segment IV with apical vesicle closely flanked by two papillae; sense organ of the third antennal segment with sensory elements consisting of two sensory clubs and two sensory rods, which are straight and smooth, and very similar in shape and length; labial palp of 0-type and tibiotarsi with clavate setae in distal whorl.

The genus *Chribellphorura* shares only one feature with the other members of Oligaphorurini, namely the shape of the postantennal organ. However, the use of postantennal organ (PAO) as the main feature to divide Onychiurinae into tribes has already been criticized as a feature that often divides related genera into separate evolutionary lines (e.g. Pomorski 1998). In addition, the definition of tribes based on a single character is insufficient.

Traditionally, the tribes of Onychiurinae have previously been defined by character combinations, which mainly include: the shape of the postantennal organ, the build of the sense organ of the third antennal segment, the presence/absence of pseudocelli and anal spines, the reduction of furca, the chaetotaxy of tibiotarsi, and the distribution of sensory setae on the body. Unfortunately, most of these characters are variable, scattered among the genera, and no longer distinguish the different tribes even when used in combination with other features.

At present, the systematic position of *Chribellphorura* within Oligaphorurini is uncertain and should be studied in greater detail.

Character	Original description	Paratype studied	
	Christiansen and Bellinger (1980)		
Ant. IV – apical vesicle	Trilobed apical bulb	Apical vesicle flanked by two papillae (Fig. 3)	
Sensorial elements of AIIIO	three sensory elements shown in	two sensory clubs and two sensory rods (Fig. 4)	
	fig. 319D (2 clubs and 1 sensory rod?)		
Th. tergum I – no. of setae	7 setae (fig. 319A)	4+5 setae (Fig. 1)	
Th. tergum I – no. of pso	absent (fig. 319A) 1 pso (Table VII)	1 pso	
Th. tergum II – no. of pso	3 pso shown (fig. 319A)	2 pso	
Th. tergum V – no. of pso	4 pso shown (fig. 319A)	3 pso	
	3 pso (Table VII)		
Abd. sternum IV	no mention	divided into two subsegment	
Ventral tube – no. of setae	6-8+6-8 distal setae	7+7 distal and 2+2 basal setae	
Anal spines	curved	straight	
Tibiotarsi I–III clavate	with 3 strongly clavate tenent hairs	2,3,3 setae present (Fig. 7)	
tenent setae in distal whiorl			
Empodium: Claw ratio	0.60–0.67	0.45	

Table 1. Differences between the original description of *Chribellphorura allanae* and the studied paratype.

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RESEARCH ARTICLE



Introduction of the Exocelina casuarina-group, with a key to its representatives and descriptions of 19 new species from New Guinea (Coleoptera, Dytiscidae, Copelatinae)

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Abstract

Nineteen new species of *Exocelina* Broun, 1886 from New Guinea are described herein: *E. adelbertensis* **sp. n.**, *E. ambua* **sp. n.**, *E. bewani* **sp. n.**, *E. cyclops* **sp. n.**, *E. ibalimi* **sp. n.**, *E. keki* **sp. n.**, *E. kumulensis* **sp. n.**, *E. mendiensis* **sp. n.**, *E. menyamya* **sp. n.**, *E. okapa* **sp. n.**, *E. piusi* **sp. n.**, *E. pseudofume* **sp. n.**, *E. pseudofume* **sp. n.**, *E. seudofuse* **sp. n.**, *E. nokapa* **sp. n.**, *E. simbaiensis* **sp. n.**, *E. pseudofume* **sp. n.**, *E. sumokedi* **sp. n.**, *and E. yoginofi* **sp. n.** All of them, together with five already described species, have been united into the newly defined *casuarina*-group, a polyphyletic complex of related species with similar shape of the median lobe and paramere setation. An identification key to all known species of the group is provided, and important diagnostic characters (habitus, color, male protarsomeres 4–5, median lobes, and parameres) are illustrated. Data on the distribution of the species are given, showing that most of the species occur in the central, mountain part of Papua New Guinea.

Keywords

Copelatinae, Dytiscidae, Exocelina casuarina-group, key, New Guinea, new species

Introduction

Herein, we introduce the new species group of the genus *Exocelina* Broun, 1886. After the *ekari*-group with 51 species, it is the second largest species group of the New Guinea *Exocelina* (Balke et al. 2007, Shaverdo et al. 2012, 2014, 2016a). The group includes 24 species: 19 new species, which are described and illustrated here, and five previously known species: *E. casuarina* (Balke, 1998), *E. fume* (Balke, 1998), *E. desii* (Balke, 1999), *E. heidiae* (Balke, 1998), and *E. messeri* (Balke, 1999). Based on the results of a molecular phylogenetic analysis and morphological study, these species are suggested to be closely related and form a monophyletic complex including two monotypic groups (undescribed species) and the *okbapensis*- and *aipo*-groups (Fig. 1; Balke 1998; Balke et al. 2007; Shaverdo and Balke 2014; Shaverdo et al. 2017; Toussaint et al. 2014, 2015). Also, they build the core of a larger monophyletic complex (including the *ullrichi*-group), which is a sister clade to all other New Guinea *Exocelina* (Toussaint et al. 2015). Morphologically, species of the *casuarina*-group are identified by a complex of characters, among which the important ones are shape of the paramere and median lobe and setation of the paramere.

Including the results of this work, 125 species of *Exocelina* are described from New Guinea and 180 species worldwide.

As in most of our previous papers on the genus (Shaverdo et al. 2012, 2013, 2014, 2016a, b, c, 2017), all species data will be presented on the species-id.net portal automatically created by ZooKeys with the publication of this paper.

Material and methods

The present work is based on material from the following collections:

ANIC	Australian National Insect Collection, Canberra, Australia		
BMNH	The Natural History Museum, London, UK		
CLH	Collection of Lars Hendrich, Munich, Germany (property of NHMW)		
IECA	Institute of Entomology, Biology Centre ASCR, České Budějovice,		
	Czech Republic		
MNHN	Muséum National d'Histoire Naturelle, Paris, France		
MZB	Museum Zoologicum Bogoriense, Cibinong, Indonesia		
NHMW	Naturhistorisches Museum Wien, Vienna, Austria		
NHMB	Naturhistorisches Museum Basel, Switzerland		
ZSM	Zoologische Staatsammlung München, Munich, Germany		

All methods follow those described in detail in our previous articles (Shaverdo and Balke 2014, Shaverdo et al. 2012, 2014). All specimen data are quoted as they appear on the labels attached to the specimens. Label text is cited using quotation marks. Comments in square brackets are ours. The following abbreviations were used: TL (total body length), TL-H (total body length without head), MW (maximum body width), and hw (handwritten). Figure 1 shows phylogenetic relationships of species within the *Exocelina casuarina*-group based on the MrBayes phylogenetic tree in figure S1 of Toussaint et al. (2015) and includes results of most recent phylogenetic investigations (Shaverdo and Balke in preparation).

Checklist and distribution of the species of the Exocelina casuarina-group

	Species	Distribution
1.	Exocelina adelbertensis sp. n.	PNG: Madang
2.	<i>Exocelina ambua</i> sp. n.	PNG: Southern Highlands
3.	<i>Exocelina bewani</i> sp. n.	PNG: Sandaun
4.	Exocelina casuarina (Balke, 1998)	IN: Papua: Nabire
5.	<i>Exocelina cyclops</i> sp. n.	IN: Papua: Jayapura
6.	Exocelina desii (Balke, 1999)	PNG: East Sepik, Simbu, Eastern and
		Western Highlands
7.	Exocelina fume (Balke, 1998)	IN: Papua: Pegunungan Bintang
8.	Exocelina heidiae (Balke, 1998)	PNG: Morobe
9.	<i>Exocelina ibalimi</i> sp. n.	PNG: Sandaun
10.	<i>Exocelina keki</i> sp. n.	PNG: Madang, Eastern Highlands
11.	<i>Exocelina kumulensis</i> sp. n.	PNG: Enga
12.	<i>Exocelina mendiensis</i> sp. n.	PNG: Southern Highlands
13.	<i>Exocelina menyamya</i> sp. n.	PNG: Morobe
14.	Exocelina messeri (Balke, 1999)	PNG: East Sepik
15.	<i>Exocelina okapa</i> sp. n.	PNG: Eastern Highlands
16.	<i>Exocelina piusi</i> sp. n.	PNG: East Sepik
17.	<i>Exocelina pseudofume</i> sp. n.	PNG: Madang
18.	<i>Exocelina pseudopusilla</i> sp. n.	PNG: Simbu
19.	<i>Exocelina pusilla</i> sp. n.	PNG: Madang, Simbu
20.	<i>Exocelina sima</i> sp. n.	PNG: Eastern Highlands, Simbu
21.	<i>Exocelina simbaiensis</i> sp. n.	PNG: Western Highlands
22.	<i>Exocelina simbaijimi</i> sp. n.	PNG: Western Highlands
23.	<i>Exocelina sumokedi</i> sp. n.	IN: Papua: Puncak
24.	<i>Exocelina yoginofi</i> sp. n.	PNG: Eastern Highlands

Abbreviations: IN Indonesia; PNG Papua New Guinea.

Notes on diagnostic characters and phylogeny of the Exocelina casuarina-group

The diagnostic characters of the group are:

- beetles small or medium-sized (TL-H 2.7-5.5 mm);

- habitus elongate to oval, in most species oblong-oval (broadest approximately at elytral midlength); with rounded pronotal and elytral sides, body outline continuous;
- pronotum short, trapezoidal, with posterior angles not drawn backwards;
- coloration reddish to piceous, mainly uniform, sometimes with paler head and pronotum and darker elytra;
- microreticulation and punctation of dorsal surface very fine to strongly impressed, beetles shiny to matt dorsally;
- metacoxae and abdominal ventrites 1–5 (and 6 in males) with thin, almost longitudinal striae/strioles;
- pronotum and elytra without striae or strioles;
- pronotum with or without lateral bead;
- antennomeres not modified;
- male protarsomeres 1–3 not expanded laterally;
- male protarsomere 4 cylindrical, narrow, with anterior angle slightly expanded in some species, with a large, hook-like to thin, long, slightly curved anterolateral seta;
- male protarsomere 5 long and narrow, sometimes slightly concave ventrally;
- median lobe of aedeagus with continuous outline in ventral and lateral view; almost straight or slightly curved in lateral view; in ventral view, almost parallel-sided, often narrowed distally before apex or towards it, or broadened subdistally; apex usually with thickened sides, slightly or distinctly enlarged ("swollen", often ventrally of shape of a baby pacifier), rounded, truncate, or slightly concave in ventral view;
- ventral sclerite of median lobe more or less deeply divided apically;
- median lobe without setation, in some species with minuscule spines;
- paramere without dorsal notch and with long, dense, thin setae, situated along dorsal margin, subdistal setae usually denser and stronger than proximal ones.

Although the species of the group do not form a monophyletic complex with the distinguished autapomorphic morphological character (Fig. 1; Toussaint et al. 2014, 2015), we designate this species group since its representatives are assumed to be closely related and for ease of their identification. The group can be clearly differentiated (keyed out) using the characters proposed above (also in Shaverdo and Balke in preparation). Additionally, most of its species are readily distinguished by the thickened apex of their median lobe in lateral view, which is a character in common for all the members of this group. Surprisingly, in ventral view, this "swollen" apex can be very differently formed, from broadly pointed to truncate or slightly concave. In addition, the shape (absence of dorsal notch) and setation (subdistal setae denser than proximal ones) of the paramere is useful for species differentiation of this group, especially the few species that do not have this characteristic "swollen" apex or where it is not strongly enough expressed, from some species of the *okbapensis*- and *ransikiensis*-groups.

Phylogenetically, the group is polyphyletic and includes five different clades, which are partially supported morphologically and contribute to two larger monophyletic complexes: 1) clades I and II plus the *okbapensis*-group and 2) clades III, IV, and V plus

two monotypic groups (two undescribed species, which are very different morphologically from all the other species of the clades) (Fig. 1; Toussaint et al. 2015).

Clade I includes *E. simbaiensis* sp. n., *E. yoginofi* sp. n. and, probably, *E. okapa* sp. n. (based on morphology). These species build a monophyletic complex with the species of the *okbapensis*- and *aipo*-groups. Interestingly, the two latter species demonstrate a distinct similarity with the species of the *okbapensis*-group in the shape of the median lobe and setation of paramere, though *E. simbaiensis* sp. n. does not.

Clade II is morphologically rather heterogeneous and is comprised of the largest (size) representatives of the group. Three of them, *E. desii*, *E. simbaijimi* sp. n. and, probably, *E. heidiae* (based on morphology), form a monophyletic complex and have broad, similar in shape median lobes. The remainder have median lobes distinctly narrower and more different in shape.

Clade III includes species without lateral pronotal bead, except for *Exocelina piusi* sp. n., which has narrow but distinct pronotal bead and seems to form a separate lineage. There are two monophyletic complexes in the clade: 1) *E. casuarina, E. fume*, and *E. ibalimi* sp. n. with a large, hook-like anterolateral seta of the male protarsomere 4 and 2) *E. keki* sp. n. and *E. pseudofume* sp. n. with a thin, long, slightly curved anterolateral seta of the male protarsomere 4, as well as *E. messeri* and *E. sima* sp. n., which also have a similar shape of this seta. The representatives of this clade best demonstrate a "swollen" apex of the median lobe.

Clade IV is the most homogeneous and includes the smallest in size species of the group. They are morphologically very similar, and three of them, *E. cyclops* sp. n., *E. bewani* sp. n., and *E. adelbertensis* sp. n., are a good example of recent allopatric speciation along the north coast of New Guinea (Toussaint et al. 2014).

Clade V includes two very different species. Exocelina menyamya sp. n. is the most uncharacteristic representative of the group because the apex of its median lobe is thin, flattened, and with ventral impression. The second species is *E. pusilla* sp. n., one of the smallest species of the group. Based on its size and coloration, this species could have been placed into the clade IV but the molecular analysis, as well as the shape of its median lobe, showed that it is a separate lineage of inland mountain Exocelina. Most likely E. pseudopusilla sp. n. belongs to this clade too. This species is very similar to E. pusilla sp. n., but larger and more elongate, with denser and coarser dorsal punctation and microreticulation and different shape of the median lobe (for more details on species delimitation, see the species descriptions). Exocelina pusilla sp. n. has wider distribution. Both species are known from the Mount Wilhelm, but from different altitudes: E. pusilla sp. n. only from 200 m (from other localities, it is known from up to 500 m) and E. pseudopusilla sp. n. only from 1200 m. If this species delimitation is correct, then this is the first distinct example in Exocelina of altitudinal peripatric speciation, which is also assumed for the Exocelina species of Weyland area (Toussaint et al. 2014).

Thus, this group, as defined now, is the subject of further study and may be divided into subgroups or even groups as and when additional species are discovered.



Figure 1. Phylogenetic relationships of the *Exocelina casuarina*-group based on the MrBayes phylogenetic tree in figure S1 of Toussaint et al. (2015).

Species descriptions (in alphabetic order)

1. Exocelina adelbertensis Shaverdo & Balke, sp. n.

http://zoobank.org/3DB2B98C-7582-4CA5-92CC-A3962AC09EC4 Figs 14, 38

Exocelina undescribed sp. MB1297: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina adalbert_*New_Guinea_MB1297: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Madang Province, Adelbert Mts, Keki to Sewan, 04°41.80'S, 145.25.46'E, 650 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Madang, Adalbert [sic!] Mts., Keki to Sewan, 650m, 7.v.1994, 04.41.802S 145.25.460E, Balke (PNG 54)", "M.Balke 1297" [green] (ZSM).

Description. *Body size and form*: Beetle small: TL-H 3.1 mm, TL 3.4 mm, MW 1.9 mm, with broader, oval habitus.

Coloration: Brownish, with head and pronotum paler. Head reddish brown, darker posterior to eyes. Pronotum reddish brown on sides, dark brown on disc. Elytra brown. Head appendages yellowish red, legs reddish, distally darker, especially metathoracic legs (Fig. 14).

Surface sculpture: Submatt dorsally. As in *E. sumokedi* sp. n., except for more strongly impressed microreticulation.

Structures: Pronotum with lateral bead. Its lateral sides with longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, rounded anteriorly. Blade of prosternal process lanceolate, relatively broad, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 slightly truncate.

Male: Antennae simple (Fig. 14). Protarsomere 4 with medium-sized, thick, curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with anterior row of 17 and posterior row of 6 relatively short, thin setae (Fig. 38D). Median lobe in lateral view slightly curved, with thickened, angulate apex; in ventral view, subparallel, very slightly narrowed distally, and with broadly truncate apex. Paramere slightly concave on dorsal side and with dense setae on subdistal part; proximal setae sparser (Fig. 38A–C). Abdominal ventrite 6 with 4–5 lateral striae on each side.

Female: Unknown.

Affinities. Exocelina adelbertensis sp. n. is very similar to E. sumokedi sp. n. and E. bewani sp. n. but it has slightly more strongly impressed microreticulation, therefore, dorsal surface is distinctly less shiny. Median lobe is more thickened, similar to that of E. sumokedi sp. n. but its apex is curved downwards and with stronger terminal angulation. The species is also similar to E. cyclops sp. n., E. pseudopusilla sp. n., and E. pusilla sp. n., see their "Affinities" and the "Key".

Distribution. Papua New Guinea: Madang Province. The species is known only from the type locality (Fig. 50).

Etymology. The species is named after Adelbert Mountains. The species name is an adjective in the nominative singular.

2. Exocelina ambua Shaverdo & Balke, sp. n.

http://zoobank.org/E9D7093B-F927-45D4-8A84-9E76A639FD39 Figs 21, 45

Exocelina undescribed sp. MB1290: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina ambuaensis*_New_Guinea_MB1290: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Southern Highlands Province, Tari, Mt Ambua, 05°57.55'S, 143°04.99'E, 2,100 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Southern Highlands, Tari, Mt Ambua, 2100m, 14.v.2006, 05.57.550S 143.04.993E, Balke (PNG 64)" (ZSM). *Paratypes*: 3 males, 2 females with the same label as the holotype, one of the males with an additional green label "M.Balke 1290" (NHMW, ZSM).

Description. *Body size and form:* Beetle medium-sized: TL-H 4.3–4.7 mm, TL 4.8–5.2 mm, MW 2.2–2.5 mm (holotype: TL-H 4.4 mm, TL 4.8 mm, MW 2.3 mm), with oblong habitus.

Coloration: Brown to piceous, with head and pronotum paler. Head reddish brown to piceous, with small darker areas posterior to eyes. Pronotum dark brown to piceous, paler on sides and darker on disc. Elytra dark brown to piceous, with vague narrow reddish to brownish sutural lines. Head appendages and legs proximally reddish brown, legs distally darker, brownish, especially metathoracic legs (Fig. 21).

Surface sculpture: Matt dorsally. Head with dense, coarse punctation (no spaces between punctures or spaces 2 times size of punctures), finer and sparser anteriorly; diameter of punctures equal to diameter of cells of microreticulation. Pronotum and elytra with dense, coarse punctation, sparser and finer than on head. Pronotum and elytra with strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles, abdominal ventrites with distinct microreticulation and strioles. Metaventrite medially, metacoxal plates, and abdominal ventrites with fine, sparse punctation.

Structures: Pronotum with distinct lateral bead. Its lateral sides with distinct longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, rounded anteriorly. Blade of prosternal process lanceolate, relatively narrow, slightly convex, and smooth, with distinct lateral bead and few lateral setae. Abdominal ventrite 6 slightly truncate.

Male: Antennae simple (Fig. 21). Protarsomere 4 with anterior angle slightly expanded, with large, thick, strongly curved anterolateral hook-like seta. Protarsomere

5 slightly concave ventrally, with anterior band of ca 70 and posterior band of ca 30 relatively long setae (Fig. 45D). Median lobe in lateral view short, slightly curved, and evenly tapering to dully pointed apex, apex not bent downwards; in ventral view, almost subparallel and distally slightly narrowed to apex, apex roundly truncate. Paramere slightly concave on dorsal side, with long, dense subdistal setae, proximal ones finer (Fig. 45A–C). Abdominal ventrite 6 with 13–15 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. *Exocelina ambua* sp. n. is similar to *E. mendiensis* sp. n. but differs from it in smaller size, coarser and denser dorsal punctation and microreticulation, and shape of the median lobe.

Distribution. Papua New Guinea: Southern Highlands Province. The species is known only from the type locality (Fig. 50).

Etymology. The species is named after Mt Ambua. The name is a noun in the nominative singular standing in apposition.

3. Exocelina bewani Shaverdo & Balke, sp. n.

http://zoobank.org/8B3BBF57-4E24-446C-BC66-44AB12E15B7E Figs 13, 37

Exocelina undescribed sp. MB1296: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina bewani_*New_Guinea_MB1296: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Sandaun Province, Bewani Mts, approximately 03°05.13'S, 141°10.23'E., 400 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Sandaun, Bewani Stn., limestone creek@base of Bewani Mts., 400 m, 12.iv.2006, nr. 03.05.130S 141.10.227E, Balke & Sagata (PNG 39)", "M.Balke 1296" [green] (ZSM). *Paratypes*: 2 males, 1 female with the same label as the holotype (NHMW, ZSM).

Description. *Body size and form:* Beetle small: TL-H 3.05–3.25 mm, TL 3.35–3.55 mm, MW 1.8–1.9 mm (holotype: TL-H 3.05 mm, TL 3.35 mm, MW 1.8 mm), with broader, oval habitus.

Coloration: Brownish, with head and pronotum paler. Head reddish brown to brownish, sometimes paler anteriorly. Pronotum reddish brown on sides, brown to dark brown on disc. Elytra brown to dark brown, sometimes with narrow reddish sutural lines. Head appendages yellowish red, legs reddish, distally darker, especially metathoracic legs (Fig. 13).

Surface sculpture: Shiny but with dense, distinct punctation dorsally. As in E. sumokedi sp. n.

Structures: Pronotum with lateral bead. Its lateral sides with shallow longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, narrowly rounded anteriorly. Blade of prosternal process lanceolate, relatively broad, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 slightly truncate.

Male: Antennae simple (Fig. 13). Protarsomere 4 with medium-sized, thick, curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with anterior row of 21 and posterior row of 4 relatively short setae (Fig. 37D). Median lobe in lateral view slightly curved, with slightly thickened, angulate, and curved downwards apex; in ventral view, subparallel, with broad and slightly concave apex. Paramere slightly concave on dorsal side and with dense setae on subdistal part; proximal setae sparser (Fig. 37A–C). Abdominal ventrite 6 with 3 or 4 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. Exocelina bewani sp. n. is very similar to E. sumokedi sp. n. but is larger and has a less striated abdominal ventrite 6; also, its median lobe is not narrowed distally in ventral view and with apex broad and slightly concave ventrally and curved downwards in lateral view. The species is also similar to E. adelbertensis sp. n., E. cyclops sp. n., E. pseudopusilla sp. n., and E. pusilla sp. n., see their "Affinities" and the "Key".

Distribution. Papua New Guinea: Sandaun Province. The species is known only from the type locality (Fig. 50).

Etymology. The species is named after the Bewani Mountains. The name is a noun in the nominative singular standing in apposition.

4. Exocelina casuarina (Balke & Hendrich, 1998)

Figs 2, 26

- Copelatus (Papuadytes) casuarinus Balke & Hendrich, 1998 in Balke 1998: 328; Nilsson 2001: 76 (catalogue).
- Papuadytes casuarinus (Balke & Hendrich, 1998): Nilsson and Fery 2006: 56 (comb. n.).
- *Exocelina casuarina* (Balke & Hendrich, 1998): Nilsson 2007: 33 (comb. n.); Nilsson and Hájek 2018: 65 (catalogue).

Type locality. Papua: Nabire Regency, 62 km of road Nabire to Enarotali, ca 03°30.936'S, 135°42.945'E, 250 m a.s.l. Note: the road only goes up to Enarotali, Ilaga is much further in the mountains, therefore, people now refer to the road as Nabire-Enarotali.

Type material studied. *Holotype*: male "IR 23-W. New Guinea, track Nabire-Ilaga, KM 62, 250m, 24.vii.1991 Balke & Hendrich leg.", "HOLOTYPUS" [red], "Copelatus casuarinus Balke des. 1997" [red] (NHMW). *Paratypes*: 3 males with the same labels as the holotype and with red labels "Paratypus Copelatus casuarinus Balke des. 1997", one of them additionally with labels "M.Balke 3281" [green] and "M.Balke 6408" [green text] (NHMW). Additional material. 1 female "IRIAN JAYA: Paniai Prov. road Nabire-Ilaga, km 65 29.8.1996, 250m leg. M. Balke (96 # 6)" (NHMW). 4 males, 2 females "West New Guinea/Paniai Prov/JR 22 track Nabire-Ilaga km 62 250m, 24.7.1991, forest pools leg. Balke & Hendrich" (CLH). 1 male "W.-Neuguinea/Paniai Prov. Straße Nabire-Ilaga km 5 700m, 22.-2.9.1990/IR 11 leg: Balke & Hendrich" (CLH).

Diagnosis. For complete description, see Balke (1998: 328). Beetle medium-sized: TL-H 3.6–4.05 mm; oblong-oval; reddish brown to dark brown, sometimes with reddish to reddish brown pronotal sides and head anteriorly; submatt, with fine but rather dense punctation and strongly impressed microreticulation; pronotum without lateral bead; male antennae simple (Fig. 2); male protarsomere 4 with large, thick, strongly curved anterolateral hook-like seta; male protarsomere 5 long and narrow, with anterior band of more than 60 and posterior row of 12 relatively long, thin setae (Fig. 26D); median lobe in lateral view slightly curved and apically rounded, in ventral view, almost subparallel and not narrowed before truncate or slightly concave apex; paramere slightly concave on dorsal side and with long, dense, thin setae, situated along dorsal margin: subdistal setae strong and dense, setae in middle part shorter and sparser, proximal setae long but sparser than subdistal ones (Fig. 26A–C). Female without evident differences in external morphology from males, except for non-modified pro- and mesotarsi and abdominal ventrite 6 without striae.

Affinities. Exocelina casuarina is the only species of the casuarina-group in Nabire Regency. In this area, Exocelina is represented mainly by the species of the ekari-group, which are small in size and have no pronotal bead. From them, as well as from *E. ransikiensis* Shaverdo et al., 2016d with the same characters, the species differs in larger size and the different shape of the median lobe. From *E. bagus* ((Balke & Hendrich, 2001), in Balke (2001)), which is similar in size and surface sculpture to *E. casuarina*, the species differs in simple male antennae and the different shape of the median lobe. From *E. damantiensis* (Balke, 1998) of the danae-group, the only species with the pronotal bead in the Nabire-Enarotali area, *E. casuarina* differs in absence of the pronotal bead, evidently stronger dorsal punctation and microreticulation, and the different shape of the median lobe.

Within the *casuarina*-group, the species is more similar to *E. fume* (Balke, 1998) and *E. ibalimi* sp. n., with which it shares not only absence of the pronotal bead, but also a large, strongly curved anterolateral hook-like seta of the male protarsomere 4 (see their "Affinities" and the "Key").

Distribution. Papua: Nabire Regency. The species is known only from the area close to the type locality (Fig. 50).

5. Exocelina cyclops Shaverdo & Balke, sp. n.

http://zoobank.org/236B93F4-6599-499D-8325-5FB446714AF2 Figs 12, 36

Exocelina undescribed sp. MB3330: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

Exocelina cyclops New Guinea MB3330: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua: Jayapura Regency, Cyclops Mts, 02°32.03'S, 140°30.41'E, 710 m a.s.l.

Type material. *Holotype*: male "Indonesia: Papua, Cyclops Mts., 710 m, 02°32.031'S, 140°30.412'E, local collector ca. 1997" (ZSM). *Paratypes*: 1 male with the same label as the holotype (NHMW). 1 male, 2 females "Indonesia: Papua, Cyclops Mts., 1120 m, 02°31.516'S, 140°30.436'E, local collector ca. 1997" (MZB, ZSM). 2 males, 1 female "Indonesia: Papua, Cyclops Mts., 615 m, 02°32.031'S, 140°30.412'E, local collector ca. 1997" (NHMW, ZSM). 2 males "Indonesia: Papua, Cyclops Mts., Doyo, 365 m, local collector ca. 1997" (ZSM).

Description. *Body size and form:* Beetle small: TL-H 3.0–3.25 mm, TL 3.25–3.55 mm, MW 1.65–1.8 mm (holotype: TL-H 3.1 mm, TL 3.4 mm, MW 1.7 mm), with oblong-oval habitus.

Coloration: Reddish. Dorsal surface almost uniformly yellowish red to reddish brown, with paler anterior part of head and pronotum laterally; head appendages and legs yellowish red (Fig. 12). All type specimens are teneral, therefore, coloration may be darker.

Surface sculpture: Submatt dorsally. As in *E. pseudopusilla* sp. n. but microreticulation more weakly impressed, dorsal surface shinier.

Structures: Pronotum with lateral bead. Its lateral sides with distinct longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, rounded anteriorly. Blade of prosternal process lanceolate, relatively broad, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 slightly truncate.

Male: Antennae simple (Fig. 12). Protarsomere 4 with medium-sized, thick, curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with anterior band of 30 and posterior row of 7 relatively long setae (Fig. 36D). Median lobe in lateral view slightly curved, with slightly thickened, straight apex; in ventral view, subparallel, very slightly narrowed distally, with broad, truncate apex. Paramere slightly concave on dorsal side, with long, dense subdistal setae, median and proximal ones finer and sparser (Fig. 36A–C). Abdominal ventrite 6 with 4–6 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. Exocelina cyclops sp. n. is similar to E. sumokedi sp. n., E. adelbertensis sp. n., and E. bewani sp. n., but has coarser dorsal punctation. In this character, the species is more similar to E. pusilla sp. n. and E. pseudopusilla sp. n. but it differs from them in much broader and differently shaped median lobe (not distinctly narrowed distally, with apex thicker in lateral and ventral views) and from the latter, also in smaller size and slightly shinier dorsal surface.

Distribution. Papua: Jayapura Regency. The species is known only from the Cyclops Mountains (Fig. 50).

Etymology. The species is named after the Cyclops Mountains. The name is a noun in the nominative singular standing in apposition.

6. Exocelina desii (Balke, 1999)

Figs 15, 39

Copelatus (Papuadytes) desii Balke, 1999: 274; Nilsson 2001: 76 (catalogue). Papuadytes desii (Balke, 1999): Nilsson and Fery 2006: 56 (comb. n.).

Exocelina desii (Balke, 1999): Nilsson 2007: 33 (comb. n.); Nilsson and Hájek 2018: 65 (catalogue).

Exocelina desii MB1399: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3, and information S5–S6.

Type locality. Papua New Guinea: East Sepik Province, Amboin Patrol Post, Karawari Lodge, ca 04°29'05.8"S, 143°26'37.5"E, < 100 m a.s.l.

Type material studied. *Paratype*: female "PAPAU [sic!] NEW GUINEA East Sepik Province, Amboin Patrol Post, Karawari Lodge 14Jan.1983, A.C.Messer", "Paratypus Copelatus desii M. Balke des. 1999" [red] (NHMW). Note: The holotype has not been found. According to Balke (1999), it was deposited in the Natural Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Additional material. Western Highlands: 3 females "Papua New Guinea: Western Highlands, Mt. Hagen town area, 1600m, 7.xii.1994 05.49.745S 144.22.357E Balke & Kinibel (PNG 131)" (ZSM). 1 male, 1 female "Papua New Guinea: Western Highlands, Kurumul, 6Km SW Kudjip, small stream, 1584m, 13.vi.1994, 05.53.426S 144.36.600E, John (PNG 78)", the female with an additional green label "M.Balke 1342" (ZSM). Eastern Highlands: 5 males "Papua New Guinea: Eastern Highlands, Akameku-Brahmin, Bismarck Range, 1900m, 23.xi.1994, 05.54.284S 145.22.271E, Balke & Kinibel (PNG 108)", one of them with an additional green label "M.Balke 1399" (NHMW, ZSM). 3 males, 2 females "Papua New Guinea: Eastern Highlands, Akameku-Brahmin, Bismarck Range, 1500m, 24.xi.1994, 05.51.964S 145.23.604E, Balke & Kinibel (PNG 111)" (NHMW, ZSM). Simbu: 3 males, 1 female "Collection Naturhistorisches Museum Basel", "Papua New Guinea Simbu prov. L. Ciek lgt.", Kundiawa, Mu vill. 145°02'E 4°42'S III.2001, 1900m" (NHMB). 1 male "Ibisca Niugini, PNG 28-30.x.2012 Mount Wilhelm 1700m", "-5,759269238 145,235611 FIT-MW1700-K-2/8-d01 / Plot 11 / P1959 Vial 05833" (IECA). 1 male "-5,759269238 145,235611 FIT-MW1700-J-1/8-d01 / Plot 10 / P1950 Vial 02485", "Ibisca Niugini, PNG 25-27.x.2012 Mount Wilhelm 1700m" (ZSM). 2 females "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1700m -5,759269238 145,235611 MW1700 / P1943 Vial 04017" (ZSM). 1 female "Ibisca Niugini, PNG 31.x-2.xi.2012 Mount Wilhelm 1700m -5,759269238 145,235611 MW1700 / P1953 Vial 07522" (ZSM). 1 female "Ibisca Niugini, PNG 2-4.xi.2012 Mount Wilhelm 1700m -5,759269238

145,235611 MW1700 / P1914 Vial 07577" (ZSM). 1 female "Ibisca Niugini, PNG 25-27.x.2012 Mount Wilhelm 1700m -5,759269238 145,235611 MW1700 / P1878 Vial 02411" (ZSM). 1 female "Ibisca Niugini, PNG 5-7.xi.2012 Mount Wilhelm 1700m", "-5,759269238 145,235611 FIT-MW1700-O-6/8-d12 / Plot 15 / P1995 Vial 05666" (ZSM). 1 female "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1700m -5,759269238 145,235611", "FIT-MW1700-H-2/8-d03 / Plot 8 / P1935 Vial P1935-CODYTI" (ZSM). 1 female "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1700m -5,759269238 145,235611", "FIT-MW1700-I-2/8-d03 / Plot 9 / P1943 Vial P1943-CODYTI" (ZSM). 1 female "Ibisca Niugini, PNG 28-30.x.2012 Mount Wilhelm 1700m", "-5,759269238 145,235611 FIT-MW1700-T-2/8-d04 / Plot 20 / P2031 Vial 05553" (ZSM). 1 female "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1700m", "-5,760916233 145,2353363 MW1700 / P1895 Vial P1895-CODYTI" (ZSM). 1 female "Ibisca Niugini, PNG 4-6.xi.2012 Mount Wilhelm 1700m", "-5,760916233 145,2353363 FIT-MW1700-C-6/8-d11 / Plot 3 / P1899 Vial 04070" (ZSM). 1 female "Ibisca Niugini, PNG 25-27.x.2012 Mount Wilhelm 1700m -5,759910107 145,234726 MW1700 / P1886 Vial 07540" (ZSM). 1 female "Ibisca Niugini, PNG 28-30.x.2012 Mount Wilhelm 2200m", "-5,75897789 145,1860657 FIT-MW2200-F-7/8-d13 / Plot 6 / P2314 Vial 07373-CODYTI" (ZSM). 1 female "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 2200m", "-5,75897789 145,1860657 FIT-MW2200-K-6/8-d12 / Plot 11 / P2353 Vial 11687" (ZSM). 1 female "Ibisca Niugini, PNG 28-30.x.2012 Mount Wilhelm 2200m -5,760178089 145,186264 MW2200 / P2282 Vial 07152" (ZSM). 2 females "Ibisca Niugini, PNG 29-31.x.2012 Mount Wilhelm 2200m -5,760178089 145,186264 FIT-MW2200-N-7/8-d14/ Plot 14 / P2378 Vial 15681" (ZSM). 2 females "Ibisca Niugini, PNG 27–29.x.2012 Mount Wilhelm 2200m FIT-MW2200-O-6/8-d12 / Plot 15 / P2385 Vial ...-CODYTI" (ZSM). 1 female "04103 Ibisca Niugini 2012" (ZSM). 1 female "04103" (ZSM).

Diagnosis. For complete description, see Balke (1999: 274). Beetle medium-sized: TL-H 3.5–4.3 mm, oblong-oval; reddish brown to brown, with paler pronotum; submatt, with dense, rather coarse punctation and rather strongly impressed microreticulation; pronotum with distinct lateral bead; male antennae simple (Fig. 15); male protarsomere 4 with anterior angle slightly expanded, with large, thick, strongly curved anterolateral hook-like seta; male protarsomere 5 slightly concave ventrally, with anterior band of ca 100 and posterior band ca 40 of relatively long setae (Fig. 39D); median lobe in lateral view evenly broad, with rounded, not curved downwards apex, in ventral view, evenly tapering, with broadly pointed apex; paramere slightly concave on dorsal side and with long, dense, thin setae, situated along dorsal margin; subdistal setae strong and dense, setae in middle part slightly shorter and sparser, proximal setae long but sparser than subdistal ones (Fig. 39A–C).

Affinities. In the area of its distribution, *E. desii* co-occurs with numerous species of the *ekari-*, *ullrichi-*, *broschii-*, *larsoni-*, and *danae-*groups. From them, the species differs in size, coloration, surface sculpture, simple male antennae, and the shape of the median lobe.

Within the *casuarina*-group, it is very similar in coloration and surface sculpture to the co-occurring *E. pusilla* sp. n. and *E. pseudopusilla* sp. n. but can be distinguished from them by larger size and evidently thicker median lobe.

Distribution. Papua New Guinea: East Sepik, Simbu, Western Highlands, and Eastern Highlands Provinces (Fig. 50).

7. Exocelina fume (Balke, 1998)

Figs 3, 27

Copelatus (Papuadytes) fume Balke, 1998: 330; Nilsson 2001: 76 (catalogue). Papuadytes fume (Balke, 1998): Nilsson and Fery 2006: 56 (comb. n.). Exocelina fume (Balke, 1998): Nilsson 2007: 33 (comb. n.); Nilsson and Hájek 2018: 66 (catalogue).

Type locality. Papua: Pegunungan Bintang Regency, Borme, 04°24'S, 140°25'E, 1800 m a.s.l.

Type material studied. *Holotype*: male "IRIAN JAYA Zentralmassive 140°25'E 04°24'S, "Borme, 1800m 16.8.1992 leg. Balke (12, 12A)", "HOLOTYPUS" [red], "Copelatus fume Balke des. 1997" [red] (NHMW). *Paratypes*: 9 males with the same label as the holotype and additionally with red labels "Paratypus Copelatus fume Balke des. 1997", two of them with labels "M.Balke 3275" [green], and "M.Balke 3276" [green] and "M.Balke 6405" [green text] (NHMW). Note: There are two additional paratypes of *E. fume*, which do not belong to this species but to *E. ketembang* (Balke, 1998) and *E. erteldi* (Balke, 1998).

Diagnosis. For complete description, see Balke (1998: 330). Beetle medium-sized: TL-H 3.7–4.4 mm; oblong-oval; brown to dark brown, with reddish brown pronotal sides, head, and sometimes also sides of elytra, in some specimens, disc of pronotum and elytron almost piceous; submatt, with fine but rather dense punctation and strongly impressed microreticulation; pronotum without lateral bead; male antennae simple (Fig. 3); male protarsomere 4 with large, thick, strongly curved anterolateral hook-like seta; male protarsomere 5 long and narrow, with anterior band of more than 60 and posterior row of 6 relatively long, thin setae (Fig. 27D); median lobe in lateral view slightly curved, with apex curved downwards, with visible angle on dorsal side, in ventral view, distally distinctly narrowed to truncate apex; paramere slightly concave on dorsal side and with long, dense, thin setae, situated along dorsal margin: subdistal setae strong and dense, setae in middle part shorter and sparser, proximal setae long, only slightly sparser than subdistal ones (Fig. 27A–C).

Affinities. In the area of its distribution, *E. fume* co-occurs with *E. takime* (Balke, 1998) and species of the *ekari-*, *aipo-*, *okbapensis-*, *aipomek-*, *erteldi-*, and *danae-*groups. From species of the *ekari-*group, the species differs in larger size, evidently stronger dorsal punctation and microreticulation, and the shape of the median lobe. In the lat-

ter two characters, *E. fume* differs also from the species of the remaining groups, as well as in absence of the pronotal bead and simple male antennae.

Within the *casuarina*-group, the species is more similar to *E. casuarina* and *E. ibalimi* sp. n., especially the latter one, from which can be distinguished by paler coloration and the shape of the median lobe (see their "Affinities" and the "Key").

Distribution. Papua: Pegunungan Bintang. The species is known only from the type locality (Fig. 50).

8. Exocelina heidiae (Balke, 1998)

Figs 16, 40

Copelatus (Papuadytes) heidiae Balke, 1998: 331; Nilsson 2001: 76 (catalogue).

Papuadytes heidiae (Balke, 1998): Nilsson and Fery 2006: 56 (comb.n.).

Exocelina heidiae (Balke, 1998): Nilsson 2007: 33 (comb. n.); Nilsson and Hájek 2018: 66 (catalogue).

Type locality. Papua New Guinea: Morobe Province, Herzog Range, Wagau (Vagau), ca 06°48'S, 146°48'E, ca 1300 m a.s.l.

Type material studied. *Paratypes*: 3 males "Stn. No. 150", "NEW GUINEA: Morobe Dist., Herzog Mts., Vagau, C.4,000ft. 4–17.i.1965", "M. E. Bacchus. B. M. 1965–120", "Paratypus Copelatus heidiae sp.n. Balke des. 1997" [red] (NHMW). 1 female "Stn. No. 140A", "NEW GUINEA: Morobe Dist., Herzog Mts., Vagau, C.4,000ft. 4–17.i.1965", "M. E. Bacchus. B. M. 1965–120", "Paratypus Copelatus heidiae sp.n. Balke des. 1997" [red] (NHMW).

Diagnosis. For complete description, see Balke (1998: 331). Beetle mediumsized: TL-H 4.35–4.9 mm; broader, oblong-oval; dark brown, with reddish brown pronotal sides and head anteriorly, in some specimens, disc of pronotum and elytron almost piceous; submatt, with very fine, on elytra often almost invisible punctation and strongly impressed microreticulation; pronotum with lateral bead; male antennae simple (Fig. 16); male protarsomere 4 with anterior angle very slightly expanded, with large, thick, strongly curved anterolateral hook-like seta; male protarsomere 5 long and narrow, slightly concave ventrally, with anterior band of ca 70 and posterior band of ca 30 relatively long setae (Fig. 40D); median lobe in lateral view evenly broad, with rounded, not curved downwards, only slightly thickened apex, in ventral view, with subparallel sides and roundly truncate apex; paramere slightly concave on dorsal side and with long, dense, thin setae, situated along dorsal margin distinctly divided to dense and strong subdistal setae and sparser proximal ones, setae in middle short and fine (Fig. 40A–C).

Affinities. In the Herzog Range area, *E. heidiae* co-occurs with Exocelina *jasminae* (Balke, 1998), two species of the *ekari*-group, and four species of the *danae*-group. From all of them, the species differs in larger size and the shape of the median lobe. Additional characters for the species separations are presence of the pronotal bead, simple male antennae, and dorsal punctation and microreticulation.

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Within the *casuarina*-group, the species is more similar to *E. simbaijimi* sp. n. (see its "Affinities" and the "Key").

Distribution. Papua New Guinea: Morobe Province. The species is known only from the type locality, Wagau in Herzog Range (Fig. 50).

9. Exocelina ibalimi Shaverdo & Balke, sp. n.

http://zoobank.org/F2B4E65B-545D-4F76-8ED4-6D9C43DA6CAB Figs 4, 28

Exocelina undescribed sp. MB0657: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina ibalimi*_New_Guinea_MB0657: Toussaint et al. 2015: Supplementary information S5–S6.

Type locality. Papua New Guinea: Sandaun Province, Mianmin area, ca 04°55.78'S, 141°38.18'E, 1080 m a.s.l.

Type material. Holotype: male "Papua New Guinea: Sandaun, Mianmin area, >600m, 13.i.2010, Ibalim & Pius (PNG235)" (ZSM). Paratypes: 15 males, 14 females with the same label as the holotype, 2 males with additional labels "M.Balke 4929", "M.Balke 4932", and one female with "M.Balke 4930" (NHMW, ZSM). 4 males, 1 female "Papua New Guinea: Sandaun, Ofektaman, 820m, 17.x.2008, 5.04.113S 141.35.841E, Ibalim (PNG 190)", two males additionally with green labels "M.Balke 3724", "M.Balke 3725" (NHMW, ZSM). 3 females "Papua New Guinea: Sandaun, Mianmin, 670m 20.x.2008, 4.53.292S 141.34.118E, Ibalim (PNG 191)" (ZSM). 2 males "Papua New Guinea: Sandaun, Mianmin (river), 990m, 23.x.2008, 4.54.570S 141.35.490E, Ibalim (PNG 192)" (ZSM). 3 males "Papua New Guinea: Sandaun, Mianmin (pool), 990m, 23.x.2008, 4.54.570S 141.35.490E, Ibalim (PNG 193)", two of them with additional green labels "M.Balke 3739", "M.Balke 3740" (ZSM). 4 males, 4 females "Papua New Guinea: Sandaun, Mianmin (river), 1080m, 24.x.2008, 04.55.780S 141.38.185E, Ibalim (PNG 195)" (NHMW, ZSM). 6 males, 12 females "Papua New Guinea: Sandaun, Mianmin (pool), 1080m, 24.x.2008, 04.55.780S 141.38.185E, Ibalim (PNG 196)" (ZSM). 2 males, 1 female "Papua New Guinea: Sandaun, Mianmin (river) 700m, 21.x.2008, 04.52.858S 141.31.706E Ibalim (PNG 197)" (ZSM). 5 males, 3 females "Papua New Guinea: Sandaun, Mianmin (pool), 700m, 21.x.2008, 04.52.858S 141.31.706E, Ibalim (PNG 198)" (NHMW, ZSM). 2 males "Papua New Guinea: Sandaun, Mianmin area, >1000m, 23.xii.2009, Ibalim & Pius (PNG232)" (ZSM). 4 males, 1 female "Papua New Guinea: Sandaun, Mianmin area, >1000m, 26.xii.2009, Ibalim & Pius (PNG233)" (NHMW, ZSM). 8 males, 3 females "Papua New Guinea: Sandaun, Mianmin area, >600m, 13.i.2010, Ibalim & Pius (PNG236)", one of them with "M.Balke 4925" (NHMW, ZSM). 5 males, 8 females "Papua New Guinea: Sandaun, Mianmin area, >700m, 14.i.2010, 0 4 54.540S 141 36.953E, Ibalim & Pius (PNG238)" (NHMW, ZSM). 1 male "Papua New Guinea: Sandaun, Mianmin 2, 1150 m, 20.x.2003, 04 52.562S 141 37.038E,

K. Sagata (WB70)", "M. Balke 658" [green text] (ZSM). 2 males "Papua New Guinea: Sandaun, MekilK [!], 1718m, 14.x.2003, 4 48.742S 141 39.075E, K. Sagata (WB106)", one of them with "M. Balke 661" [green text] (ZSM). 1 male "Papua New Guinea: Sandaun: Mekil (WB106), 14.x.2003, K. Sagata, M Balke: MB 660", "M. Balke 660" [green text] (ZSM). 1 female "Papua New Guinea: Sandaun, Sokamin village, 1200m, 9.x.2003, 4 51.883S 141 37.534E, K. Sagata (WB97)", "M. Balke 657" [green text] (ZSM). 2 males, 1 female "Papua New Guinea: Sandaun, Sokamin4, 1200m, 19.x.2003, 4 50.845S 141 37.865E, K. Sagata (WB100)", males with green text labels "M. Balke 683" and "M. Balke 684" (ZSM).

Description. *Body size and form:* Beetle size variable but generally beetle mediumsized: TL-H 3.45–4.3 mm, TL 3.75–4.8 mm, MW 1.8–2.25 mm (holotype: TL-H 4.15 mm, TL 3.75 mm, MW 2 mm), with oblong-oval habitus, slightly more attenuated posteriorly.

Coloration: Brown to piceous, with head and pronotum paler. Head reddish brown to piceous, darker posteriorly. pronotum reddish brown to piceous, broadly paler on lateral sides and sometimes also narrowly anteriorly and posteriorly. Elytra uniformly brown to piceous. Head appendages and legs yellowish red to reddish brown, legs distally darker, especially metathoracic legs (Fig. 4). Teneral specimens paler.

Surface sculpture: Submatt dorsally. Head with rather dense punctation (spaces between punctures 1–2 times size of punctures), evidently finer and sparser anteriorly; diameter of punctures smaller than diameter of cells of microreticulation. Pronotum and elytra with fine but rather dense punctation, sparser and finer than on head. Pronotum and elytra with strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and very fine sparse punctation.

Structures: Pronotum without lateral bead. Base of prosternum and neck of prosternal process with distinct ridge, rounded anteriorly. Blade of prosternal process lanceolate, relatively narrow, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 broadly rounded or slightly truncate.

Male: Antennae simple (Fig. 4). Protarsomere 4 with large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with anterior band of more than 80 and posterior row of 11 relatively long, thin setae (Fig. 28D). Median lobe in lateral view slightly curved, its apex rounded and not or only very slightly curved downwards; in ventral view, distally distinctly narrowed to truncate apex. Paramere slightly concave on dorsal side and with long, dense, thin setae situated along dorsal margin: subdistal setae denser, proximal setae sparser, setae in middle shorter, thinner (Fig. 28A–C). Abdominal ventrite 6 with 7–11 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Variability. The species has variability in size, coloration and shape of the median lobe. Beetles are small to medium-sized (see the measurements above) and with coloration: from reddish head and pronotum and dark brown elytra to uniformly piceous with reddish brown pronotal sides. Median lobe shows different shape of its apex: in

lateral view, it is not curved or differently slightly curved downwards reminding that of *E. fume* but without distinct angle.

Affinities. *Exocelina ibalimi* sp. n. is very similar to *E. fume* but differs from it in shape of the median lobe: its apex not curved or only slightly curved downwards, more or less rounded in lateral view, without distinct angle on the dorsal side. The species also has dorsal punctation distinctly finer and microreticulation less strongly impressed than in *E. fume*.

Distribution. Papua New Guinea: Sandaun Province (Fig. 50).

Etymology. The species is named for Sentiko Ibalim, one of the great young PNG entomologists, who collected most of these beetles. The species name is a noun in the genitive case.

10. Exocelina keki Shaverdo & Balke, sp. n.

http://zoobank.org/0C2652F3-452D-4826-918A-90D6C5C5ECA8 Figs 6, 30

Exocelina undescribed sp. MB1530: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina pseudokeki_*New_Guinea_MB1530: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Madang, Adelbert Mts, creek near Keki, 04°42.30'S, 145°25.09'E, 790 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Madang, Keki, Adalbert [sic!] Mts., 500m, 29.xi.2006, nr 04.43.058S 145.24.437E, Balke & Kinibel (PNG 118)" (ZSM). *Paratypes*: **Madang:** 9 males, 4 females with the same labels as the holotype, one male with an additional green label "M.Balke 1530" (NHMW, ZSM). 1 male, 3 females "Papua New Guinea: Madang, Adalbert [sic!] Mts., creek nr Keki, 790m, 28.xi.1994, 04.42.300S 145.25.089E, Binatang Boys leg. (PNG 53a)" (ZSM). 1 male, 2 females "Papua New Guinea: Madang, Keki-Sewan, Adalbert [sic!] Mts., 700m, 30.xi.2006, nr 04.41.802S 145.25.460E, Binatang Boys (PNG 120)" (ZSM). **Eastern Highlands:** 1 male "Papua New Guinea: Eastern Highlands, Bena Bridge, 1400m, 8.xii.2007, 06.10.781S 145.26.034E, Balke & Sagata (PNG 164)" (ZSM).

Description. *Body size and form*: Beetle small: TL-H 3.15–3.65 mm, TL 3.45–4.0 mm, MW 1.65–1.9 mm (holotype: TL-H 3.65 mm, TL 4 mm, MW 1.85 mm), with oblong habitus.

Coloration: Reddish to reddish brown, with head and pronotum paler. Head yellowish red to reddish brown, with small darker areas posterior to eyes. Pronotum yellowish red to reddish brown, with small brown to dark brown area on disc. Elytra reddish brown to brown, with narrow reddish sutural lines. Head appendages yellowish red, legs reddish, distally darker, especially metathoracic legs (Fig. 6). Teneral specimens paler.

Surface sculpture: Submatt dorsally. Head with rather dense punctation (spaces between punctures 1–2 times size of punctures), evidently finer and sparser anteriorly;

diameter of punctures smaller than diameter of cells of microreticulation. Pronotum and elytra with dense, distinct but fine punctation, sparser and finer than on head. Pronotum and elytra with strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and very fine sparse punctation.

Structures: Pronotum without lateral bead, in few specimens with its traces in posterior part. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively narrow, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 rounded.

Male: Antennae simple (Fig. 6). Protarsomere 4 with anterolateral seta thin, long, smaller than more laterally situated large setae, slightly curved downwards. Protarsomere 5 long and narrow, with anterior band of more than 40 and posterior row of 7 relatively long, thin setae (Fig. 30D). Median lobe in lateral view almost straight, its apex rounded and not curved downwards; in ventral view, distally distinctly narrowed before rounded, narrow apex. Paramere slightly concave on dorsal side and with dorsal setae distinctly divided to long, dense subdistal setae and sparser proximal ones (Fig. 30A–C). Abdominal ventrite 6 with 3–5 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Distribution and variability. Papua New Guinea: Madang and Eastern Highlands (Fig. 50). The species is known mainly from Keki area in Adelbert Mountains; only one beetle was collected in Bena, Eastern Highlands. It shows no morphological difference from the specimens of Keki populations, except for a small difference in the median lobe shape, which could be an expression of species variability. The species might have the same pattern of distribution as *Exocelina brahminensis* Shaverdo et al., 2012, which has a wide distribution in the Momase Region and is known from Adelbert Mountains and Bena.

Affinities. *Exocelina keki* sp. n. is very similar to *Exocelina messeri* (Balke, 1999) in body form and coloration, but has much more distinct dorsal punctation and stronger microreticulation, as well as median lobe more slender, with apex smaller and narrower in ventral view; the ventral setae of male protarsomere 5 are much less numerous and clearly divided into anterior band and posterior row.

Etymology. The species is named after Keki Village. The name is a noun in the nominative singular standing in apposition.

11. *Exocelina kumulensis* Shaverdo & Balke, sp. n. http://zoobank.org/B665E92E-4CB0-4D47-87DF-08DAFAFFA4F2 Figs 25, 49

Exocelina undescribed sp. MB1360: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina hagenensis*_New_Guinea_MB1360: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Enga Province, Kumul Lodge at foot of Mt Hagen, 05°47.55'S, 143°58.76'E, 2700 m a.s.l.

Type material. *Holotype*: male "M. Balke 1360" [green], "Papua New Guinea: Enga, Kumul Lodge @ foot of Mt. Hagen, 2700m, 5.xii.2006, 05.47.548S 143.58.761E, Balke & Kinibel (PNG 124)" (ZSM).

Description. *Body size and form*: Beetle large: TL-H 5.4 mm, TL 6.0 mm, MW 2.9 mm, with broader, oblong-oval habitus.

Coloration: Piceous, with paler pronotum. Head piceous, narrowly brownish anteriorly and with two vague brownish spots between eyes. Pronotum dark brown, piceous on disc. Elytra piceous, with vague narrow brownish sutural lines. Head appendages and legs proximally reddish brown, legs distally darker, brownish, especially metathoracic legs (Fig. 25).

Surface sculpture: Submatt dorsally. Head with dense, coarse punctation (no spaces between punctures or spaces of equal size of punctures), finer and sparser anteriorly; diameter of punctures equal to diameter of cells of microreticulation. Pronotum with relatively dense but fine punctation, sparser and finer than on head. Elytra with finer punctation than on pronotum. Pronotum and elytra with strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles, abdominal ventrites with distinct microreticulation and strioles. Metaventrite medially, metacoxal plates, and abdominal ventrites with fine, sparse punctation.

Structures: Pronotum with distinct lateral bead. Its lateral sides with distinct longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively short, broad, slightly convex and smooth in the middle, with distinct lateral bead and few lateral setae, lateral sides flattened. Abdominal ventrite 6 rounded.

Male: Antennae simple (Fig. 25). Protarsomere 4 with anterior angle slightly expanded, with large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 slightly concave ventrally, with anterior band of ca 100 and posterior band of ca 40 relatively long setae (Fig. 49D). Median lobe in lateral view long, slightly curved, with small, very slightly bent downwards, thickened apex; in ventral view, evenly tapering to broadly pointed apex. Paramere slightly concave on dorsal side and with weak dorsal setation, setae on subdistal part stronger, denser, more evident than proximal setae (Fig. 49A–C). Abdominal ventrite 6 with 17–18 lateral striae on each side.

Female: Unknown.

Affinities. *Exocelina kumulensis* sp. n. is similar to *E. mendiensis* sp. n. but differs from it by being larger, having coarser and denser dorsal punctation and by the shape of the median lobe.

Distribution. Papua New Guinea: Enga Province. The species is known only from the type locality (Fig. 50).

Etymology. The species is named after Kumul Lodge. The name is an adjective in the nominative singular.

12. Exocelina mendiensis Shaverdo & Balke, sp. n.

http://zoobank.org/5703539F-668B-4E41-A659-CCA7FD2884DA Figs 24, 48

Exocelina undescribed sp. MB1337: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina mendiensis*_New_Guinea_MB1337: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Southern Highlands Province, Sopulkul, 30–35 km NE Mendi, 06°02.94'S, 143°46.49'E, 2680 m a.s.l.

Type material. *Holotype*: male "M. Balke 1337", "Papua New Guinea: Southern Highlands, Sopulkul, 30–35 km NE Mendi, 2680 m, 16.vi.2006, 06.02.944S 143.46.485E, John (PNG 79)" (ZSM). *Paratypes*: 1 male, 2 females with the same label as the holotype (NHMW, ZSM).

Description. *Body size and form*: Beetle large: TL-H 4.8–5.5 mm, TL 5.3–5.9 mm, MW 2.6–2.75 mm (holotype: TL-H 4.8 mm, TL 5.3 mm, MW 2.6 mm), with broader, oblong-oval habitus.

Coloration: Piceous. Head piceous, narrowly brownish anteriorly and sometimes with two brownish spots between eyes. Pronotum piceous, brownish laterally and anteriorly. Elytra piceous, sometime with narrow brownish sutural lines. Head appendages and legs proximally reddish brown, legs distally darker, brownish, especially metathoracic legs (Fig. 24).

Surface sculpture: Submatt dorsally. Head with relatively dense punctation (no spaces between punctures or spaces 2 times size of punctures), sparser anteriorly, denser and coarser between eyes; diameter of punctures smaller than or equal to diameter of cells of microreticulation. Pronotum with relatively dense but fine punctation, sparser and finer than on head. Elytra with very fine, sparse punctation. Pronotum and elytra with rather strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles, abdominal ventrites with distinct microreticulation and strioles. Metaventrite medially, metacoxal plates, and abdominal ventrites with very fine, sparse punctation.

Structures: Pronotum with distinct lateral bead. Its lateral sides with distinct longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively narrow, slightly convex, and smooth, with distinct lateral bead and few lateral setae. Abdominal ventrite 6 slightly truncate.

Male: Antennae simple (Fig. 24). Protarsomere 4 with anterior angle slightly expanded, with large, thick, strongly curved anterolateral hook-like seta. Protarsomere

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. *Exocelina mendiensis* sp. n. is similar to the larger species of the group, *E. kumulensis* sp. n. and *E. ambua* sp. n., but differs from them in its darker coloration, shinier dorsal surface and shape of the median lobe. Also, see under *E. okapa* sp. n.

Distribution. Papua New Guinea: Southern Highlands Province. The species is known only from the type locality (Fig. 50).

Etymology. The species is named after Mendi Village. The name is an adjective in the nominative singular.

13. Exocelina menyamya Shaverdo & Balke, sp. n.

http://zoobank.org/B6435BF0-3067-44BD-946E-8772C350CAD1 Figs 20, 44

Exocelina undescribed sp. MB1377: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina menyamya_*New_Guinea_MB1377: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Morobe Province, Menyamya, Mount Inji, 07°14.26'S, 146°01.40'E, 1500 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Morobe, Menyamya, Mt Inji, deep well, 1500m, 14.xi.2006, 07.14.264S 146.01.400E, Balke & Kinibel (PNG 98)", "M.Balke 1377" [green] (ZSM).

Description. *Body size and form:* Beetle medium-sized: TL-H 4.25 mm, TL 4.8 mm, MW 2.2 mm, with oblong-oval habitus.

Coloration: Brown, with reddish pronotum. Head brown, with slightly darker areas posterior to eyes. Pronotum broadly reddish laterally and dark brown medially from anterior to posterior margins. Elytra uniformly brown, in the middle with traces of narrow reddish sutural lines. Head appendages and legs proximally yellowish red, legs distally darker, reddish brown, especially metathoracic legs (Fig. 20).

Surface sculpture: Matt dorsally. Head with rather dense, coarse punctation (spaces between punctures 1–2 times size of punctures), evidently finer and sparser anteriorly; diameter of punctures smaller than or equal to diameter of cells of microreticulation. Pronotum and elytra with distinct punctation, sparser and finer than on head. Pronotum and elytra with strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates

with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and very fine sparse punctation.

Structures: Pronotum with distinct lateral bead. Its lateral sides with longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively short, broad, slightly convex and smooth in the middle, with distinct lateral bead and few lateral setae, lateral sides slightly flattened. Abdominal ventrite 6 slightly truncate.

Male: Antennae simple (Fig. 20). Protarsomere 4 with large, thick, slightly curved anterolateral hook-like seta. Protarsomere 5 ventrally with anterior band of more than 50 and posterior row of 13 relatively long, thin setae (Fig. 44D). Median lobe in lateral view narrowed to apex, with thin, slightly curved upwards apex; in ventral view, narrowed before apex, with apex rounded, of shape of a baby pacifier, with distinct ventral impression. Paramere slightly concave on dorsal side and with long, dense, thin setae situated along dorsal margin, subdistal setae denser, proximal setae much sparser, setae in middle shorter, thinner (Fig. 44A–C). Abdominal ventrite 6 with 19–22 lateral striae on each side.

Female: Unknown.

Affinities. *Exocelina menyamya* sp. n. is similar to *E. casuarina* and *E. fume* in body size, shape, and coloration but can be distinguished from them by the completely different shape of the median lobe and presence of the pronotal bead.

Distribution. Papua New Guinea: Morobe Province. The species is known only from the type locality (Fig. 50).

Etymology. The species is named after Menyamya Village. The name is a noun in the nominative singular standing in apposition.

14. Exocelina messeri (Balke, 1999)

Figs 5, 29

Copelatus (Papuadytes) messeri Balke, 1999: 274; Nilsson 2001: 77 (catalogue). Papuadytes messeri (Balke, 1999): Nilsson and Fery 2006: 56 (comb. n.). Exocelina messeri (Balke 1999): Nilsson 2007: 34 (comb. n.); Nilsson and Hájek 2018:

67 (catalogue).

Type locality. Papua New Guinea: East Sepik Province, Amboin Patrol Post, Karawari Lodge.

Type material studied. *Paratypes*: 2 males "Papua New Guinea: East Sepik Province, Amboin Patrol Post, Karawari Lodge, 7 Feb.1983, A.C. Messer", "Paratypus Copelatus *messeri* Balke des. 1999" [red] (NHMW). Note: The holotype has not been found. According to Balke (1999), it was deposited in the Natural Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Diagnosis. For complete description, see Balke (1999: 274–275). Beetle small: TL-H 3.2–3.7 mm; oblong-oval, more strongly attenuated posteriorly; reddish to reddish brown, with head and pronotum slightly paler; shiny, with very fine, sparse punc-

tation, almost invisible on elytra and weakly impressed microreticulation; pronotum without lateral bead, sometimes with its traces in posterior part; male antennae simple (Fig. 5); male protarsomere 4 with anterolateral seta thin, long, smaller than more laterally situated large setae, slightly curved downwards; male protarsomere 5 long and narrow, with more than 80 relatively long, thin setae, which divided in anterior and posterior ones proximally and mixed up together in distal half of tarsomere (Fig. 29D); median lobe in lateral view almost straight, its apex rounded and not curved downwards, in ventral view, distally narrowed before apex, apex broad, slightly rounded; paramere slightly concave on dorsal side and with dorsal setae distinctly divided into long, dense subdistal setae and sparser, rather inconspicuous proximal ones, setae in middle part short and fine (Fig. 29A–C).

Affinities. See under E. keki sp. n.

Distribution. Papua New Guinea: East Sepik Province. The species is known only from the type locality (Fig. 50).

15. Exocelina okapa Shaverdo & Balke, sp. n.

http://zoobank.org/A1C1E56D-459F-4BF1-A670-7EDE937644FA Figs 23, 47

Type locality. Papua New Guinea: Eastern Highlands Province, Wapi Creek, Kimiagomo, Okapa, 06°25.41'S, 145°34.48'E, 1900 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Eastern Highlands, Wapi Creek, Kimiagomo, Okapa, 1900m, 9.viii.2005, 6 25.407S 145 34.480E, K.Sagata (WB122)" (ZSM). *Paratypes*: 5 males, 2 females with the same label as the holotype (NHMW, ZSM). 1 male, 3 females "Papua New Guinea: Eastern Highlands, Tegupate creek Kimiagomo, Okapa, 1900m, 9.viii.2005, 6 25.407S 145 34.480E, K.Sagata (WB124)" (NHMW, ZSM). 1 male, 2 females "Papua New Guinea: Eastern Highlands, Kimiagomo vill, north Okapa stn, 1900, 30.iv.2006, 06.25.407S 145.34.480E, Sagata (PNG 80)" (NHMW, ZSM). 1 male, 4 females "Papua New Guinea: Eastern Highlands, Yuyulio, Kimiagomo-Okapa, 2100m, 13.iv.2003, 06 25.255S 145 34.233E, K. Sagata (WB7)" (NHMW, ZSM). 1 male "Papua New Guinea: Eastern Highlands, Kainantu, Yoginofi, 1900m, 9.v.1994, 06.21.799S 145.45.463E, Balke & Sagata (PNG 55)" (ZSM).

Additional material. 3 females "Papua New Guinea: Eastern Highlands, Hano kotu, Kimiagomo, Okapa, 1661m, 11.viii.2006, 06 25.096S 145 34.556E, K.Sagata (WB129)" (ZSM).

Description. *Body size and form*: Beetle medium-sized: TL-H 3.95–4.7 mm, TL 4.3–5.05 mm, MW 2.05–2.5 mm (holotype: TL-H 4.3 mm, TL 4.7 mm, MW 2.3 mm), with oblong-oval habitus, slightly more attenuated posteriorly.

Coloration: Piceous, with reddish brown pronotum. Head reddish brown to piceous, paler anteriorly and darker posterior to eyes. Pronotum dark brown to piceous, with reddish to reddish brown sides narrowly or broadly. Elytra dark brown to piceous,

sometime with narrow reddish sutural lines. Head appendages and legs proximally yellowish red, legs distally darker, reddish brown, especially metathoracic legs (Fig. 23). Teneral specimens paler.

Surface sculpture: Shiny dorsally. Head mostly with fine, sparse punctation (spaces between punctures 2–3 times size of punctures) but punctation denser and coarser between eyes; diameter of punctures smaller than diameter of cells of microreticulation. Pronotum and elytra with very fine, sparse punctation, sometimes inconspicuous on elytra. Pronotum and elytra with weakly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles, abdominal ventrites with distinct microreticulation and strioles. Metaventrite medially, metacoxal plates, and abdominal ventrites with very fine, sparse, often inconspicuous punctation.

Structures: Pronotum with distinct lateral bead. Its lateral sides with distinct longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively narrow, slightly convex, and smooth, with distinct lateral bead and few lateral setae. Abdominal ventrite 6 rounded.

Male: Antennae simple (Fig. 23). Protarsomere 4 with large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 ventrally with anterior band of ca 60 and posterior row of 20 relatively long, thin setae (Fig. 47D). Median lobe in lateral view slightly curved, with apex dully pointed, slightly bent downwards; in ventral view, broadened subdistally, with broad, rounded apex. Paramere slightly concave on dorsal side and with dense setae on subdistal part; proximal setae inconspicuous (Fig. 47A–C). Abdominal ventrite 6 with 8–12 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. *Exocelina okapa* sp. n. is similar to *E. yoginofi* sp. n. but differs from it in very weak dorsal punctation and microreticulation and more slender median lobe. The species is also similar to *E. mendiensis* sp. n. but differs from it in distinctly smaller size and differently shaped apex of the median lobe.

Distribution. Papua New Guinea: Eastern Highlands Province (Fig. 50).

Etymology. The species is named after Okapa Station. The name is a noun in the nominative singular standing in apposition.

16. *Exocelina piusi* Shaverdo & Balke, sp. n. http://zoobank.org/A1C1E56D-459F-4BF1-A670-7EDE937644FA Figs 9, 33

Exocelina undescribed sp. MB4921: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina piusi_*New_Guinea_MB4921: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: East Sepik Province, Lembena, 04°56.859'S, 143°59.375'E, 1,250 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: East Sepik, Lembena, 335m, 10.ix.2009, 04 56.859S 143 59.375E, Ibalim & Pius (PNG250)", "M. Balke 4920" (ZSM). *Paratype*: 1 male with the same label as the holotype, "M. Balke 4921" (ZSM).

Description. *Body size and form*: Beetle small: TL-H 3.5–3.6 mm, TL 3.9–4.0 mm, MW 1.95–2.0 mm (holotype: TL-H 3.6 mm, TL 4 mm, MW 1.95 mm), with oblong-oval habitus.

Coloration: Specimens teneral. Reddish brown, with pronotum slightly paler. Head reddish brown, with small darker areas posterior to eyes. Pronotum yellowish brown, darker on disc. Elytra reddish brown. Head appendages yellowish red, legs reddish, distally darker, especially metathoracic legs (Fig. 9).

Surface sculpture: Submatt dorsally. Head with fine, sparse punctation (spaces between punctures 2–3 times size of punctures), only with some larger punctures between eyes; diameter of punctures smaller than diameter of cells of microreticulation. Pronotum and elytra with very fine, sparse punctation. Pronotum and elytra with rather strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and very fine, sparse punctation.

Structures: Pronotum with narrow lateral bead. Its lateral sides with inconspicuous, shallow longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively broad, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 rounded.

Male: Antennae simple (Fig. 9). Protarsomere 4 with large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with anterior band of ca 40 and posterior row of 6 relatively long, thin setae (Fig. 33D). Median lobe in lateral view slightly curved, broad, with apex bent downwards, not distinctly thickened, slightly angulate; in ventral view, almost subparallel and distally distinctly narrowed to apex, apex roundly truncate, of shape of a baby pacifier. Paramere slightly concave on dorsal side, with long, dense dorsal setae: subdistal setae strong and dense, setae in middle part shorter and sparser, proximal setae longer and stronger than subdistal ones (Fig. 33A–C). Abdominal ventrite 6 with 9–10 lateral striae on each side.

Female: Unknown.

Affinities. *Exocelina piusi* sp. n. is similar to *E. messeri* and, especially, to *E. pseudo-fume* sp. n. in body shape, coloration, and dorsal punctation and microreticulation, but differs from them in presence of narrow pronotal bead and shape of the median lobe.

Distribution. Papua New Guinea: East Sepik Province (Fig. 50).

Etymology. The species is named for Pius, a local collector. The species name is a noun in the genitive case.

17. Exocelina pseudofume Shaverdo & Balke, sp. n.

http://zoobank.org/CDB94F20-4781-43BE-8079-521A5E8E6B74 Figs 7, 32

*Exocelina fume_*New_Guinea_MB 4169: Toussaint et al. 2015: supplementary figs S1–S2, table S3, and information S5–S6.

Type locality. Papua New Guinea: Madang Province, Wannang, 05°15.458'S, 145°02.389'E, 270 m a.s.l.

Type material studied. *Holotype*: male "Papua New Guinea: Madang, Wannang, 270m 31.x.2008, 05.15.458S 145.02.389E, Posman, (PNG187)" (ZSM). *Paratypes*: 6 males, 1 female with the same label as the holotype, one of males additionally with "M.Balke 4169" [green] (NHMW, ZSM).

Description. Body size and form: Beetle medium-sized: TL-H 3.3–3.6 mm, TL 3.6–3.95 mm, MW 1.8–2.0 mm (holotype: TL-H 3.3 mm, TL 3.6 mm, MW 1.9 mm), with oblong-oval habitus.

Coloration: Reddish to reddish brown, with head and pronotum paler. Head yellowish red to reddish brown, with small darker areas posterior to eyes. Pronotum yellowish red to reddish brown, darker (to brown) on disc. Elytra reddish brown to brown, sometimes with narrow yellowish or reddish sutural lines. Head appendages and legs yellowish red, legs distally darker, especially metathoracic legs (Fig. 7). All specimens are slightly teneral, therefore, the species coloration might be more darker.

Surface sculpture: Shiny dorsally. Head with rather dense punctation (spaces between punctures 1–2 times size of punctures), evidently finer and sparser anteriorly; diameter of punctures smaller than diameter of cells of microreticulation or equal to it. Pronotum and elytra with very distinct punctation, sparser and slightly finer than on head. Pronotum and elytra with weakly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and very fine sparse punctation.

Structures: Pronotum without lateral bead. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively narrow, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 rounded.

Male: Antennae simple (Fig. 7). Protarsomere 4 with anterolateral seta thin, long, smaller than more laterally situated large setae, slightly curved downwards. Protarsomere 5 long and narrow, with anterior band of ca 40 and posterior row of 10 relatively long setae (Fig. 32D). Median lobe in lateral view slightly curved, its apex strongly bent downwards, with visible angle on dorsal side; in ventral view, almost subparallel

and distally narrowed to truncate apex. Paramere slightly concave on dorsal side and with long, dense, thin setae, situated along dorsal margin: subdistal setae denser than setae in middle and proximal parts (Fig. 32A–C). Abdominal ventrite 6 with 5–8 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. *Exocelina pseudofume* sp. n. is similar to *E. messeri* and *E. keki* sp. n. but it has distinctly broader and more oval habitus, shinier dorsal surface due to weaker microreticulation, as well as median lobe of different shape: thicker, with apex broader and curved downwards, with visible angle on dorsal side in lateral view. The shape of median lobe is similar to that of *E. fume*.

Distribution. Papua New Guinea: Madang (Fig. 50).

Etymology. The species is named "pseudofume" because shape of its median lobe remains that of *E. fume*. The name is a noun in the nominative singular standing in apposition.

18. Exocelina pseudopusilla Shaverdo & Balke, sp. n.

http://zoobank.org/D1246773-6373-4A1D-AF63-B8BFBCCE69D1 Figs 18, 42

Type locality. Papua New Guinea: Simbu Province, Mount Wilhelm, 05°43'15.145"S, 145°16'10.0927"E, 1,200 m a.s.l.

Type material. Holotype: male "Ibisca Niugini, PNG 1-3.xi.2012 Mount Wilhelm 1200 m -5,720873833 145,2694702 MW1200 / P1611 Vial 16950" (MNHN). Paratypes: 1 male "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1200m -5,720873833 145,2694702 MW1200 / P1513 Vial 09099" (IECA). 1 male "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1200m", "-5,720873833 145,2694702 FIT-MW1200-E-2/8-d03 / Plot 5 / P1521 Vial 17210" (NHMW). 1 female "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1200m -5,720873833 145,2694702 MW1200 / P1553 Vial 09007" (ZSM). 1 female "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1200m -5,720873833 145,2694702 MW1200 / P1561 Vial 16873" (ZSM). 1 female "Ibisca Niugini, PNG 28-30.x.2012 Mount Wilhelm 1200m -5,720873833 145,2694702 MW1200 / P1601 Vial 17313" (ZSM). 1 female "Ibisca Niugini, PNG 28-30.x.2012 Mount Wilhelm 1200m -5,720873833 145,2694702 MW1200 / P1633 Vial 18848" (MNHN). 2 females "Ibisca Niugini, PNG 28-30.x.2012 Mount Wilhelm 1200m -5,720873833 145,2694702 MW1200 / P1609 Vial 18855" (BMNH, ZSM). 1 female "Ibisca Niugini, PNG 28-30.x.2012 Mount Wilhelm 1200m -5,720873833 145,2694702 MW1200 / P1633 Vial 18848" (ZSM). 1 female "Ibisca Niugini, PNG 30.x.-1.xi.2012 Mount Wilhelm 1200m -5,720873833 145,2694702 MW1200 / P1634 Vial 17605" (ZSM). 1 female "Ibisca Niugini, PNG 27-29.x.2012 Mount Wilhelm 1200m", "-5,720873833 145,2694702 FIT-MW1200-G-2/8-d03 / Plot 7 / P1537 Vial 17367" (ZSM). 1 female "Ibisca Niugini, PNG 28–30.x.2012 Mount Wilhelm 1200m", "-5,720873833 145,2694702 FIT-MW1200-S-2/8-d04 / Plot 19 / P1633 Vial 18847-CODYTI" (ANIC).

Description. *Body size and form*: Beetle small: TL-H 3.25–3.55 mm, TL 3.65–3.95 mm, MW 1.8–1.85 mm (holotype: TL-H 3.5 mm, TL 3.85 mm, MW 2.0 mm), with oblong to oblong-oval habitus.

Coloration: Reddish brown to dark brown, with head and pronotum paler. Head reddish to reddish brown, with small darker areas posterior to eyes. Pronotum reddish to reddish brown, with dark brown disc. Elytra brown to dark brown, with narrow reddish sutural lines. Head appendages yellowish red, legs reddish, distally darker, especially metathoracic legs (Fig. 18). Teneral specimens paler.

Surface sculpture: Submatt dorsally. Head with dense, coarse punctation (no spaces between punctures or spaces of equal size of punctures), evidently finer and sparser anteriorly; diameter of punctures equal to or larger than diameter of cells of microreticulation. Pronotum and elytra with dense and coarse punctation, sparser and finer than on head. Pronotum and elytra with rather strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and fine sparse punctation.

Structures: Pronotum with narrow lateral bead. Its lateral sides with distinct longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively broad, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 slightly truncate or very slightly concave.

Male: Antennae simple (Fig. 18). Protarsomere 4 with anterior angle slightly expanded, with large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with anterior band of ca 40 and posterior row of 13 relatively long, thin setae (Fig. 42D). Median lobe in lateral view simple, slightly curved; in ventral view, evenly tapering to broadly pointed apex, side of apex slightly thickened. Paramere slightly concave on dorsal side and with dense setae on subdistal part; proximal setae finer (Fig. 42A–C). Abdominal ventrite 6 with 9–10 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. *Exocelina pseudopusilla* sp. n. is similar to *E. pusilla* sp. n. but larger, more elongate, with denser and coarser dorsal punctation and microreticulation and differently shaped median lobe. See also under *E. cyclops* sp. n.

Distribution and note on taxonomy. Papua New Guinea: Simbu Province (Fig. 50). So far, this species is known only from the Mount Wilhelm, where it occurs at the high altitudes (1200 m), whilst *E. pusilla* sp. n. is also known from the Mount Wilhelm but only from 200 m. We consider the specimens from 1200 m as a distinct species (not belonging to *E. pusilla* sp. n.) because of the morphological differences mentioned above and because no intermediate forms were found. We realize a possibility that they might be just a larger, more elongate, and more strongly punctured and reticulated form of *E. pusilla* sp. n. adapted to the high altitudes. However, based on the
present material, we cannot confirm it. For that, further morphological and molecular studies and more material, including one from intermediate altitudes, are requited.

Etymology. The species was mistaken for *E. pusilla* sp. n. due to their similarity. The name is a noun in the nominative singular standing in apposition.

19. Exocelina pusilla Shaverdo & Balke, sp. n.

http://zoobank.org/EA2F0829-7152-4555-8B5C-DE2184A07ADB Figs 10, 35

Exocelina undescribed sp. MB1364: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina pusilla_*New_Guinea_MB1364: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Madang Province, Akameku-Brahmin, Bismarck Range, 05°47.03'S, 145°24.13'E, 250–500 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Madang, Akameku-Brahmin, Bismarck Range, 250–500m, 25.xi.2006, nr 05.47.026S 145.24.131E, Balke & Kinibel (PNG 115)", "M.Balke 1364" [green] (ZSM). *Paratypes*: Madang: 3 males, 31 exs. with the same label as the holotype (NHMW, ZSM). Simbu: 1 male "Ibisca Niugini, PNG 9–11.xi.2012 Mount Wilhelm 200m", "-5,739897251 145,3297424 FIT-MW200-P-8/8-d16 / Plot 16 / P0835 Vial 14281-CODYTI" (ZSM). 2 females "Ibisca Niugini, PNG 11.ii-11.iv.2012 Mount Wilhelm 200m -5,739897251 145,3297424 MW0200 / P0760 Vial 07137" (ZSM). 1 female "Ibisca Niugini, PNG 2–4.xi.2012 Mount Wilhelm 200m -5,739897251 145,3297424 MW0200 / P0768 Vial 06033" (ZSM).

Description. *Body size and form*: Beetle small: TL-H 2.95–3.25 mm, TL 3.2–3.6 mm, MW 1.65–1.85 mm (holotype: TL-H 2.95 mm, TL 3.25 mm, MW 1.65 mm), with oblong-oval habitus.

Coloration: Reddish to reddish brown, with head and pronotum paler. Head yellowish red to reddish, with small darker areas posterior to eyes. Pronotum yellowish red to reddish, with small brownish area on disc. Elytra reddish brown to brown, with narrow reddish sutural lines. Head appendages yellowish red, legs reddish, distally darker, especially metathoracic legs (Fig. 10). Teneral specimens paler.

Surface sculpture: Shiny dorsally. Head with dense, coarse punctation (no spaces between punctures or spaces 2 times size of punctures), evidently finer and sparser anteriorly; diameter of punctures equal to or larger than diameter of cells of microre-ticulation. Pronotum and elytra with dense and coarse punctation, sparser and finer than on head. Pronotum and elytra with weakly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and fine sparse punctation.

Structures: Pronotum with narrow lateral bead. Its lateral sides with longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, rounded anteriorly. Blade of prosternal process lanceolate, relatively broad, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 slightly truncate or very slightly concave.

Male: Antennae simple (Fig. 10). Protarsomere 4 with anterior angle slightly expanded and large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with anterior band of ca 40 and posterior row of 12 relatively long, thin setae (Fig. 35D). Median lobe in lateral view simple, slightly curved; in ventral view, evenly tapering to broadly pointed apex, side of apex slightly thickened. Paramere slightly concave on dorsal side and with dense setae on subdistal part; proximal setae finer and much sparser (Fig. 35A–C). Abdominal ventrite 6 with 5–10 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. Exocelina pusilla sp. n. is very similar to *E. cyclops* sp. n. in body shape, coloration, and surface sculpture but differs in having distinctly thinner and distally narrowed median lobe. It is also similar to *E. adelbertensis* sp. n., *E. bewani* sp. n., and *E. sumokedi* sp. n. but has coarser dorsal punctation and differently shaped median lobe. See also under *E. pseudopusilla* sp. n.

Distribution. Papua New Guinea: Madang and Simbu Provinces (Fig. 50).

Etymology. The species name derives from the Latin "pusillus" (small, tiny) to express small size of these beetles. The species name is an adjective in the nominative singular.

20. Exocelina sima Shaverdo & Balke, sp. n.

http://zoobank.org/03716131-0FB0-4A66-B212-B578D967F0DE Figs 8, 31

Type locality. Papua New Guinea: Simbu/Eastern Highlands Province, Crater Mountain, Sera – Herowana, Sima River, ca 06°06'57.5"S, 145°03'39.4"E, 1,250 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Simbu / EHP, Crater Mountain, Sera – Herowana, Sima river, 1250m, 15IX2002, Balke & Sagata, (PNG 016)" (ZSM).

Description. *Body size and form:* Beetle small: TL-H 3.6 mm, TL 4.0 mm, MW 2.0 mm, with broader, oval habitus.

Coloration: Reddish brown head and pronotum and piceous elytra. Head reddish in its anterior half and dark brown in posterior one. Pronotum dark brown on disc and gradually paler to yellowish red laterally. Elytra dark brown, paler laterally and almost piceous on disc. Head appendages yellowish red, legs reddish, distally darker, especially metathoracic legs (Fig. 8).

Surface sculpture: Shiny dorsally. Head with rather dense punctation (spaces between punctures 1–2 times size of punctures) but fine punctation; diameter of punctures smaller than diameter of cells of microreticulation. Pronotum and elytra with distinct punctation, sparser and finer punctation than on head. Pronotum and elytra with weakly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and very fine sparse punctation.

Structures: Pronotum without lateral bead. Base of prosternum and neck of prosternal process with distinct ridge, rounded anteriorly. Blade of prosternal process lanceolate, elongate, relatively broad, slightly convex, with distinct lateral bead and few. Abdominal ventrite 6 rounded.

Male: Antennae simple (Fig. 8). Protarsomere 4 with anterolateral seta long and thin, equal to more laterally situated large setae, slightly curved downwards. Protarsomere 5 long and narrow, with anterior band of more than 40 and posterior row of 12 relatively long, thin setae (Fig. 31D). Median lobe in lateral view short, slightly curved, with enlarged, rounded, not bent downwards apex; in ventral view, narrow, subparallel, and with truncate apex. Paramere very slightly concave on dorsal side and with long, dense, thin setae, situated along dorsal margin: subdistal setae strong and dense, setae in middle part shorter and sparser, proximal setae long but sparser than subdistal ones (Fig. 31A–C). Abdominal ventrite 6 without lateral striae on each side, except one with setae.

Female: Unknown.

Affinities. In absence of the pronotal bead and thin and not hook-like anterolateral seta of the male protarsomere 4, *Exocelina sima* sp. n. is similar to *E. keki* sp. n., *E. messeri*, and *E. pseudofume* sp. n. However, the species distinctly differs from them in more oval body form and more strongly expressed bicolor dorsal surface: reddish head and pronotum and piceous elytra, as well as in a characteristic shape of the median lobe and male abdominal ventrite 6 without lateral striae. The latter character is unique among New Guinea *Exocelina*.

Distribution. Papua New Guinea: Simbu and Eastern Highlands Provinces, Crater Mountain. This species is known only from the type locality (Fig. 50).

Etymology. The species is named after Sima River. The name is a noun in the nominative singular standing in apposition.

21. Exocelina simbaiensis Shaverdo & Balke, sp. n.

http://zoobank.org/11CCE13F-F7DC-40A0-967D-C7F70EB423C2 Figs 19, 43

Exocelina undescribed sp. MB3315: Toussaint et al. 2014: supplementary figs 1–4, table 2;

Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina simbaiensis*_New_Guinea_MB3315: Toussaint et al. 2015: supplementary information S5–S6.

Exocelina inengensis MB3309: Toussaint et al. 2015: supplementary figs S1–S2, table S3, and information S5–S6.

Type locality. Papua New Guinea: Western Highlands Province, Simbai, Ineng River, 05°14.94'S, 144°32.82'E, 2,000 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Western Highlands, Simbai, Ineng River, 2000m, 27.ii.2007, 05.14.943S 144.32.818E, Kinibel (PNG 135)" (ZSM). *Paratypes*: 4 males, 9 females with the same label as the holotype, one male with an additional green label "M.Balke 3309" (NHMW, ZSM). 1 male, 1 female "Papua New Guinea: Western Highlands, Simbai area, 2200m, 6.iii.2007, 05.18.752S 144.31.849E, Kinibel (PNG 149)", male additionally with "M.Balke 3316" [green] (ZSM). 2 females "Papua New Guinea: Western Highlands, Simbai area, 2500m, 8.iii.2007, 05.14.202S 144.33.651E, Kinibel (PNG 150)" (NHMW, ZSM). 1 female "M.Balke 3315" [green], "Papua New Guinea: Western Highlands, Jimi Valley, above Sendiap Station, 2000m, 6.iii.2007, 05.19.314S 144.31.266E, Kinibel (PNG 148)" (ZSM).

Description. *Body size and form*: Beetle small to medium-sized: TL-H 3.3–4.15 mm, TL 3.65–4.5 mm, MW 1.8–2.15 mm (holotype: TL-H 3.9 mm, TL 4.25 mm, MW 2.0 mm), with rather oblong habitus.

Coloration: Dark brown to piceous, sometimes with reddish pronotum. Head dark brown to piceous, paler anteriorly. Pronotum dark brown to piceous, with reddish brown lateral sides and sometimes anteriorly and narrowly posteriorly. Elytra dark brown to piceous, sometimes with narrow reddish sutural lines. Head appendages and legs proximally yellowish red, legs distally darker, reddish (Fig. 19).

Surface sculpture: Matt dorsally. Head with dense punctation (no spaces between punctures or spaces 2 times size of punctures), finer and sparser anteriorly; diameter of punctures equal to diameter of cells of microreticulation. Pronotum and elytra with slightly sparser and finer punctation than on head. Head, pronotum and elytra with strongly impressed microreticulation. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and fine, sparse but distinct punctation.

Structures: Pronotum with distinct lateral bead. Its lateral sides with distinct longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively narrow, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 broadly rounded.

Male: Antennomere simple, slightly stout (Fig. 19). Protarsomere 4 with anterior angle slightly expanded, with large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 long and narrow, slightly concave ventrally, with anterior band of ca 40 and irregular posterior row of 17 relatively long setae (Fig. 43D). Median lobe in lateral view slightly curved, its apex thickened, bent downwards; in ventral view, slightly broadened medially, with broadly pointed apex. Paramere very slightly concave on dorsal side and with dense setae on subdistal part; proximal setae inconspicuous (Fig. 43A–C). Abdominal ventrite 6 with 7–12 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Variability. The specimens from Ineng River are larger: TL-H 3.5–4.15 mm; remaining specimens: TL-H 3.3–3.7 mm. In addition, the population from Ineng River shows variability in how strongly apex of the median lobe bent downwards in lateral view.

Affinities. *Exocelina simbaiensis* sp. n. is similar to *E. yoginofi* sp. n. in body form, size, and coloration, but differs from it in distinctly stronger punctation and microre-ticulation and in thickened apex of the median lobe.

Distribution. Papua New Guinea: Western Highlands Province, near Simbai (Fig. 50).

Etymology. The species is named after Simbai area. The name is an adjective in the nominative singular.

22. Exocelina simbaijimi Shaverdo & Balke, sp. n.

http://zoobank.org/0B6B7A59-3532-4BE4-BAC1-7A61681B5DF1 Figs 17, 41

Exocelina undescribed sp. MB3312: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina simbaijimi*_New_Guinea_MB3312: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Western Highlands Province, Simbai-Jimi, 05°16.07'S, 144°27.89'E, 1,500 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Western Highlands, Simbai -Jimi, 1500m, 2.iii.2007, 05.16.074S 144.27.886E, Kinibel (PNG 140)" (ZSM). *Paratypes*: 6 males with the same label as the holotype (NHMW, ZSM). 2 males, 3 females "Papua New Guinea: Western Highlands, Simbai, Kairong River, 1850m, 2.iii.2007, 05.14.840S 144.28.457E, Kinibel (PNG 139)", one male with an additional green label "M.Balke 3310" (NHMW, ZSM). 3 males, 1 female "Papua New Guinea: Western Highlands, Jimi, 1500m, 2.iii.2007, 05.16.335S 144.27.930E, Kinibel (PNG 141)" (ZSM). 7 males, 1 female "Papua New Guinea: Western Highlands, Gonzsidai-Sarup, 1700m, 4.iii.2007, 05.19.060S 144.28.671E, Kinibel (PNG 144)", one male with an additional green label "M.Balke 3312" (NHMW, ZSM). 2 males, 1 female "Papua New Guinea: Western Highlands, Kundum, 1400m, 03.III.2007, 05.16.096S 144.27.869E, Kinibel (PNG 142)" (NHMW, ZSM).

Additional material. 1 female "Papua New Guinea: Western Highlands, Simbai, 1800–2000m, 25.ii.2007, 05.16.330S 144.33.176E, Kinibel (PNG 133)" (ZSM). 1 female "Papua New Guinea: Western Highlands, Simbai, 1800–2000m, 1.iii.2007, 05.14.2760S 144.28.741E, Kinibel (PNG 138)" (ZSM).

Description. *Body size and form*: Beetle medium-sized: TL-H 4.05–5.0 mm, TL 4.4–5.4 mm, MW 2.1–2.55 mm (holotype: TL-H 5.0 mm, TL 5.4 mm, MW 2.5 mm), with oblong-oval habitus.

Coloration: Piceous, with head and pronotum paler. Head dark brown to piceous, reddish brown to brown anteriorly, with small darker areas posterior to eyes. Pronotum reddish brown to brown laterally and piceous on disc. Elytra brown to piceous, sometimes with narrow reddish sutural lines. Head appendages and legs proximally reddish, legs distally darker, brown, especially metathoracic legs (Fig. 17). Teneral specimens paler.

Surface sculpture: Submatt dorsally. Head with rather dense, coarse punctation (spaces between punctures 1–2 times size of punctures), evidently finer and sparser anteriorly; diameter of punctures smaller than or equal to diameter of cells of microreticulation. Pronotum with distinct punctation, sparser and finer than on head. Elytra with very fine and sparse punctation. Pronotum and elytra with strongly impressed microreticulation. Head with microreticulation stronger. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and fine, sparse punctation.

Structures: Pronotum with distinct lateral bead. Its lateral sides with longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, slightly rounded anteriorly. Blade of prosternal process lanceolate, relatively narrow, slightly convex, and smooth, with distinct lateral bead and few lateral setae. Abdominal ventrite 6 slightly truncate or broadly rounded.

Male: Antennae simple (Fig. 17). Protarsomere 4 with anterior angle slightly expanded, with large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 long and narrow, slightly concave ventrally, with anterior band of more than 80 and posterior band of ca 30 relatively long setae (Fig. 41D). Median lobe in lateral view evenly broad, with rounded, slightly angulated, thickened apex; in ventral view, almost subparallel, with broadly rounded apex, with thickened margins. Paramere slightly concave on dorsal side and with long, dense, thin setae situated along dorsal margin: subdistal setae denser, proximal setae sparser, setae in middle finer (Fig. 41A–C). Abdominal ventrite 6 with 9–14 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. *Exocelina simbaijimi* sp. n. is similar to *E. heidiae* in body size and form but differs from it in darker coloration, more distinct dorsal punctation, broader median lobe, with more angulated apex in lateral view and more thickened margins in ventral view.

Distribution. Papua New Guinea: Western Highlands Province (Fig. 50).

Etymology. The species is named after Simbai-Jimi area. The name is a noun in the nominative singular standing in apposition.

23. Exocelina sumokedi Shaverdo & Balke, sp. n.

http://zoobank.org/23A6509D-8E6A-4D0D-B585-0073ADE777D3 Figs 11, 34

Type locality. Papua: Puncak Regency, south from Iratoi, 03°16'48.6"S, 137°20'02.9"E, 150 m a.s.l.

Type material. *Holotype*: male "Indonesia: Papua, S Iratoi, hunting camp, 150m, 28.v.2006, -3,2801742386 137,334125172346, local collectors" (MZB). *Paratypes*: 11 males, 13 females with the same label as the holotype (MZB, NHMW, ZSM). 6 males, 2 females "Indonesia: Papua, S Iratoi, river camp, 161m, 20./25.v.2006, -3,3522959 137,295029880478, local collectors" (NHMW, ZSM). 1 female "Indonesia: Papua,

Rouaffer, Iratoi, hill in forest, 164m, 6.ix.2005, -3,2403086 137,3329744, local collectors" (ZSM).

Description. *Body size and form*: Beetle small: TL-H 2.7–3.2 mm, TL 3.0–3.55 mm, MW 1.55–1.9 mm (holotype: TL-H 2.95 mm, TL 3.25 mm, MW 1.75 mm), with broader, oval habitus.

Coloration: Brownish, with head and pronotum paler. Head yellowish red to reddish brown in anterior half and brown to dark brown in posterior ones. Pronotum yellowish red to reddish brown on sides, brown to dark brown on disc. Elytra brown to dark brown, with narrow reddish sutural lines. Head appendages yellowish red, legs reddish, distally darker, especially metathoracic legs (Fig. 11). Teneral specimens paler.

Surface sculpture: Shiny dorsally. As in *E. pusilla* sp. n. but punctation finer and sparser and microreticulation weakly impressed.

Structures: Pronotum with lateral bead. Its lateral sides with shallow longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, rounded anteriorly. Blade of prosternal process lanceolate, relatively broad, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 broadly rounded or slightly truncate.

Male: Antennae simple (Fig. 11). Protarsomere 4 with medium-sized, thick, curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with anterior row of 17 and posterior row of 6 relatively short setae (Fig. 34D). Median lobe in lateral view slightly curved, with thickened, not curved downwards apex; in ventral view, distinctly narrowed subdistally, with roundly truncate apex. Paramere slightly concave on dorsal side and with dense setae on subdistal part; proximal setae finer and sparser (Fig. 34A–C). Abdominal ventrite 6 with 5–8 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. Exocelina sumokedi sp. n. is similar to E. pusilla sp. n. but is smaller, darker, more oval, shinier, with finer and sparser dorsal punctation and weaker microreticulation, with shallow longitudinal impressions on lateral sides of pronotum and different shape of the median lobe. The species is also similar to E. adelbertensis sp. n., E. bewani sp. n., E. cyclops sp. n., and E. pseudopusilla sp. n., see their "Affinities" and "Key".

Distribution. Papua: Puncak Regency. The species is known only from the Iratoi area (Fig. 50).

Etymology. The species is named for our friend Bob Sumoked (Tomohon, Sulawesi). The species name is a noun in the genitive case.

24. Exocelina yoginofi Shaverdo & Balke, sp. n.

http://zoobank.org/1F4C342B-17BB-4331-83CF-5AC202F7A881 Figs 22, 46

Exocelina undescribed sp. MB1302: Toussaint et al. 2014: supplementary figs 1–4, table 2; Toussaint et al. 2015: supplementary figs S1–S2, table S3.

*Exocelina yoginofi*_New_Guinea_MB1302: Toussaint et al. 2015: supplementary information S5–S6.

Type locality. Papua New Guinea: Eastern Highlands Province, Kainantu, Yoginofi, 06°21.80'S, 145°45.46'E, 1,900 m a.s.l.

Type material. *Holotype*: male "Papua New Guinea: Eastern Highlands, Kainantu, Yoginofi, 1900m, 9.v.1994, 06.21.799S 145.45.463E, Balke & Sagata (PNG 55)" (ZSM). *Paratypes*: 6 males, 8 females with the same label as the holotype, one male with an additional green label "M.Balke 1302" (NHMW, ZSM). 1 male, 1 female "Papua New Guinea: Eastern Highlands, 37 km S Goroka, Hogave vill., Mt. Michael, 2179–2800m, 9.-15.vii.2009, 06.22.479S 145.15.256E, Sagata (PNG230)" (ZSM).

Description. *Body size and form*: Beetle medium-sized: TL-H 3.45–4.0 mm, TL 3.85–4.45 mm, MW 1.85–2.15 mm (holotype: TL-H 3.9 mm, TL 4.3 mm, MW 2.0 mm), with oblong-oval habitus.

Coloration: Dark brown to piceous, with paler pronotum. Head reddish to dark brown, paler anteriorly and posteriorly. Pronotum brown to dark brown, with reddish brown lateral sides and sometimes anteriorly and narrowly posteriorly, darker on disc, sometimes to piceous. Elytra brown to piceous, sometimes with narrow reddish sutural lines. Head appendages and legs proximally yellowish red, legs distally darker, reddish brown (Fig. 22).

Surface sculpture: Submatt dorsally. Head with rather dense punctation (spaces between punctures 1–2 times size of punctures), finer and sparser anteriorly; diameter of punctures smaller than or equal to diameter of cells of microreticulation. Pronotum and elytra with sparser and finer punctation than on head. Head, pronotum and elytra with rather strongly impressed microreticulation. Metaventrite and metacoxae distinctly microreticulate, metacoxal plates with longitudinal strioles and transverse wrinkles. Abdominal ventrites with distinct microreticulation, strioles, and fine, sparse but distinct punctation.

Structures: Pronotum with distinct lateral bead. Its lateral sides with distinct longitudinal impressions. Base of prosternum and neck of prosternal process with distinct ridge, rounded anteriorly. Blade of prosternal process lanceolate, relatively broad, slightly convex, with distinct lateral bead and few setae. Abdominal ventrite 6 rounded.

Male: Antennomere simple (Fig. 22). Protarsomere 4 with large, thick, strongly curved anterolateral hook-like seta. Protarsomere 5 long and narrow, with narrow anterior band of ca. 40 and posterior row of 14 relatively long setae (Fig. 46D). Median lobe in lateral view slightly curved, with apex dully pointed, slightly bent downwards; in ventral view, broadened subdistally, with broad, rounded apex. Paramere very slightly concave on dorsal side and with dense setae on subdistal part; proximal setae inconspicuous (Fig. 46A–C). Abdominal ventrite 6 with 6–8 lateral striae on each side.

Female: Without evident differences in external morphology from males, except for not modified protarsi and abdominal ventrite 6 without striae.

Affinities. *Exocelina yoginofi* sp. n. is similar to *E. simbaiensis* sp. n. in body form, size, and coloration, but differs from it in distinctly finer punctation and microreticulation and in having the apex of the median lobe not thickened. Also, see under *E. okapa* sp. n.

Distribution. Papua New Guinea: Eastern Highlands Province (Fig. 50).

Etymology. The species is named after Yoginofi Village. The name is a noun in the nominative singular standing in apposition.

Key to species of the Exocelina casuarina-group

The key is based mostly on the male characters. In many cases, females cannot be assigned to species due to similarity of their external and internal structures (for female genitalia see Figs 17a and 17b in Shaverdo et al. (2005)). Some species are rather similar in point of external morphology; therefore, in most cases the male genitalia need to be studied for reliable species identification. Numbers in brackets refer to an arrangement of the species descriptions above.

1	Pronotum without lateral bead
_	Pronotum with lateral bead
2	Male protarsomere 4 with anterolateral seta hook-like, large, strongly curved
_	Male protarsomere 4 with anterolateral seta thin, long, equal or smaller than more laterally situated large setae, slightly curved
3	Median lobe not or slightly narrowed before truncate or slightly concave apex in ventral view (Fig. 26A)
_	Median lobe distinctly narrowed before truncate apex in ventral view (Figs 27A, 28A)
4	Apex of median lobe curved downwards, with visible angle on dorsal side in lateral view (Fig. 27B). Dorsal punctation coarser, microreticulation more strongly impressed
_	Apex of median lobe not or only slightly curved downwards in lateral view (Fig. 28B). Dorsal punctation distinctly finer, microreticulation less strongly impressed
5	Beetle more oval, broader, with pronotum reddish brown and elytra piceous (Fig. 8). Median lobe shorter, almost parallel-sided in ventral view, with distinctly rounded apex in lateral view (Fig. 31A, B)
_	Beetle elongate, narrower, with reddish to reddish brown dorsal coloration (Figs 5–7). Median lobe different
6	Dorsal punctation almost invisible on elytra (Fig. 5). Median lobe narrowed to slightly rounded, broad apex in ventral view (Fig. 29A). Ventral setae of male protarsomere 5 much more numerous, usually not divided into two rows/bands (Fig. 29D)(14) <i>messeri</i>
_	Dorsal punctation distinct on elytra (Figs 6, 7). Median lobe different. Ven- tral setae of male protarsomere 5 much less numerous, clearly divided into anterior band and posterior row7

7	Dorsal microreticulation more strongly impressed (Fig 6), beetle submatt.
	Apex of median lobe narrow and founded in ventral view and not curved downwards in lateral view (Fig. $30A$ B) (10) babi
	Dorsal microraticulation less strongly impressed (Fig. 7) heatle shinier. Aper
_	of median lobe broad and truncate in ventral view and strongly curved down.
	wards in lateral view (Fig. 32 A B) (17) pseudofuma
8	Beetle reddich brown more oval Usually smaller TL H < 3.6 mm
0	Beetle reddish brown to piceous elongate oblong oval Usually larger TLH
_	> 4 0 mm if smaller see below 14
9	Beetle larger, TL-H 3 5–3 6 mm, with finer and sparser dorsal punctation
/	and weaker microreticulation. Median lobe as in Fig. 33A, B (16) <i>piusi</i>
_	Beetle smaller, TL-H 2.7–3.25 mm, usually with distinctly coarser dorsal
	punctation and sometimes, stronger microreticulation. Median lobe different
	(e.g., Fig. 34)
10	Median lobe with thinner apex in lateral view, apex narrowed to tip in ventral view
	(Fig. 35B, A). Male protarsomere 4 with larger anterolateral hook-like seta; anterior
	setae of male protarsomere 5 more numerous (Fig. 35D)
_	Median lobe with apex thickened in lateral view, apex not narrowed to tip,
	broad, differently truncate in ventral view (e.g., Fig. 36B, A). Male protar-
	somere 4 with smaller anterolateral hook-like seta; anterior setae of male pro-
	tarsomere 5 less numerous (e.g., Fig. 36D)11
11	Median lobe distinctly narrowed distally, with apex roundly truncate in ven-
	tral view (Fig. 34A)(23) <i>sumokedi</i>
_	Median lobe not or very slightly narrowed distally, with apex distinctly trun-
	cate or slightly concave in ventral view (e.g., Fig. 36A)12
12	Apex of median lobe not curved downwards in lateral view (Fig. 36B)
_	Apex of median lobe curved downwards in lateral view (Figs 37B, 38B)13
13	Apex of median lobe narrower in lateral view and slightly concave in ventral
	view (Fig. 37A)(3) bewani
-	Apex of median lobe broader in lateral view and truncate in ventral view (Fig. (1)
1 /	(1) adelbertensis
14	Apex of median lobe strait, flatted, and thin apex in lateral view and broadly
	elongated, lanceolate, impressed in ventral view (Fig. 44A, B)
	(15) menyamya
_	Apex of median lobe of different shape, never so flatted and impressed ven- trally usually thickneed in lateral view (e.g. Fig. 30 Å B)
15	Median lobe evenly broad with rounded not curved downwards aper in
1)	lateral view (e.g. Fig. 39B)
	Median lobe parrowed towards apex apex pointed or slightly rounded usu.
_	ally curved downwards in lateral view (e.g. Fig. $43R$) 19
16	Beetle smaller, TL-H 3 5–4 3 mm, reddish brown to brown with distinctly
10	stronger dorsal punctation. Median lobe smaller and thinner (Fig. 39A B)
	(6) desii

_	Beetle larger, TL-H 4.05–5.0 mm, dark brown to piceous, with dorsal punc- tation finer and sparser. Median lobe larger and more robust (Figs 40, 41)
17	Beetle dark brown, with elytral punctation finer. Median lobe thinner and narrower in lateral view (Fig. 40 B)
_	Beetle dark brown to piceous, with elytral punctation more distinct. Median lobe thicker and broader in lateral view (Fig. 41 B)(22) <i>simbaijimi</i>
18	Beetle more elongate, almost parallel-sided, smaller, TL-H 3.25–4.15 mm, with strong dorsal punctation and microreticulation
_	Beetle more oval, larger, TL-H 3.45–5.5 mm, with dorsal punctation and microreticulation in some species much finer and sparser
19	Beetle smaller, TL-H 3.25–3.55 mm, reddish brown to dark brown (Fig. 18). Apex of median lobe slightly thickened, not bent downwards in lateral view (Fig. 42B)
_	Beetle larger, TL-H 3.3–4.15 mm, dark brown to piceous (Fig. 19). Apex of median lobe more strongly thickened, bent downwards in lateral view (Fig. 43B).
20	Beetle smaller, TL-H 3.45–4.7 mm
_	Beetle larger, TL-H 4.8–5.5 mm
21	Apex of median lobe not bent downwards in lateral view, roundly truncate in ventral view (Fig. 45B, A). Beetle matt, with strong dorsal microreticulation (Fig. 21)
_	Apex of median lobe bent downwards in lateral view, rounded in ventral view (e.g., Fig. 46B, A). Beetle shiny or submatt, with dorsal microreticulation weaker (e.g., Fig. 22)
22	Beetle smaller, TL-H 3.45–4.0 mm, submatt, with distinct dorsal punctation and microreticulation (Fig. 22). Median lobe as in Fig. 46A, B
_	Beetle larger, TL-H 3.95–4.7 mm, shiny, with extremely fine, inconspicuous dorsal punctation and weak microreticulation (Fig. 23). Median lobe as in Fig. 47A, B
23	Dorsal punctation and microreticulation weaker (Fig. 24). Median lobe as in Fig. 48A, B
_	Dorsal punctation and microreticulation stronger (Fig. 25). Median lobe as in Fig. 49A, B

Habitat

The studied species have the same habitat preferences as those described in Shaverdo et al. (2012). They are associated with running water, but avoid the current, i.e., their preferred microhabitats are small creeks, small and quiet backflows, puddles at the edge of streams and creeks, and other similar situations.



Figures 2–4. Habitus and coloration 2 *Exocelina casuarina* (Balke, 1998) 3 *E. fume* (Balke, 1998) 4 *E. ibalimi* sp. n.



Figures 5–8. Habitus and coloration 5 *Exocelina messeri* (Balke, 1999) 6 *E. keki* sp. n. 7 *E. pseudofume* sp. n. 8 *E. sima* sp. n.



Figures 9–14. Habitus and coloration 9 Exocelina piusi sp. n. 10 E. pusilla sp. n. 11 E. sumokedi sp. n. 12 E. cyclops sp. n. 13 E. bewani sp. n. 14 E. adelbertensis sp. n.



Figures 15–17. Habitus and coloration 15 *Exocelina desii* (Balke, 1999) 16 *E. heidiae* (Balke, 1998) 17 *E. simbaijimi* sp. n.



Figures 18–21. Habitus and coloration 18 Exocelina pseudopusilla sp. n. 19 E. simbaiensis sp. n. 20 E. menyamya sp. n. 21 E. ambua sp. n.



Figures 22–25. Habitus and coloration 22 *Exocelina yoginofi* sp. n. 23 *E. okapa* sp. n. 24 *E. mendiensis* sp. n. 25 *E. kumulensis* sp. n.



Figure 26. *Exocelina casuarina* (Balke, 1998) **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 27–28. 27 *Exocelina fume* (Balke, 1998) **28** *E. ibalimi* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 29–30. 29 *Exocelina messeri* (Balke, 1999) **30** *E. keki* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 31–32. 31 *Exocelina sima* sp. n. **32** *E. pseudofume* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 33–34. 33 *Exocelina piusi* sp. n. **34** *E. sumokedi* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 35–36. 35 *Exocelina pusilla* sp. n. **36** *E. cyclops* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 37–38. 37 *Exocelina bewani* sp. n. **38** *E. adelbertensis* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figure 39. *Exocelina desii* (Balke, 1999) **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.

D

С



Figures 40–41. 40 *Exocelina heidiae* (Balke, 1998) **41** *E. simbaijimi* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 42–43. 42 *Exocelina pseudopusilla* sp. n. **43** *E. simbaiensis* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 44–45. 44 *Exocelina menyamya* sp. n. **45** *E. ambua* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figures 46–47. 46 *Exocelina yoginofi* sp. n. **47** *E. okapa* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figure 48. *Exocelina mendiensis* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.



Figure 49. *Exocelina kumulensis* sp. n. **A** Median lobe in ventral view **B** Median lobe in lateral view **C** Paramere in external view **D** Male protarsomeres 4–5 in ventral view.

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RESEARCH ARTICLE



Amazonopsis, an unusual new genus of riffle beetle from South America with two new species (Coleoptera, Elmidae, Elminae)

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Abstract

Amazonopsis gen. n. is described to include *A. theranyi* sp. n. from Peru, Venezuela and French Guiana, and *A. camachoi* sp. n. from Venezuela. The descriptions are accompanied by figures illustrating the male and female habitus of *A. theranyi*, the male habitus of *A. camachoi*, and male genitalia of both species. *Amazonopsis theranyi* exhibits pronounced secondary sexual dimorphism which likewise may be a characteristic of the genus. *Amazonopsis* males have modified protarsal and mesotarsal claws, a pair of small spines on the anterior prosternum, and a pair of ventrally directed processes on the posterior metaventrite. Females of *A. theranyi* display a pair of unique, oval perforations in the cuticle of the pronotum and have unmodified claws; females of *A. camachoi* are unknown. Descriptions are furnished of the stream habitats and microhabitats where the study specimens were collected.

Keywords

Aquatic beetles, French Guiana, Neotropics, peri-Amazonian, Peru, sexual dimorphism, taxonomy, Venezuela

Introduction

Presently 40 genera and over 250 species of the aquatic beetle family Elmidae are known from South America (Manzo 2005, Maier and Spangler 2011, Maier 2012), including 25 genera and 102 species from the Amazon region (Passos et al. 2010). The Guiana

Shield in northern South America so far has yielded 22 genera including the endemics *Elachistelmis* Maier, 2012, *Hypsilara* Maier & Spangler, 2011, *Jolyelmis* Spangler & Faitoute, 1991, *Neblinagena* Spangler, 1985, *Neolimnius* Hinton, 1939, and *Roraima* Kodada & Jäch, 1999. In recent years, taxonomic checklists have been compiled for several South American countries, including Argentina (Manzo and Archangelsky 2014), French Guiana (Queney 2012), Ecuador (Monte and Mascagni 2012), Paraguay (Shepard and Aguilar Julio 2010), Peru (Shepard and Chaboo 2015), and parts of Colombia (González-Córdoba et al. 2015, 2016) and Brazil (Fernandes 2010, Passos et al. 2009), and for the Neotropical Region in general (Segura et al. 2013). Current research activity on the family in South America results in frequent articles describing new taxa.

Specimens of an unusual new genus and species of elmid were collected in the Amazon Basin of southeastern Peru in 2012 during a water quality survey of stream macroinvertebrates conducted by the Stroud Water Research Center (Avondale, Penn-sylvania, USA) in conjunction with the Amazon Center for Environmental Education and Research (ACEER) (West Chester, Pennsylvania, USA) (Howard 2012, Sweeney 2014). In 2016, I collected additional specimens of the genus in French Guiana while participating in the Diversity of Aquatic Insects of French Guiana (DIAG) project (Clavier 2017). Two specimens from Venezuela, collected in 1985 and 2004, were found in different museum collections. The larva is unknown.

The purpose of this paper is to describe this distinctive new genus of elmid, its two new species, and the stream habitats from which they were collected.

Materials and methods

Four specimens collected by the Stroud–ACEER project in Peru were taken from artificial leaf packs, consisting of plastic mesh bags filled with 7 g of fresh *Inga edulis* Martius (Fabaceae) leaves, which were deployed in the stream for about four weeks (Howard 2012, Sweeney 2014). After retrieval of the leaf packs, the contents were examined for specimens which were preserved in 90% ethanol. The specimens were then taxonomically sorted and distributed to specialists for identification. I was involved with identification of the Elmidae collected during the project. Subsequently, while a member of the DIAG team in French Guiana, I collected two specimens from a stream in the interior. They were dislodged into the current from naturally occurring leaf and stick packs and captured in a D-frame aquatic net. They were then preserved in 95% ethanol in the field. Two specimens from Venezuela were borrowed from the National Museum of Natural History (Washington, DC, USA) and the Museo del Instituto de Zoologia Agrícola (Maracay, Venezuela).

Water quality measurements of the streams were provided by the Stroud Water Research Center for the specimens collected in Peru during the ACEER project (Sweeney 2014), and by Hydreco Guyane (Kourou, French Guiana) for those collected in French Guiana during the DIAG project (S. Clavier in litt.). Those from Cerro de la Neblina, Venezuela, were obtained from a publication describing species of *Stegoelmis* (Elmidae) collected concurrently at the site (Spangler 1990).
Specimens were examined in the lab using a Leica MZ 12.5 stereo microscope fitted with an ocular micrometer. Measurements of total body length represent the length of the pronotum plus the length of the elytra, excluding the head and the variable space between the pronotum and elytra; measurements of body width are composed of both elytra at their widest point. The habitus images were taken with a Visionary Digital BK Plus Lab System fitted with a Canon EOS 7D camera. A Syncroscopy AutoMontage system was used for the genitalia images. All of the specimens are double-mounted on card points and pins. Males have the aedeagi removed and stored with glycerin in genitalia vials beneath the donor specimens.

Label data are reported verbatim as found on the specimen labels: " / " indicates separate lines on one label and " // " indicates separate labels. Brackets " [] " indicate additional clarifying information not included on the label.

The distribution map is an alteration of a map of South America provided free on the internet by d-maps (2018) of Trets, France.

Specimens will be deposited in the following institutions:

EMEC	Essig Museum of Entomology, University of California, Berkeley, CA,
	USA
MALUZ	La Universidad del Zulia, Maracaibo, Venezuela
MNHN	Muséum National d'Histoire Naturelle, Paris, France
MUSM	Museo de Historia Natural, Universidad Nacional Mayor de San Marcos,
	Lima, Peru
USNM	National Museum of Natural History, Washington, DC, USA

Results

Amazonopsis gen. n.

http://zoobank.org/D193A59E-A5B8-4A0C-BC42-E82454C15902 Figs 1–10

Type species. Amazonopsis theranyi sp. n.

Other species. Amazonopsis camachoi sp. n.

Diagnosis. The flattened and bent pro- and mesotarsal claws of the males (Figs 1, 4, 9) and the pronotal perforations of the females (Fig. 3) are unique among the Elmidae, and both sexes lack pronotal and elytral carinae.

Generic description. Male. Body stout, elongate-oval, at least 2× as long as wide; convex dorsally. Surface of dorsum and parts of venter covered by thin, pale gray, microreticulate plastron; thick, glossy plastron present laterally on sterna and adjacent surfaces of coxae, legs (except tarsi), lower margin of hypomeron, abdominal ventrites (except along midline), and entire epipleuron; head (vertex, frons, clypeus) and pronotum with short, broad, flat, pale yellow setae. Tibial cleaning fringes well-developed, formula 2-2-1. *Head.* Antenna filiform, with 11 antennomeres. Vertex with V-shaped

carina opening anteriorly; frons slightly elevated between eyes; eyes large, subcircular in outline. Clypeus rectangular, wider than long. Labrum rectangular, not as wide as clypeus. Mandible with three short, rounded, apical teeth. Maxillary palpus with four palpomeres. Labial palpus with three palpomeres. Pronotum. Subquadrate, slightly wider than long, widest at midlength; without carinae or gibbosities. Disc, including punctures, covered with pale microreticulate plastron. Scutellum subcircular to ovate, flat. *Elytron*. Elongate, about 3× as long as wide; without carinae except for swollen, raised base of third interval; humeral angles protuberant. Disc with 10 longitudinal rows of coarse, deep punctures; row 10 near margin with much smaller punctures than rows 1-9. Epipleuron with excavation adjacent to marginal lobe of abdominal ventrite 4. Surface of disc, including punctures, with thin, pale microreticulate plastron, often abraded; cuticle beneath very shiny, reddish-brown. Leg. Femur and tibia covered with thin, shiny layer of dense plastron; tarsus without plastron. Prothoracic leg shortest, metathoracic leg longest. Pro- and mesocoxa globose, metacoxa transverse. Pro- and mesotibia each with anterior and posterior cleaning fringes of long setae; metatibia with a single, posterior fringe. Claws long, without basal teeth; protarsal and mesotarsal inner and outer claws dissimilar; protarsal inner and mesotarsal outer claws enlarged, laterally flattened, bent at base; protarsal outer and mesotarsal inner claws smaller, narrower; metatarsal claws shorter, flattened, but basically unmodified. Venter. Pale microreticulate plastron present on ventral surfaces except at midline; plastron yellow and most evident near lateral thoracic margins and on abdominal ventrites. Prosternum slightly shorter than metaventrite; anterior margin curved posteriad, bounded by pair of small, ventrally directed spines; prosternal process about 2× as long as wide, margins raised, bluntly rounded at apex. Mesoventrite shortest; deep cavity present to accommodate prosternal process. Metaventrite longest, slightly longer than prosternum; metathoracic discrimen distinct; posteromedial margin with pair of ventrally directed processes. Abdomen with five ventrites; ventrites 1-4 decreasing in length posteriorly, ventrite 5 longer than ventrite 1; ventrites narrower medially and wider laterally; ventrite 4 lateral margin with lobe to link with groove on epipleuron, posterior margin strongly raised and rounded. Genitalia. Trilobate, typical form.

Female. Although the female of *A. camachoi* is unknown, it is possible, if not likely, that secondary sexual dimorphism is a generic characteristic. Females of *A. the-ranyi* exhibit the following differences (Fig. 3): pronotum with two, moderately large, oval perforations of the cuticle on either side of the midline; claws all unmodified; prosternum and metaventrite without paired, ventrally directed spines or processes.

Etymology. "Amazon", a Greek word for a legendary race of warrior women, refers to the robust, unique features of the beetles as well as the provenance of the genus; plus "-opsis" from the Greek meaning "look, appearance, likeness." Gender, feminine.

Comparative notes. In Manzo (2005), *Amazonopsis* keys to the couplet containing *Pagelmis* Spangler, 1981 and *Stenhelmoides* Grouvelle, 1908, because of its extensive dorsal plastron and lack of pronotal and elytral carinae, but matches neither genus. *Amazonopsis* has a generally uniform distribution of plastron (except for abraded areas), while *Pagelmis* (Spangler 1981) and *Stenhelmoides* (Grouvelle 1908) exhibit characteristic patterns. In addition, the epipleuron-clasping projection on abdominal ventrite 4 in *Amazonopsis* is lacking in *Pagelmis* and *Stenhelmoides*. *Amazonopsis* is similar to *Portelmis* Sanderson, 1953, in that both lack elytral carinae, possess a V-shaped ridge behind the eyes, and have a pair of abdominal lobes linking the abdomen to the elytra (Sanderson 1953). Unlike *Amazonopsis, Portelmis* has the lateral margin of the fifth, rather than the fourth, abdominal ventrite prolonged to link with the elytral epipleuron; most species have pronotal sublateral carinae; and the tibial cleaning fringes are poorly developed. *Xenelmis* Hinton, 1936, has a similar body form, but at less than 2 mm long is less than half the size of *Amazonopsis*. Like *Amazonopsis, Xenelmis* lacks pronotal carinae, but dissimilarly has two sublateral elytral carinae (Hinton 1936).

Amazonopsis theranyi sp. n.

http://zoobank.org/ED249675-189F-484F-8E9C-2A42FCA6B81B Figs 1–8

Type material. Holotype male deposited in MUSM, labeled: "**PERU**: [Dpto.] Madre de Dios / Tambopata, Quebrada / Santo Rosario, el. 230 m / -12.8788, -69.7396 / 29-V-2012, T. Gonzales // collected from artificial / leaf pack of *Inga edulis* / leaves, ACEER-Stroud / project 2012–2013 // HOLOTYPE / *Amazonopsis* / theranyi Barr" [red label, handwritten]. **Allotype female** deposited in MUSM, labeled "PERU: [Dpto.] Madre de Dios / Tambopata, Quebrada / Santo Rosario, el. 230 m / -12.8788, -69.7396 / 4-VII-2012, T. Gonzales // collected from artificial / leaf pack of *Inga edulis* / leaves, ACEER-Stroud / project 2012–2013 // ALLOTYPE / *Amazonopsis* / theranyi Barr" [red label, handwritten]. **Paratypes** (2) locality as above, 29-V-2012 [yellow labels, printed] (1 M & 1 F, EMEC).

Additional material examined. FRENCH GUIANA / ca. 4 km ESE Saül / Cr.[ique] Nouvelle France / 03.6063, -53.1762 / 9-XI-2016, C. B. Barr // Parc Amazonien / de Guyane just / below Point Chaud / coll. from leaf pack (1 F, EMEC); as above, ca. 4.5 km SE Saül / Cr.[ique] Nouvelle France / 03.5972, -53.1779 / 9-XI-2016, C. B. Barr // Parc Amazonien / de Guyane at / Courant Doublé / coll. from leaf pack (1 F, MNHN); VENEZUELA. T. F. Amaz.[onas] / Cerro de la Neblina / 1 km S Basecamp / 0°50'N, 66°10'W / 140 m, 8 Feb. 1985 // Small pool full of / dead leaves; rain- / forest ridge / W. E. Steiner & R. Halling collrs. (1 M, USNM).

Diagnosis. *Amazonopsis theranyi* males (Figs 1, 2, 4, 5) differ from those of *A. cama-choi* (in parentheses) (Figs 9, 10) by the following characters: elytra with low protuberances at humeral angles (protuberances prominent), third elytral interval slightly raised (prominently raised), all intervals with fine, sparse setae (odd-numbered intervals with longitudinal rows of thick setae); protarsomere 5 with sparse setae barely extending to base of claws (two apical clusters of long, curved setae extending well beyond base of claws); protarsal claws elongate, moderately curved (short, strongly curved), outer claw without inner tooth (with inner tooth), claws of similar width (outer claw narrower); outer mesotarsal claw shorter than tarsomere 5 (as long as tarsomere 5) and 2× wider than inner claw (at least 3× wider); distance between prosternal spines narrower than labrum (as wide as); metaventrite with pair of small, tooth-like processes (prominent, lobe-like); male genitalia with penis as wide at base as paramere base (much wider than), penis narrower at midlength than paramere at midlength (wider than), phallobase length subequal to that of parameres (longer than).

Description. Holotype male. Length, 4.20 mm; width, 1.90 mm. Cuticle mostly covered with pale, thin microreticulate layer dorsally and ventrally, with thicker, glossy, golden-yellow plastron ventrolaterally on thoracic sterna and abdominal ventrites; cuticle shiny, dark reddish-brown where exposed. Antenna. Yellow-brown. Antennomeres 1–10 clavate, antennomere 11 fusiform; antennomeres 1 and 2 each stouter than 3-10 which are of similar size and shape; antennomeres 3-10 each with dense tuft of setae at apicoventral margin, overlapping base of next; antennomere 11 with an elongated patch of short setae near the ventral apex. Head. Vertex, frons and clypeus covered with pale, microreticulate plastron and broad, flat, yellow setae. Clypeus dark brown, barely emarginate at center of apical margin, setae slightly less dense than on vertex and frons. Labrum dark brown, barely emarginate, apicolateral angles broadly rounded; surface with small, evenly spaced punctures and short, fine setae; apical and lateral margins with fringe of pale, dense setae, longest laterally. Mandible with three short, rounded, apical teeth. Maxillary palpus yellow-brown; palpomere 4 slightly flattened and curved, longer than 1–3 combined, with oval patch of sensillae at apex. Labial palpus with palpomeres 1 and 2 short, dark brown; palpomere 3 longer than 1 and 2 combined, yellow-brown, ovoid and moderately flattened. Pronotum. Length, 1.20 mm; width, 1.50 mm. In dorsal view, lateral margins coarsely granulate, unevenly arcuate; anterior margin trisinuate, strongly arcuate at middle; anterolateral angles acute, depressed. In lateral view, moderately convex. Disc covered with pale microreticulate plastron and deep, closely spaced, coarse punctures; punctures larger towards the lateral margins, smaller towards the midline; punctures generally spaced a diameter apart; punctures lined with plastron and associated with very short, erect setae; anteromedial disc and lateral areas with broad, flat, recumbent, yellow setae. Center of midline with narrow, lightly impressed, bare, longitudinal line; length about ¹/₂ that of pronotum. Scutellum subcircular. *Elytron.* Length, 3.00 mm; width, 0.95 mm. Surface covered with pale, thin microreticulate plastron, abraded at center of disc; punctures striate, deep, coarse, lined with plastron; intervals of striae with fine, sparse setae. Humeral angle with low, knob-like protuberance; base of third interval slightly swollen and raised; lateral margins smooth, recurved with narrow, longitudinal band of hypomeron plastron visible; shallow sulcus about one interval wide adjacent to lateral margin, extending from humeral angle to apical 1/5; elytra constricted at apical 1/5 at point of linkage with abdominal ventrite 4 lateral lobe; apex evenly rounded, moderately produced. Legs. Femora and tibiae covered by thin layer of shiny, pale yellow plastron, sparsely setose and shallowly punctate; tarsus redbrown, without plastron. Procoxa posterior surface coarsely punctate; dense patch of long, golden-yellow setae present on lateral face. Prothoracic leg with tibia longer than femur, tarsus shorter; profemur with oval patch of long, recumbent, golden-yellow setae on anterior surface near base; protibia with pair of cleaning fringes nearly 1/2 as



Figure 1. *Amazonopsis theranyi* sp. n., paratype male from Peru, length 4.15 mm **a** Dorsal habitus **b** Ventral habitus **c** Lateral habitus.

long as tibia, posterior fringe slightly shorter; protarsus with tarsomeres 1–4 bearing dense tufts of moderately long setae in two rows at apicoventral margins; tarsomere 5 longer than the others combined, with moderately long setae on ventral surface and a few longer, golden-yellow setae at apex which barely extend over base of claws. Protarsal claws dissimilarly shaped, long, laterally flattened, sharply acute; inner claw



Figure 2. *Amazonopsis theranyi* sp. n., male genitalia of holotype from Peru **a** Dorsal view **b** Lateral view **c** Ventral view.

enlarged, base bent outward, tip bent ventrally; outer claw shorter, base and tip not bent. Mesocoxa coarsely punctate and granulate; dense patch of long, golden-yellow setae present on lateral face and adjacent sternum. Mesothoracic leg similar to prothoracic leg except mesofemur with elongate patch of long, recumbent golden-yellow setae on posterior surface extending from near base to half femoral length; mesotibia with pair of cleaning fringes nearly ²/₃ as long as tibia. Mesotarsal claws dissimilarly shaped, much longer than protarsal claws, laterally flattened, sharply acute; outer claw enlarged, slightly curved, bent about 90° at base then flattened and widened, more than 2× wider than inner claw; inner claw slightly shorter and much narrower. Metacoxa medial surface with longitudinal, sulcate row of coarse, deep punctures; posterolateral surface with dense patch of long, golden-yellow setae. Metathoracic leg similar to other legs except tibia much longer than femur; single cleaning fringe on posterior face about ²/₃ as long as tibia; both claws slightly flattened but basically unmodified, stout, shorter than pro- and mesotarsal claws. *Venter.* Hypomeron with large, coarse, closely spaced punctures, more than 2× diameter of lateral pronotal punctures; ventral margin with broadly rounded lobe directed toward coxa; longitudinal band of golden-yellow plastron present on central ventral margin. Prosternum anterior margin raised, bearing two small, ventrally directed spines; distance between spines narrower than labrum; anterolateral margin behind each eye having a small, nearly semicircular notch; prosternal process about 2× as long as wide, with elevated margin; prosternal disc covered with pale, microreticulate plastron, scattered broad, flat, yellow setae, and large circular punctures spaced slightly less than a puncture diameter apart; golden-yellow plastron present laterally. Mesoventrite depressed between mesocoxae; punctation similar to that of prosternum; disc with pale, microreticulate plastron, mesepimeron with band of dense, golden-yellow plastron. Metaventrite depressed between mesocoxae; discrimen sulcate; posteromedial margin with two low, obtuse, ventrally directed processes; punctures more oval than circular in shape, closer together near midline; disc with pale yellow plastron except along midline, most dense laterad and on metepisternum. Abdomen with pale yellow plastron on all surfaces except for areas of bare, shiny cuticle at midline; ventrites 1-4 non-setose, ventrite 5 with fine, scattered setae; punctures not as large as those on thoracic sternites, becoming progressively smaller with each succeeding ventrite; punctures evenly spaced but less dense than on thoracic sternites; ventrite 1 anterior margin between metacoxae smoothly arcuate; ventrites 1-4 moderately convex at lateral ¹/₄; ventrite 5 with two basolateral swellings each bordered by a shallow depression, apical ¹/₃ depressed and margin broadly rounded. Genitalia (Fig. 2). Elongate, narrow. Phallobase as long as parameres, narrowest at basal 1/3. Paramere in dorsal and ventral views (Fig. 2a, c) sinuous, moderately narrow, narrowest ²/₃ distance from base; apex bluntly rounded,



Figure 3. *Amazonopsis theranyi* sp. n. females, dorsal habitus **a** Paratype from Peru, length 4.00 mm **b** Non-paratype from French Guiana, length 4.15 mm.

clasping tip of penis; paramere in lateral view (Fig. 2b) mostly parallel-sided, apical 1/5 expanded, paddle-like, tip curved slightly ventrad; inner surface shallowly canaliculate. Penis barely shorter than parameres, thin; base about as wide as paramere base, gradually narrowed to just past midlength then widening slightly; apex pointed; corona and fibula absent; basal apophyses about 1/4 as long as phallobase.

Allotype female. Length (excluding head), 4.25 mm; width, 2.00 mm. Pronotum 1.25 mm long, 1.55 mm wide; elytron 3.15 mm long, 1.00 mm wide. Secondarily sexually dimorphic as follows: pronotum with two, moderately large, oval perforations of the cuticle on either side of midline; all claws normal, not modified,



Figure 4. *Amazonopsis theranyi* sp. n., paratype male from Venezuela, length 4.05 mm **a** Dorsal habitus **b** Ventral habitus **c** Lateral habitus.

shorter than those of males; anterior margin of prosternum without paired spines; posterior margin of metaventrite without paired, ventrally directed processes. Otherwise, similar to the male.

Variation. The most striking variation is the strong secondary sexual dimorphism exhibited by males and females. Males (Figs 1, 4) have the following characteristics which females (Fig. 3) lack: curved, flattened and enlarged pro- and mesotarsal claws; pair of small spines on the prosternal anterior margin; pair of prominent processes on metasternal posterior margin. Females have a pair of oval perforations in the pronotal cuticle. Males and females are of similar size. The males (n = 3), 4.05–4.20 mm, and females (n = 4), 4.00–4.25 mm, also vary little in length. All specimens showed variability in the amount of plastron present on the elytra. Most individuals have the plastron lacking to some extent on the elytral intervals, with remnants mostly restricted to the lateral margins, striae, and punctures. This is presumably due to abrasion from the environment.



Figure 5. *Amazonopsis theranyi* sp. n. , male genitalia of paratype from Venezuela **a** Dorsal view **b** Lateral view **c** Ventral view.

The single male specimen from Venezuela (Figs 4, 5) varied somewhat from the two males from Peru (Figs 1, 2) in the following manner: body slightly narrower; metaventral processes larger; genitalia (Fig. 5), in dorsal view, with penis thinner in apical ½ and with parameres thinner and not sinuate laterally. The differences are not marked, and with just one individual to compare with only two others, proposing it as a separate species of *Amazonopsis* seems inadvisable.

Etymology. Named for Therany Gonzales Ojeda of ACEER, Puerto Maldonado, Madre de Dios, Peru, the collector of the type series.

Distribution. This species is currently known only from widely separated, single localities in southeastern Peru, southwestern Venezuela, and French Guiana (Fig. 6).

Habitat. Quebrada Santo Rosario (Fig. 7), the type locality, is a small, second order tributary of the Río Tambopata which feeds the Río Madre de Dios, a major tributary of the Amazon River in Peru. The stream has a small watershed and flows from mostly undisturbed lowland forest at an elevation of 230 m. It was selected as a "control" site by the ACEER project because it was considered non-impacted by human activity. ACEER coordinator Therany Gonzales (in litt.) observed "It is a very clean stream because their [sic] head waters are into a primary forest between the road and the Inambari river that steel [sic] remains pretty well conserved... Collecting macroinvertebrates in this stream was very productive. We got a great diversity and abundance of macroinvertebrates." The specimens of *Amazonopsis* were collected from



Figure 6. Map of northern South America showing collection localities of *Amazonopsis theranyi* sp. n. (circles) and *A. camachoi* sp. n. (diamond) (map template provided by d-maps of Trets, France).



Figures 7, 8. Stream habitats of *Amazonopsis theranyi* sp. n. 7 Quebrada Santo Rosario, Peru, type locality 8 Crique Nouvelle France, French Guiana.

artificial leaf pack samples containing the leaves of *Inga edulis*, a leguminous tree common near streams in the region. Water quality data taken during the ACEER project are as follows: water temperature 25.2 °C, pH 5.13, dissolved oxygen 6.49 mg/L at 25 °C (79%), conductivity 5 μ S/cm, and turbidity 4 NTU (Sweeney 2014). Observations from my field notes at the site on September 14 and 15, 2013, during which Bill Shepard and I were unsuccessful in collecting additional specimens of *Amazonopsis*, were: water tannin-stained, current slow; bottom substrate of clay and mud with some cobbles; waterlogged wood, a few leaf packs, and root masses present. Quebrada Santo Rosario is intersected by the Interoceanic Highway near the San Juan community about 73 km southwest of Puerto Maldonado.

Crique Nouvelle France (Fig. 8) is a jungle stream in the watershed of the Maroni River, contained wholly within protected Parc Amazonien de Guyane near the community of Saül, in a remote area of central French Guiana. The stream is shallow and sand-bottomed with occasional areas of boulders which form small cascades. Logs, branches and leaf packs litter the channel, and the water is tannin-stained. The specimens were collected from leaf packs or other woody debris. Elevations at the two collection sites are approximately 150 m and 210 m. Water quality measurements taken at the time are as follows: water temperature 23.8 °C, pH 6.6, dissolved oxygen 7.05 mg/L (85.4%), conductivity 44.3 μ S/cm, and turbidity 3.61 NTU (Clavier, in litt.).

The information for the Cerro de la Neblina site, a tributary Río Baria, was provided by collector Warren Steiner (in litt.) from his field notes: "small whitewater stream [where I] spent an hour collecting ... in leafy side pools near flowing part of stream ... ". The label data with the specimens states "small pool full of dead leaves" as well as an elevation of 140 m. In addition, Spangler (1990: 30) gave a description of the site as follows: "The small whitewater tributary ... was about 1 m wide and 1 to 2 cm deep and was shaded by a dense canopy" ... "a small, marshy, meandering whitewater rivulet with occasional shallow, leafy pools ...".

Associated taxa. Aquatic byrrhoid beetles collected at the same localities as Amazonopsis theranyi include: PERU: Gyrelmis brunnea Hinton, 1940, G. longipes Hinton, 1940, G. maculata Hinton, 1940, Hintonelmis Spangler, 1966, Neoelmis Musgrave, 1935, Pilielmis Hinton, 1971, Portelmis (Elmidae); Psephenops Grouvelle, 1898 (Psephenidae). FRENCH GUIANA: Cylloepus Erichson, 1847, Gyrelmis brunnea, G. nubila Hinton, 1940, G. spinata Hinton, 1940, G. thoracica Hinton, 1940, Heterelmis Sharp, 1882, Hexacylloepus Hinton, 1940, Hintonelmis apama Hinton, 1971, Phanocerus Sharp, 1882 (Elmidae); undescribed genus/species (Protelmidae); Dryops Oliver, 1791, Elmoparnus collinsae Spangler & Steiner, 1983, Platyparnus bollowi (Hinton, 1939), P. frater (Hinton, 1939) (Dryopidae); Lutrochus Erichson, 1847 (Lutrochidae). VEN-EZUELA: Gyrelmis Hinton, 1940, Hexacylloepus, Neoelmis, Pilielmis, Stegoelmis fera Spangler, 1990, S. geayi (Grouvelle, 1908), S. tuberosa Spangler, 1990 (Elmidae); new genus (Protelmidae); Dryops, Pelonomus Erichson, 1847 (Dryopidae). Note: Venezuelan records are cited from Spangler (1990: 30).

Amazonopsis camachoi sp. n.

http://zoobank.org/A5C08C02-A65B-45DA-B485-F5341BD18185 Figs 9, 10

Type material. Holotype male deposited in MALUZ, labeled: "VENEZUELA, Bolívar / Muncipio Gran Sabana / El Paují. 25/IV/2004 al / 02/V/2004 J. Camacho, / J. Perozo, Col. // 04°28'06" N / 61°35'38" W / 880msnm // MALUZ 10031 / LUZ-Venezuela // HOLOTYPE / *Amazonopsis* / *camachoi* Barr" [red label, handwritten].

Diagnosis. *Amazonopsis camachoi* males (Figs 9, 10) differ from those of *A. the-ranyi* (in parentheses) (Figs 1, 2, 4, 5) by the following characters: elytra with pronounced protuberances at humeral angles (low protuberances), third elytral interval prominently raised (slightly raised), odd-numbered intervals with longitudinal rows of thick setae (all intervals with fine, sparse setae); protarsomere 5 with two apical clusters of long, curved setae extending well beyond base of claws (sparse setae barely extending to base of claws); protarsal claws short, strongly curved (elongate, moderately curved), outer claw with inner tooth (without inner tooth), outer claw width narrower than that of inner claw (width similar); outer mesotarsal claw as long as tarsomere 5 (shorter than tarsomere 5) and at least 3× wider than inner claw (2× wider); distance between prosternal spines as wide as labrum (distance narrower); metaventrite with pair of prominent lobe-like processes (processes less prominent, tooth-like); male genitalia with parameres very narrow and straight (wider and sinuate), penis much wider at base than paramere base (width subequal), phallobase longer than parameres (length subequal).

Description. Holotype male (Figs 9, 10). Length, 4.70 mm; width, 2.00 mm. Cuticle mostly covered with pale, thin microreticulate layer dorsally and ventrally, with thicker, pale yellow plastron ventrolaterally on thoracic sterna and abdominal ventrites; cuticle shiny, dark reddish-brown where exposed. Antenna. Yellow-brown. Antennomeres 1-10 clavate, antennomere 11 fusiform; antennomeres 1 and 2 each stouter than 3-10 which are of similar size and shape; antennomeres 3-10 each with dense tuft of setae at apicoventral margin, overlapping base of next; antennomere 11 with a faintly visible, elongated patch of short setae near the ventral apex. Head. Vertex, frons and clypeus covered with pale, microreticulate plastron and broad, flat, yellow setae. Clypeus dark brown, barely emarginate at center of apical margin, setae slightly less dense than on vertex and frons. Labrum redbrown, barely emarginate, apicolateral angles broadly rounded; surface with small, evenly spaced punctures and short, fine setae; apical and lateral margins with fringe of pale, dense setae, longest laterally. Mandible with three short, rounded, apical teeth. Maxillary palpus yellow-brown; palpomere 4 slightly flattened and curved, longer than 1-3 combined, with oval patch of sensillae at apex. Labial palpus with palpomeres 1 and 2 short, yellow-brown; palpomere 3 longer than 1 and 2 combined, yellow-brown, ovoid and moderately flattened. Pronotum. Length, 1.40 mm; width, 1.60 mm. In dorsal view, lateral margins coarsely granulate, evenly arcuate; anterior margin trisinuate, emarginate at middle; anterolateral angles acute, depressed. In lateral view, disc slightly flattened at anterior 2/3. Disc covered with pale microreticulate plastron and closely spaced, coarse punctures; punctures larger



Figure 9. *Amazonopsis camachoi* sp. n., holotype male, length 4.70 mm **a** Dorsal habitus **b** Ventral habitus, lacking abdomen and right metathoracic leg **c** Lateral habitus, lacking abdomen **d** Ventral habitus of abdomen and right metathoracic leg.

and deeper near lateral and apicolateral margins, smaller and shallower, often indistinct, over much of central disc; punctures generally spaced a diameter apart; punctures lined with plastron and associated with very short, erect setae; anteromedial disc and lateral areas with broad, flat, recumbent, yellow setae. Center of midline with narrow, slightly impressed, mostly bare, longitudinal line; length about ³/₄that of pronotum. Scutellum slightly ovate. *Elytron.* Length, 3.30 mm; width, 1.00 mm. Surface covered with pale, thin microreticulate plastron; punctures striate, deep, coarse, lined with plastron; strial intervals 1, 3, 5, 7, 9 each with partial, longitudinal rows of broad, flat, recumbent, yellow setae (originally complete rows, now partly abraded). Humeral angle with prominent, knob-like, posteriorly directed protuberance; base of third interval conspicuously swollen and raised; lateral margins smooth, recurved with narrow, longitudinal band of hypomeron plastron



Figure 10. *Amazonopsis camachoi* sp. n., male genitalia of holotype **a** Dorsal view **b** Lateral view **c** Ventral view.

visible; shallow sulcus about one interval wide adjacent to lateral margin, extending from humeral angle to apical 1/5; elytra constricted at apical 1/5 at point of linkage with abdominal ventrite 4 lateral lobe; apex evenly rounded, moderately produced. *Legs.* Femora and tibiae covered by thin layer of dense plastron, sparsely setose and shallowly punctate; tarsus red-brown, without plastron. Procoxa posterior surface coarsely punctate. Prothoracic leg with tibia longer than femur, tarsus shorter (note: description is of right protarsus; left is missing); profemur with oval patch of long, recumbent pale yellow setae on anterior surface near base; protibia with pair of cleaning fringes, anterior fringe nearly ¹/₂ tibial length, posterior fringe about 1/4 tibial length; protarsus with tarsomeres 1–4 bearing tufts of long, curved setae in two rows at apicoventral margins; tarsomere 5 longer than the others combined, with moderately long setae on ventral surface and two apical clusters of long, curved, golden-yellow setae which extend well past base of claws. Protarsal claws short, stout, slightly twisted, laterally flattened, dissimilarly shaped; inner claw slightly bent at base, distal ¹/₂ widened, tip broadly acute and bent ventrally; outer claw not bent at base, inner tooth present about ¹/₃ distance from base, distal ¹/₂ narrowed, apex narrowly

acute. Mesocoxa coarsely punctate and granulate; dense patch of long, pale yellow setae present on lateral face and adjacent sternum. Mesothoracic leg similar to prothoracic leg except mesofemur with patch of long, recumbent setae on basal 1/3 of posterior surface; mesotibial cleaning fringes $\frac{2}{3}$ as long as tibia; tarsomere 5 with long, sparse, apical setae. Mesotarsal claws dissimilarly shaped, much longer than protarsal claws, laterally flattened, sharply acute; outer claw enlarged, as long as tarsomere 5, curved outward, bent more than 90° at base then flattened and widened, at least 3× wider than inner claw; inner claw much shorter, straighter and narrower. Metacoxa medial surface with band of coarse, deep punctures; posterolateral surface with dense patch of long, golden-yellow setae. Metathoracic leg similar to other legs except tibia much longer than femur; single cleaning fringe on posterior face about ²/₃ as long as tibia; tarsomere 5 with long, sparse, apical setae; both claws slightly flattened but basically unmodified, stout, shorter than pro- and mesotarsal claws. Venter. Hypomeron with large, coarse, closely spaced punctures, more than 2× diameter of lateral pronotal punctures; ventral margin with broadly rounded lobe directed toward coxa; narrow, longitudinal band of pale yellow plastron present on ventral margin. Prosternum anterior margin prominently raised, bearing two small, ventrally directed spines; distance between spines as wide as labrum; anterolateral margin behind each eye having a small, nearly semicircular notch with dorsal margin hook-shaped; prosternal process about 2× as long as wide, with elevated margin; prosternal disc covered with large, irregular punctures and microreticulate plastron, lateral margins with dense plastron. Mesoventrite depressed between mesocoxae; punctation similar to that of prosternum; disc with pale, microreticulate plastron, mesepimeron with band of more dense, pale yellow plastron. Metaventrite depressed between mesocoxae; discrimen sulcate; left posteromedial margin with a prominent, ventrally directed, lobe-like process (right process was destroyed by insect pin); punctures circular and mostly spaced less than a diameter apart; disc with pale plastron except along midline, most dense laterad and on metepisternum. Abdomen with pale yellow plastron on all surfaces except for areas of bare, shiny cuticle at midline; ventrites 1-4 mostly without setae, ventrite 5 with fine, scattered setae; punctures large, becoming progressively smaller with each succeeding ventrite; punctures evenly spaced but less dense than on thoracic sternites; ventrite 1 anterior margin between metacoxae sinuate with two shallow sinuses; ventrite 5 with two basolateral swellings each bordered by a shallow depression, apical ¹/₃ slightly depressed and margin broadly rounded. Abdomen is separated from rest of body and mounted on a card point. Genitalia (Fig. 10). Elongate, narrow. Phallobase longer than parameres, narrowest at basal 1/3. Paramere in dorsal and ventral views (Fig. 10a, c) straight, very narrow, narrowest ¹/₂ distance from base; apex narrowly rounded, clasping tip of penis; paramere in lateral view (Fig. 10b) with dorsal margin narrowed at midpoint, apex broadly rounded; inner surface shallowly canaliculate. Penis shorter than parameres; base much wider than paramere base; apical 1/2 narrow, narrowest point ³/₄ distance from base; apex narrowly rounded; corona and fibula absent; basal apophyses about $\frac{1}{3}$ as long as phallobase.

Etymology. Named for Jesús Camacho of La Universidad del Zulia, Maracaibo, Venezuela, who collected the unique type specimen.

Distribution. This species is currently known only from one locality in southeastern Venezuela (Fig. 6). **Habitat.** The collector of the specimen recalled that the stream was small, shallow, sandy, and shaded, and that its waters were dark, tannin-stained, and contained decaying leaves (Camacho, in litt.).

Associated taxa. The only other specimen known from this locality, an unidentified species of *Heterelmis* (Elmidae), is in the MALUZ collection (Camacho, in litt.).

Discussion

As pointed out in the generic diagnosis, *Amazonopsis* is unique in that no other known genera have males with such bizarrely modified claws or females with pronotal perforations. *Amazonopsis* bears similarities to both *Stenhelmoides* and *Pagelmis*, particularly regarding its extensive dorsal plastron and lack of pronotal and elytral carinae, however, the genus is distinguished by the presence of a lateral projection of the fourth abdominal ventrite and lack of distinctive plastron pattern. *Amazonopsis* also shares some morphological characteristics with *Portelmis*. At this time, lacking phylogenetic analysis, it is not possible to ascertain to which other genus or genera *Amazonopsis* is most closely related.

Given the large geographic range indicated by the four known occurrences (Fig. 6), I was not surprised to discover more than one species among the eight specimens. There are perhaps more species represented than the two species described herein, but I have chosen to be conservative for the following reasons. Regarding *A. theranyi*, the differences between the two male specimens from Peru (Figs 1, 2) and the male specimen from Venezuela (Figs 4, 5), while noteworthy, are insufficient to convince me that they are separate species. Without a larger series of specimens to examine it is difficult to determine if these differences are significant or simply normal variation. Conversely, the specimen described as *A. camachoi* is morphologically distinct, and this outweighed my reluctance to describe a new species from a single, damaged individual. That the two specimens from French Guiana are females lends some doubt to their specific diagnosis. Their morphology is very similar to that of the female specimens from Peru so I have assigned them to *A. theranyi* without designating them as paratypes. To try to resolve this question, subsequent, unsuccessful attempts were made to obtain additional specimens from the collection site in French Guiana (Clavier, in litt.).

Secondary sexual dimorphism, which occurs in several elmid genera and species, involves modifications of various surfaces and structures, particularly on the legs and venter (Kodada et al. 2016). While there are other examples of sexual variation of claw shape (e.g., some *Macronychus* Müller, 1806) (Kodada et al. 2016), none are as radical as the bent and flattened pro- and mesotarsal claws of male *Amazonopsis*. The deep pronotal perforations of female *A. theranyi* are enigmatic and unique among the Elmidae, and like the strange claws of the male, their function is presently unknown. Hypothetically, these pits could be used for chemical communication with males or have a sensory role. Their actual role perhaps could be discovered through destructive morphological examination and SEM photography, however, with precious few specimens in hand at present, that will need to wait for a future opportunity.

The *A. theranyi* specimens examined for this paper are from closed-canopy streams in humid, tropical lowland forests and share habitat similarities (Figs 7, 8). The three streams, with elevations ranging from 140–230 m, are all small, shallow, low-order streams with abundant woody debris and leaf packs; two of the streams are also tannin-stained. The type locality of *A. camachoi* is at the considerably higher elevation of 880 m, but the stream was otherwise similar: shaded, small, shallow, sandy, tannin-stained, and with decaying leaves. The limited data suggest that leaf packs are the primary microhabitat of both species. At the time the specimens were collected, three of the four streams were considered pristine and the remaining one was only slightly impacted by human activities.

At first glance it may seem that the genus Amazonopsis displays an unusual geographic distribution pattern (Fig. 6). The site in Peru is located in the Amazon Basin, the two sites in Venezuela are in the Amazon drainage and also the Guiana Shield, and the French Guiana site is on the Guiana Shield. De Granville (1992) used the French term "periamazonienne," which translates to "peri-Amazonian," to describe distributions of plants that encircle, or partially encircle, the central Amazon Basin. Vanzolini (1973) discussed similar distributions of birds and lizards in relation to postulated tropical forest refuge areas during geologic dry periods. Coincidentally or not, the four occurrences of Amazonopsis fall within these postulated refuges as well as conform to the peri-Amazonian distribution models. Likewise, the elmids Cylloepus olenus Hinton, 1945 (French Guiana, Brazil, Peru), Pagelmis amazonica Spangler, 1981 (Suriname, Ecuador), Stegoelmis geavi (Grouvelle, 1908) (French Guiana, Guyana, Venezuela, Ecuador), and Stenhelmoides strictifrons Grouvelle, 1908 (French Guiana, Guyana, Venezuela, Brazil, Peru) exhibit similar distribution patterns. At present Amazonopsis is known from just four localities in Peru, Venezuela and French Guiana, but it likely occurs in adjacent Brazil, Suriname, and Guyana as well. Although fairly widespread geographically, it may be locally uncommon because of strict habitat requirements and/or be uncommonly collected due to the lack of sampling in the specific habitats and leaf pack microhabitats where it occurs.

Acknowledgments

It was fortuitous that through Wills Flowers (Florida A&M University, Tallahassee) I heard about the Stroud–ACEER project in Peru and their need for an elmid specialist to do identifications. I owe special thanks to Bernard Sweeney and David Funk at Stroud Water Research Center (Avondale, Pennsylvania), who provided the specimens forming the basis for this study, supplementary information, and the type locality photograph (Fig. 7). ACEER participants in Peru, Therany Gonzales (Coordinador de Proyectos Educativos Ambientales, ACEER–Madre de Dios) and Ana Huamantinco Araujo (Facultad de Ciencias Biológicas, Universidad Nacional Mayor de San Marcos, Lima), respectively, provided field site and sampling details, and made available additional specimens for examination.

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CHECKLIST



An annotated checklist of Coccinellidae with four new records from Pakistan (Coleoptera, Coccinellidae)

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Abstract

Some new ladybird (Coleoptera: Coccinellidae) records collected during the last four years across Sindh are reported. A first preliminary checklist of ladybirds from Sindh is presented, consisting of one subfamily, ten tribes, 21 genera, and 29 species including four new records, namely *Bulaea lichatschovii* (Hummel), *Exochomus pubescens* Küster, *Scymnus (Pullus) latemaculatus* Motschulsky, *Scymnus (Pullus) syriacus* Marseul, and four varieties of the species *Cheilomenes sexmaculatus* (Fabricius).

Keywords

aphid, Chilocorinae, Coccidulinae, Coccinellinae, mealybug, predatory, Coccinellinae, Scymninae

Introduction

According to the most recent classification, the family Coccinellidae comprises two subfamilies: Microweiseinae Leng, 1920 and Coccinellinae Latreille, 1807 (sensu Slipinski 2007) based on phylogenetic results (Seago et al. 2011). These changes impact the status of various traditionally recognized tribes and subfamilies, as the onlysubfamilies now recognized are Microweiseinae and Coccinellinae (Canepari et al. 2016). Microweiseinae comprises three tribes: Carinodulini, Microweiseini, and Serangiini whereas Coccinellinae consists of only two tribes: Coccinellini and Chilocorini (Robertson et al. 2015)

Worldwide, nearly 6000 species spanning nearly 360 genera are known. Approximately 90 % of the species are predators of aphids, coccids, psyllids, aleyrodids, chrysomelid larvae, and mites, the remainder being herbivorous or mycetophagous (Inayatullah 1984, Majerus 1994, Obrycki and Kring 1998, Iperti and Bertand 2001, Vandenberg 2002, Hodek 2012). The Coccinellidae are an important group of beetles from both an economic standpoint in their use as biological control agents and in their diversity and adaptation to a number of differing habitats (Michels 1987).

From Pakistan, Ahmad and Ghani (1966, 1968, 1970, 1973), Inayatullah and Siddiqui (1978, 1979, 1980), and Ali et al. (2012) worked on different species of the family Coccinellidae; Iablokoff-Khnzorian (1986) described a new species Adalia puetzi from Pakistan; Hashmi and Tashfeen (1992) studied the coccinellids housed in different institutions of Pakistan and reported 162 species, identifying the coccinellids deposited in the Natural History Museum, London, but with wrong synonymies. The present authors tried to trace this valuable collection of coccinellids in the present institutions in Karachi and other cities of Pakistan but found very few coccinellids. The authors also tried to correct the wrong synonymies and wrong identifications mentioned in the above-mentioned paper with the help of checklists and taxonomic papers available. Irshad (2001) listed 71 species of coccinellids in Pakistan; Rafi et al. (2005) gave a brief external morphology of predatory coccinellids of northern parts of Pakistan with special reference to their hosts, prey and localities, and listed 37 genera and 75 species belonging to different tribes of subfamilies Chilocorinae, Coccidulinae, Coccinellinae, Scymninae, and Sticholotidinae. All listed species are very common in Pakistan and represent a much less complete inventory than that of Hashmi and Tashfeen (1992). Otherwise, the description of genitalia was totally absent. Ali et al. (2012, 2013, 2014, 2015) conducted a systematic study from Sindh Province for the first time. They listed 29 coccinellids with four new records and four varieties of Cheilomenes sexmaculatus.

According to Ghouri 1960, Kazmi 1980, Hashmi et al. (1983), Ali and Munir 1984, Ghani 1985, Inayatullah 1984, Mohyuddin and Mahmood 1993, Buriro 1996, Jan et al. 2003, Aslam et al. 2004, Abbas et al. 2007, Solangi et al. 2007, Massod et al. 2008, Rafiq et al. 2008, Arif et al. 2009, Mari and Lohar 2010, Iqbal et al. 2008, Iqbal et al. 2011, and Masood 2011, the following viz., *Schizaphis graminum* (Rondani), *Sitobion avenae* (Fabricius), *Aphis gossypii* Glover, *Aphis fabae* Scopoli, *Aphis nerii* Boyer de Fonscolombe, *Aphis craccivora* (Koch) *Rhopalosiphum maidis* (Fitch), *Therioaphis trifolii* (Monell), *Hysteroneura setariae* (Thomas), *Lipaphis erysimi* (Kaltenbach), *Brevicoryne brassicae* (Linnaeus), *Myzus persicae* (Sulzer), and *Hyadaphis coriandri* (Das) (Homoptera: Aphididae); *Amritodus atkinsoni* (Lethierry)), *Amrasca biguttula biguttula* (Ishida), *Empoasca lybica* (Bergevin and Zanon) (Homoptera: Cicadellidae); *Bemisia tabaci* (Gennadius), *Aleurolobus barodensis* (Maskell), *Dialeurodes citri* (Ashmead) and *Aleurocanthus husaini* Corbett (Homoptera: Aleyrodidae); *Brevipalpus lewisi* McGregor (Acarina: Tenuipalpidae), *Eutetranychus orientalis* (Klein), and *Tetranychus atlanticus* McG. (Acarina: Tetranychidae) are common pests of wheat, cotton, sugarcane, mango, mustard, vegetables, and fruits in Pakistan. Other works related with the taxonomy, morphology, diversity, distribution and ecology of different coccinellids include Rahman (1940), Ahmad (1969), Irshad (2001b), Khan et al. (2006), Rahatullah et al. (2010, 2011, 2012); Ali et al. (2012); Abbas et al. (2013), and Ashfaque et al. (2013). Ali (2012, 2013, 2014, 2015) was the first to report 29 coccinellid species from Sindh with a brief study on the taxonomy of the family Coccinellidae and their role in the field of biological control of important agricultural crop pests such as aphids, mealybugs, scale insects, jassids, and whiteflies.

The coccinellid fauna of Sindh, Pakistan is insufficiently known, and no checklist exists. The goal of this paper is to contribute to the knowledge of diversity and distribution of ladybirds in Sindh as well as to present the first preliminary checklist of the species recorded previously in the territory of Sindh.

Materials and methods

Ladybird records presented in this paper were collected, identified, and confirmed during the last four years by the authors following the checklists, descriptions, and keys given by Chapin and Ahmad (1966), Pang and Gordon (1986), Poorani (2004), and Rafi et al. (2005), and with the help of the following website: NBAIR (2009). Ladybirds were also identified and confirmed by Dr. Claudio Canepari (Societa Entomologica Italiana), an authority on the family Coccinellidae. Specimens were collected during field trips conducted in different parts of Sindh Province, and in reality represent random findings instead of systematic collecting. Beetles were collected in standard ways, including manual collecting, net sweeping, and using light traps. The terminologies for various taxonomic structures including genitalia and procedures used by Inayatullah and Siddiqui (1978) and Gordon (1985) were generally followed. The taxonomic structures, especially male and female genitalia, were preserved after illustration in microvials with glycerine and pinned with specimens.

Results

The coccinellids present in this checklist are classified on the basis of the new classification given by Seago et al. 2011, Robertson et al. 2015, and Canepari 2016. According to this classification all the coccinellids of the Sindh Province belong to the subfamily Coccinellinae only. It includes nine species of the tribe Coccinellini, one species of the Psylloborini, one species of the tribe Bulaeini, five species of the Chilocorini, one species of the Tribe Noviini Mulsant, one species from Tribe Hyperaspini, one species from the Tribe Stethorini, six species of Scymnini, one species of the Tribe Shirozuellini, and three species of the Tribe Sticholotidini. New records are *Bulaea lichatschovii* (Hummel), *Exo-chomus pubescens* Küster, *Scymnus (Pullus) latemaculatus* Motschulsky, *Scymnus (Pullus) syriacus* Marseul with four varieties of *Cheilomenes sexmaculatus* (Fabricius).

Subfamily Coccinellinae Latreille, 1807 Tribe Coccinellini Latreille, 1807 *Coccinella* Linnaeus, 1758

Coccinella septempunctata Linnaeus, 1758

Fig. 1

General distribution. India, Nepal, Sri Lanka, Pakistan, Palaearctic. North America (Poorani 2002).

Distribution in Sindh. Tandojam, Larkana, Mirpur Khas, Thatta, Karachi (Sarwar 2009, Mahmood et al. 2011, Ali 2013, Fazal Ellahi et al. 2017).

Host plants and prey species in Sindh. Brevicoryne brassicae (L), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera); Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida) (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, sugarcane, and rose plants (Ali 2013).

Coccinella undecimpunctata Linnaeus, 1758

Fig. 2

General distribution. India, Pakistan. Palaearctic (Poorani 2002).

Distribution in Sindh. Karachi, Hyderabad, Tandojam, Mirpur Khas and Thatta (Sarwar 2009, Mahmood et al. 2011, Ali 2013, Fazal Ellahi et al. 2017).

Host plants and prey species in Sindh. Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera); Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida) (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, brinjal, okra, wheat, cotton, sugarcane, and rose plants (Ali 2013).



Figure 1. Coccinella septempunctata Linnaeus.



Figure 2. Coccinella undecimpunctata Linnaeus.

Coccinella transversalis Fabricius, 1781

Fig. 3

General distribution. India, Nepal, Sri Lanka, Bangladesh, Indochina, Indonesia, Japan, Australia, New Zealand (Poorani 2002).

Distribution in Sindh. Hyderabad, Larkana, Mirpur Khas, and Thatta (Ali 2013).

Host plants and prey species in Sindh. Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera); Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida) (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, brinjal, okra, wheat, cotton, sugarcane, and rose plants (Ali 2013).



Figure 3. Coccinella transversalis Fabricius.

Cheilomenes Dejean, 1836

Cheilomenes sexmaculata (Fabricius, 1781) Fig. 4

General distribution. India, Bangladesh, Pakistan, Sri Lanka, Bhutan, Myanmar. Malaysia, Indonesia, Philippines, Vietnam, China, Japan, Australia (Poorani 2002).

Distribution in Sindh. Hyderabad, Larkana, Mirpur Khas, and Thatta (Sarwar 2009, Mahmood et al. 2011, Ali 2013, Balouchi and Swati 2014, Fazal Ellahi et al. 2017).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Schizaphis graminum (Rondani), Ropalosiphum maidis (Fitch), Therioaphis trifolii Monell (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll), Centrococcus insolitus Green (Pseudococcidae: Homoptera), Drosicha mangiferae (Green) (Margarodidae: Homoptera) Aleurocanthus husaini Corbett, Aleurocanthus woglumi Ashby, Aleurolobus barodensis Mask Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida), Amritodus atkinsoni Leth, Evacanthus repexus Dist (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera), Pyrilla perpusilla Walk (Fulgoridae: Homoptera), Quadraspidiotus perniciosus Comst (Diaspididae: Homoptera), Diaphorina citri Kuw (Psyllidae: Homoptera), Tetranychus orientalis Mog (Acarina: Tetranychidae) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).

Comment. Common. It is very difficult to compare this species with other taxa because of polymorphism. Six varieties of this species are reported from Pakistan.



Figure 4. Cheilomenes sexmaculata (Fabricius).

Hippodamia variegata (Goeze, 1777) Fig. 5

General distribution. Nepal, Pakistan, Afghanistan, Tibet, Mongolia, China, northern and eastern Africa, Palaearctic (Poorani 2002).

Distribution in Sindh. Hyderabad, Karachi, and Thatta (Lohar et al. 2012, Ali 2013).

Host plants and prey species in Sindh. Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera); Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida) (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, brinjal, okra, wheat, cotton, and rose plants (Ali 2013).



Figure 5. Hippodamia variegata (Goeze).

Micraspis allardi (Mulsant, 1866) Fig. 6

General distribution. India, Nepal, Pakistan, Myanmar, Indonesia (Poorani 2002).
Distribution in Sindh. Hyderabad, Mirpur Khas, Thatta and Karachi (Ali 2013).
Host plants and prey species in Sindh. Amritodus atkinsoni Teth (Cicadellidae: Homoptera) Quadraspidiotus perniciosus Comst (Diaspididae: Homoptera), Pyrilla perpusilla Walk (Fulgoridae: Homoptera) (Ali 2013).

Oenopia sauzeti Mulsant, 1866 Fig. 7

General distribution. India, Bhutan, Pakistan, Nepal, Myanmar, Thailand, China (Poorani 2002).

Distribution in Sindh. Hyderabad, Mirpur Khas, Thatta, and Karachi (Ali 2013). Host plants and Prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Schizaphis graminum (Rondani), Ropalosiphum maidis (Fitch) (Aphididae: Homoptera), Aleurolobus barodensis Mask Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida), Evacanthus repexus Dist (Cicadellidae: Homoptera), Tetranychus sp. (Acarina: Tetranychidae) on wheat, mustard, and cabbage (Ali 2013).

Propylea quatuordecimpunctata (Linnaeus, 1758)

Fig. 8

General distribution. India, Pakistan, Bangladesh, Japan, China, Europe, North America (Poorani 2002).



Figure 6. Micraspis allardi (Mulsant).



Figure 7. Oenopia mimica Weise.



Figure 8. Propylea quatuordecimpunctata (Linnaeus).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013). Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das) (Aphididae: Homoptera), Aleurolobus barodensis Mask Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida), Evacanthus repexus Dist (Cicadellidae: Homoptera) (Ali 2013).

Harmonia dimidiata (Fabricius, 1781)

Fig. 9

General distribution. India, Pakistan, Nepal, Bhutan, China, Japan, Taiwan, introduced into North America (Poorani 2002).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae(L), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Ropalosiphum maidis (Fitch), Therioaphis trifolii Monell, Macrosiphum granarium (Kirby), Schizaphis graminum (Rondani) (Aphididae: Homoptera), Amritodus atkinsoni Leth, Idioscopus nagpurensis Pruthi (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera), Tetranychus atlanticus Mog (Acarina: Tetranychidae), Adelges spp. (Adelgidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).

Tribe Bulaeini Savoiskaja, 1969

Bulaea lichatschovii (Hummel, 1827)

Fig. 10

General distribution. Pakistan, India, Central and West Asia, Afghanistan, Mediterranean region. North and Central Africa (Poorani 2002, Ali 2013).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Myzus persicae (Sulzer), Diaphorina citri Kuw (Psyllidae: Homoptera) on wheat and mustard.

Comments. Newly recorded from Pakistan.

Tribe Psylloborini Casey, 1899

Psyllobora bisoctonotata (Mulsant, 1850) Fig. 11

General distribution. India and Pakistan (Poorani 2002).Distribution in Sindh. Hyderabad and Karachi (Ali 2013).Prey in Sindh. All the members of this genus are mycophagous (Ali 2013).



Figure 9. Harmonia dimidiata (Fabricius).



Figure 10. Bulaea lichatschovii (Hummel).



Figure 11. Psyllobora bisoctonotata (Mulsant).

Tribe Chilocorini Costa, 1849 *Chilocorus* Leach, 1815b

Chilocorus nigrita (Fabricius, 1798) Fig. 12

General distribution. Agalega, American Samoa, Burma, Brazil, Ghana, Guam, Hawaii, India, Indonesia, Kenya, Madagascar, Malaysia, Marshall Islands, New Caledonia, Nepal, Oman, Pakistan, Reunion Island, Seychelles, Solomon Islands, South Africa, Swaziland, Society Islands, Tanzania, Togo, Turkey and Zimbabwe (Nandwani and Joseph 2003, NBAII 2011, Omkar and Pervez 2003, Poorani 2002, Thomas and Blanchard 2014).

Distribution in Sindh. Tandojam, Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aonidiella auranti (Mask), A. citrina (Coq), A. orientalis Newst, Aspidiotus destructor Sign, Hemiberiesia latanias (Sign), Leucaspis coniferarum Hall & Williams, Parlatoria spp, Pinnaspis strachani (Cooley), Quadraspidiotus perniciosus Comst, Tecaspis spp. (Diaspididae: Homoptera) (Ali 2013).

Exochomus (Parexochomus) nigripennis Erichson, 1843 Fig. 13

General distribution. northwestern India, Pakistan, Palaearctic, Africa (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad, and Karachi (Ali, 2013).

Host plants and prey species in Sindh. *Aphis fabae* Theobald, *Rhopalosiphum maidis* Fitch (Aphididae: Homoptera), *Parlatoria* spp. (Diaspididae: Homoptera), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera). It was recorded on trees and wild plants (Ali 2013).

Exochomus pubescens Küster, 1848

Fig. 14

General distribution. Pakistan, India, Spain, North Africa, Greece, Egypt, Syria, Palestine (Poorani 2002).

Distribution in Sindh. Karachi (Ali 2013).

Host plants and prey species in Sindh. *Parlatoria* spp. (Diaspididae: Homoptera). It was found on oak (Ali 2013).

Comment. Newly recorded from Pakistan.



Figure 12. Chilocorus nigrita (Fabricius).



Figure 13. Exochomus nigripennis (Erichson).



Figure 14. Exochomus pubescens Küster.

Priscibrumus uropygialis (Mulsant, 1853)

Fig. 15

General distribution. India, Bhutan, Pakistan, Nepal (Poorani 2002).

Distribution in Sindh. Tandojam and Hyderabad (Ali 2013).

Host plants and prey species in Sindh. Parlatoria spp., Pinnaspis strachani (Cooley), Quadraspidiotus perniciosus Comst, Tecaspis spp. (Diaspididae: Homoptera) on wild trees, and shrubs (Ali 2103).

Brumoides suturalis (Fabricius, 1798)

Fig. 16

General distribution. India, Pakistan, Bangladesh, Sri Lanka, Bhutan, Nepal (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad, and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Ropalosiphum maidis (Fitch), Therioaphis trifolii Monell, Macrosiphum granarium (Kby), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera), Drosicha mangiferae (Green) (Margarodidae: Homoptera), Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida) (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera), Tetranychus atlanticus Mog (Acarina: Tetranychidae), Adelges joshii S.O & S (Adelgidae: Homoptera), Aonidiella auranti (Mask), A. citrina (Coq), A. orientalis Newst, Aspidiotus destructor Sign, Hemiberiesia latanias (Sign), Leucaspis coniferarum Hall & Williams, Parlatoria spp, Pinnaspis strachani (Cooley), Quadraspidiotus perniciosus Comst, Tecaspis spp. (Diaspididae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).

Tribe Noviini Mulsant, 1850, Genus Rodolia Mulsant, 1850

Rodolia ruficollis Mulsant, 1850 Fig. 17

General distribution. India, Pakistan, Thailand (Poorani 2002).
Distribution in Sindh. Karachi and Mirpur Khas (Ali 2013).
Host plants and prey species in Sindh. *Icerya aegyptiaca* (Dougl) (Margarodidae: Homoptera). It was found on cotton and roses (Ali 2013).



Figure 15. Priscibrumus uropygialis (Mulsant).



Figure 16. Brumoides suturalis (Fabricius).



Figure 17. Rodolia ruficollis Mulsant.

Tribe Hyperaspini Costa, 1849, Genus Hyperaspis Chevrolat, 1836

Hyperaspis maindroni Sicard, 1929 Fig. 18

General distribution. Pakistan and India (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Centrococcus insolitus* (Green), *Naiacoccus* sp, *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green) (Margarodidae: Homoptera). It was found on cotton, okra, and trees (Ali 2013).

Tribe Stethorini Dobzhansky, 1924, Genus Stethorus Weise, 1885b

Stethorus gilvifrons (Mulsant, 1850)

Fig. 19

General distribution. India, Pakistan, Italy, Cyprus (Poorani 2002).

Distribution in Sindh. Tandojam, Hyderabad, Mirpur Khas and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Brevipalpus* sp. (Tenuipalpidae: Acarina), *Eutetranychus cernus* (B&P), *E. orientalis* (Klein), *Tetranychus atlanticus* Mog (Acarina: Tetranychidae). It was collected from eggplant, okra, and some wild plants (Ali 2013).

Tribe Scymnini Mulsant, 1846, Genus Scymnus, Mulsant, 1850

Scymnus (Scymnus) nubilus Mulsant, 1850 Fig. 20

General distribution. Pakistan, India, Bangladesh, Sri Lanka, Nepal, Myanmar, China, Asia Minor (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad, and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Ropalosiphum maidis (Fitch), Therioaphis trifolii Monell, Macrosiphum granarium (Kby), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera), Drosicha mangiferae (Green) (Margarodidae: Homoptera), Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida) (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera), Tetranychus atlanticus Mog (Acarina: Tetranychidae), Adelges joshii S.O


Figure 18. Hyperaspis maindroni Sicard.



Figure 19. Stethorus gilvifrons (Mulsant).



Figure 20. Scymnus (Scymnus) nubilus Mulsant.

& S (Adelgidae: Homoptera), Aonidiella auranti (Mask), A. citrina (Coq), A. orientalis Newst, Aspidiotus destructor Sign, Hemiberiesia latanias (Sign), Leucaspis coniferarum Hall & Williams, Parlatoria spp, Pinnaspis strachani (Cooley), Quadraspidiotus perniciosus Comst, Tecaspis spp. (Diaspididae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton and rose plants (Ali 2013).

Scymnus (Pullus) latemaculatus Motschulsky, 1858

Fig. 21

General distribution. Pakistan, India, Bangladesh, Sri Lanka, Thailand, Taiwan. (Poorani 2002; Ali 2013).

Distribution in Sindh. Tandojam, Hyderabad, and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Ropalosiphum maidis (Fitch), Therioaphis trifolii Monell, Macrosiphum granarium (Kby), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera), Drosicha mangiferae (Green) (Margarodidae: Homoptera), Amrasca devastans (Dist), Amrasca biguttula biguttula (Ishida) (Cicadellidae: Homoptera); Bemisia tabaci (Gennadius) (Aleyrodidae: Homoptera), Tetranychus atlanticus Mog (Acarina: Tetranychidae) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).

Comment. Newly recorded from Pakistan.

Scymnus (Pullus) coccivora Ayyar, 1925

Fig. 22

General distribution. India, Pakistan, Bangladesh, Sri Lanka, Malaysia (Poorani 2002).Distribution in Sindh. Tandojam, Hyderabad, and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Ropalosiphum maidis (Fitch), Therioaphis trifolii Monell, Macrosiphum granarium (Kby), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera), Drosicha mangiferae (Green) (Margarodidae: Homoptera), Tetranychus atlanticus Mog (Acarina: Tetranychidae) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).



Figure 21. Scymnus (Pullus) latemaculatus Motschulsky.



Figure 22. Scymnus (Pullus) coccivora Ayyar.

Scymnus (Pullus) castaneus Sicard, 1929 Fig. 23

General distribution. Pakistan, India, Bangladesh (Poorani 2002).

Distribution in Sindh. Tandojam, Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Ropalosiphum maidis (Fitch), Therioaphis trifolii Monell, Macrosiphum granarium (Kby), Schizaphis graminum (Rondani) (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera), Drosicha mangiferae (Green). It was found on eggplant, okra, cotton (Ali 2013).

Comment. Newly recorded from Pakistan.



Figure 23. Scymnus (Pullus) castaneus Sicard.

Scymnus (Pullus) syriacus (Marseul, 1868) Fig. 24

General distribution. Iran, Afghanistan, Pakistan (Ali 2013).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. Aphis craccivora Koch, A. gossypii Glover, Brevicoryne brassicae (L.), Lipaphis erysimi (Kaltenbach), Myzus persicae (Sulzer), Aphis gossypii (Glover), Hyadaphis coriandri (Das), Hysteroneura setariae (Thomas), Ropalosiphum maidis (Fitch), Therioaphis trifolii Monell, Macrosiphum granarium (Kby), Schizaphis graminum (Rondani) (Aphididae: Homoptera) (Ali 2013).

Comment. Newly recorded from Pakistan.

Nephus regularis (Sicard, 1929) Fig. 25

General distribution. India, Pakistan, China (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad and Karachi (Ali 2013). Prey and host plant. Aphis craccivora Koch, A. gossypii Glover, Aphis gossypii (Glover), Hyadaphis coriandri (Das), Therioaphis trifolii Monell (Aphididae: Homoptera); Phenacoccus solenopsis (Tinsley), Ferrisia virigata (Ckll) (Pseudococcidae: Homoptera), Drosicha mangiferae (Green) (Margarodidae: Homoptera) on on eggplant, okra and cotton (Ali 2013).

Tribe Shirozuellini Sasaji, 1967, Genus Ghanius Ahmad, 1973

Ghanius karachiensis Ahmad, 1973 Fig. 26

General distribution. Pakistan (Poorani 2002). Distribution in Sindh. Karachi (Ali 2013).



Figure 24. Scymnus (Pullus) syriacus (Marseul).



Figure 25. Nephus regularis (Sicard).





Host plants and prey species in Sindh. Aonidiella auranti (Mask), A. citrina (Coq), A. orientalis Newst, Hemiberiesia latanias (Sign), Leucaspis coniferarum Hall & Williams, Parlatoria spp. Pinnaspis strachani (Cooley), Quadraspidiotus perniciosus Comst, Tecaspis spp. (Diaspididae: Homoptera) (Ali 2013).

Tribe Sticholotidini Weise, 1901

Pharoscymnus flexibilis (Mulsant), 1853

Fig. 27

General distribution. India, Pakistan, Brazil, and United States (Florida) (Poorani 2002, Thomas and Blanchard 2013).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad, and Karachi (Ali 2013). Host plants and prey species in Sindh. Aspidiotus destructor Sign, Hemiberiesia latanias (Sign), Leucaspis coniferarum Hall & Williams, Parlatoria spp, Pinnaspis strachani (Cooley), Quadraspidiotus perniciosus Comst, Tecaspis spp. (Diaspididae: Homoptera), Coccus hesperidium L, Siassetia nigra (Nietn) (Coccidae: Homoptera) on wheat and mustard (Ali 2013).

Pharoscymnus simmondsi Ahmad, 1970

Fig. 28

General distribution. Pakistan, Thailand (Poorani 2002).

Distribution in Sindh. Karachi (Ali 2013).

Host plants and prey species in Sindh. Parlatoria spp., Pinnaspis strachani (Cooley), Quadraspidiotus perniciosus Comst, Tecaspis spp. (Diaspididae: Homoptera), Coccus hesperidium L, Siassetia nigra (Nietn) (Coccidae: Homoptera) on wheat and mustard (Ali 2013).

Pharoscymnus horni (Weise), 1900

Fig. 29

General distribution. India and Pakistan (Poorani 2002).

Distribution in Sindh. Karachi (Ali 2013).

Host plants and prey species in Sindh. Parlatoria spp. Pinnaspis strachani (Cooley), Quadraspidiotus perniciosus Comst, Tecaspis spp. (Diaspididae: Homoptera), Coccus hesperidium L, Siassetia nigra (Nietn) (Coccidae: Homoptera) on mustard and wheat (Ali 2013).

Discussion

Unfortunately, all the specimens were lost during the shifting of Vitoria Museum to National Museum at Karachi. From Pakistan very little taxonomic work has focussed especially on this important family of the order Coleoptera. Irshad (2001) listed 71 species of coccinellids from northern parts of Pakistan. Rafi et al. (2005) listed 37



Figure 27. Pharoscymnus flexibilis (Mulsant).



Figure 28. Pharoscymnus simmondsi Ahmad.



Figure 29. Pharoscymnus horni (Weise).

genera and 75 species and described the only external morphology of predatory coccinellids mostly collected from northern parts of Pakistan with special reference with their hosts, prey, and localities. Sindh Province has a rich insect fauna which have diversified into important cities like Karachi, Tandojam, Hyderabad, Larkana, Sukhur, and Mirpur Khas. Coccinellids fauna is still incompletely recorded from Sindh region and has been neglected in the past. All the research findings on coccinellids except Ali (2013) were documentary not taxonomic. No proper collections, identification procedures, or techniques have been used in Sindh to explore the hidden records of insects, including the coccinellid fauna. Ali (2013) worked more comprehensively on the systematics and distribution of ladybirds of Sindh Province with reference to their role in biological control programmes. He tried to highlight the importance of systematic study to make easy their identification as predators of mealybugs, aphids, jassids, whiteflies, and scale insects. This research work may be useful for the entomologists including research students of particularly the Sindh region, but also of Pakistan and other Oriental regions. The geographical distribution and synonyms used in this study for all systematically treated specimens were cited from the findings of Hashmi and Tashfeen (1992).

The present investigation continues the research carried by Ali (2013), and gives a preliminary checklist of ladybirds from Sindh consisting of only one subfamily, ten tribes, 21 genera, and 29 species including four new records: *Bulaea lichatschovii* (Hummel), *Exochomus pubescens* Küster, *Scymnus (Pullus) latemaculatus* Motschulsky, *Scymnus (Pullus) syriacus* Marseul and four varieties of *Menochilus sexmaculata* (Fabricius). All these coccinellids from Pakistan are now placed into the subfamily Coccinellinae and the subfamily Microweiseinae according to the recent classification studies. The coccinellid specimens were deposited in the Natural History Museum, Department of Zoology, University of Karachi, Karachi, Pakistan.

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RESEARCH ARTICLE



A new genus record and species of Dromoceryx Schmidt-Goebel, 1846 (Coleoptera, Carabidae, Lebiini) from Taiwan, with a revised key to species

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Abstract

We describe a new genus record for Taiwan and a new species of the genus *Dromoceryx* Schmidt-Goebel, 1846. We add to the known fauna and distribution of the genus with a description, habitus, genitalic images, as well as a geographic range map for *Dromoceryx nigrofovealis* **sp. n.** A revised key to all species of the genus is included.

Keywords

Carabidae, Dromiina, Lebiini, new species, new record, Taiwan

Introduction

Until a thorough revision of this genus by Mateu (1984) in French, *Dromoceryx* was considered by many (Atkinson 1890; Bates 1892; Andrewes 1923) to be a likely synonym of *Metabletus* Schmidt-Goebel, 1846. Mateu treated the three known species and cited the structure of the mentum (with a median tooth), glossal sclerite, unique elytral macula pattern, and genitalic form of both male and female as characteristics that define *Dromoceryx* as a genus. Other than an apparent South (India) and South-east (Vietnam) Asian distribution, little else is known about the natural history of this group. Here, we describe a new species of the genus *Dromoceryx* based on the examination of several specimens recently collected in Taiwan.

Materials and methods

Material

This work is based on the study of 36 specimens. Adult specimens were collected by or borrowed from various institutions listed below, along with a four-letter coden used to identify sources of specimens (Arnett et al. 1993). The names of the curators of these collections appear in parentheses below.

CMNH	Section of Invertebrate Zoology, Carnegie Museum of Natural History, 4400	
	Forbes Avenue, Pittsburgh, Pennsylvania, U.S.A. 15213-4080 (R. L. Davidson).	
NCHU	Department of Entomology, National Chung Hsing University, Taichung	
	City 402, Taiwan (Man-Miao Yang).	
NMNS	National Museum of Natural Science, One Guancian Road Taichung City	
	404, Taiwan (Jing-Fu Tsai).	
TARI	Insect Collection of the Taiwan Agricultural Research Institute, Wufeng Dis-	
	trict, Taichung City 41362, Taiwan (Chi-Feng Lee).	
UASM	E.H. Strickland Entomology Museum, University of Alberta, Edmonton, Al-	

berta, Canada, T6G 2H1 (Danny Shpeley).

Methods

Fieldwork. We first encountered this species when Yen-Chiu Lan (University of Kang Ning, Tainan) provided specimens collected from her 2010 faunistic study on the insects of Kenting National Park, Pingtung County, Taiwan. Our examination of this material indicated that it was both a new genus record for Taiwan and a new species for the genus *Dromoceryx*. After scouring other museums for specimens of this species, it was clear that little was known about the habitat preferences or biology of *Dromoceryx* species other than that they readily came to ultraviolet light and light traps. Because of this, we were eager to locate more individuals in the field. Adults of this species had also been previously collected from the Liouguei Research Center of southern Taiwan. In April of 2014, Yi-Ming Weng, Dash Hwang, and Wesley Hunting, went there for several days to try and locate this seemingly uncommon insect species. During that time we were able to collect three individuals, two specimens from a mercury vapour light sheet and one in mixed primary forest on deadwood.

Preparation and examination of adults. Standard methods were used for mounting, dissecting, and preparing genitalia, among other technical procedures (Ball and Hilchie 1983; Frania and Ball 2007). Genitalia and other small structures were preserved in glycerine and stored in microvials that were pinned beneath the specimen from which they had been removed.

Images and illustrations. A photograph of species habitus (Fig. 1) was taken using a Nikon D7100 fitted with an AF-S VR Micro-NIKKOR 105mm f/2.8G IF-ED lens and mounted on a copy stand. Photographs of genitalia (Fig. 2a–d) were taken with a

Nikon D7100 mounted on a Olympus SZX16 trinocular stereoscopic microscope and layered together using Zerene Stacker (Zerene Systems LLC, Richland, WA). A line drawing of the female genital tract (Fig. 3) was prepared by taking photographs with a Nikon D7100 and then importing them into Adobe Illustrator 11.0 (Adobe Systems, Inc., Mountainview, CA). Plates were also prepared using Adobe Illustrator 11.0.

The Geographic range map was prepared using a modified map from Ginkgo Maps (http://www.ginkgomaps.com); projection used is NAD Lambert Conformal Conic, 1983.

Measurements. Measurements were made at 25× with a Wild M5 stereoscopic microscope fitted with an ocular micrometer. Various measurements are expressed in the text by abbreviations, as used by Ball and Shpeley (2005) and Hunting (2013):

- **HL** Length of head, measured on left side, from base of left mandible to posterior margin of compound eye.
- HW Width of head, maximum transverse distance across head, including eyes.
- **PL** Length of pronotum along midline.
- **PWM** Maximum width of pronotum.
- ML Metepisternum length.
- **MW** Metepisternum width.
- **EL** Length of elytra from basal ridge to apex.
- **EW** Maximum width of elytra.
- **OBL** Overall body length.

The shape of the head and pronotum is shown by the ratio of the width over length (**HW/HL**; **PWM/PL**, **ML/MW**), and elytral shape is indicated by the ratio of the length to the width (**EL/EW**).

To indicate the range of body size of each species, the overall body length (**OBL**) was measured from the apex of the extended mandibles to the apex of the elytra of both the largest and smallest individuals of each species (Frania and Ball 2007).

The size of male genitalia was determined by drawing a straight line between the apical area and the basal lobe of the phallus. The size of female genitalia was determined by drawing a straight line across the outside margin of widest portion of left lateral tergite to outside margin of widest portion of right lateral tergite.

Systematic zoology

Order Coleoptera Linnaeus, 1758 Family Carabidae Latreille, 1802 Subfamily Lebiinae Bonelli, 1810

Genus Dromoceryx Schmidt-Goebel, 1846

Type species. *Dromoceryx dorsalis* Schmidt-Goebel, 1846: 40–41. Atkinson 1890: 75; Andrewes 1923: 18; Mateu 1984: 404; Lorenz 2005: 478.

Taxonomic note. The type of *D. dorsalis* is in the National Museum of Natural History (NMPC), Prague, Czech Republic. According to Andrewes (1923) and Mateu (1984), it is a single specimen with no antennae or palpi and is in otherwise poor condition.

Recognition. This genus is distinguished from others by the following combination of characters: Broad and somewhat flattened body. Small size: 3.5–4.5 mm. Glossal sclerite broad, with narrow latero-apical lobes, four setae visible at apex, two longer seta more laterally and two shorter setae more medially. Mentum with single shallow tooth. Head and pronotum brunneous to piceous, elytral disc testaceous with black macula. Gonocoxite 2 slightly spatulate, broadly rounded at apex; two lateral ensiform setae, one on each side, seta-like as opposed to spine-like, two nematiform setae. For a detailed account and figures of the male and female genitalia of the already described species of *Dromoceryx*, see Mateu (1984).

Key to species of the genus Dromoceryx

1	Relatively large (4.4-4.5 mm). Elytral disc rufous to red, macula in apical
	portion of elytra, not contacted to apical third of elytral suture. India, Chen-
	nai (Madras) D. magnus Mateu
_	Smaller, < 4.1 mm. Elytral disc testaceous, macula covering, at least, basal
	two-thirds of elytral suture. India and elsewhere2
2	Overall body length 3.0-3.2 mm. Elytra disc with isodiametric sculpticells.
	India, Chennai (Madras) D. flavocircumdatus Mateu
_	Overall body length > 3.4 mm. Elytra disc with transverse sculpticells3
3	Elytra with foveae of umbilical setae piceous (Fig. 1). Disc of pronotum brun-
	neo-piceous to piceous. Taiwan D. nigrofovealis sp. n.
_	Elytra with foveae of umbilical setae testaceous. Disc of pronotum brunne-
	ous. India, Vietnam

Dromoceryx nigrofovealis sp. n.

http://zoobank.org/4FBD41B7-BA20-484E-9BB6-757A6F05B4FD Figs 1, 2A–D, 3, 4

Etymology. The name of this species refers to the foveae of the lateral umbilical seta, which is piceous to black.

Type material. HOLOTYPE, male, labeled: "TAIWAN: Kaohshiung City / Maolin dist., Chung-Shin vill. / Liouguei Research Center / 22.9709N, 120.6822E"; "m.v. light sheet / 670m, Acc. Ti-209a / April 14, 2014, Y. Weng / D. Hwang & W. Hunting" [NCHU]. 35 PARATYPES, sex and label data follows. 1 male, labeled same as holotype [NCHU]. 1 female, "TAIWAN: Kaohshiung City / Maolin dist., Chung-Shin vill. / Liouguei Research Center / 22.9709N, 120.6822E"; "hand coll., April 15, 2014 / 640m, Acc. Ti-210d / Y.M. Weng, D. Hwang / & W. M. Hunting" [NCHU].



Figure 1. Dorsal habitus and color pattern of Dromoceryx nigrofovealis, new species. Scale bar: 1 mm.

2 males, 4 females, "TAIWAN: Kaohsing. / Shanping., 640 m / 1–10 April 1998/ R. Davidson, J. Rawlins / C. Young" [CMNH]. 3 males, 2 females, "TAIWAN: Kaohsing./ Shanping., 640 m / 21–30 April 1998 / C. Young, R. Davidson / J. Rawlins" [CMNH]. 4 males, 3 females, "TAIWAN Hengchun / Kenting Park/ IV / 7–8/2004 / C.S. Lin & W.T. Yang / UV Light trap" [NMNS]. 1 male, 1 female, "TAIWAN Hengchun/ Kenting Park / II/16–17/2005 / C.S. Lin & W.T. Yang / UV Light trap" [NMNS]. 4 males, 2 females, "TAIWAN: Tainan Co. / Mt. Kantou Trail / (崁頭山步 道) by light/ 2014.III.29. leg. 賴保成 / 23°15'36.55"N, 120°30'00.85"E [NCHU]. 4 males, 3 females, "TAIWAN: Pingdong Co. / Kenting Forest Research / Area (墾丁森林遊樂區) / 2010.V.15 by light"; "2010-5-15-Kenting Forest / Recreation Area (墾丁森林/遊樂區) – Light trap / -Coleoptera- 53"; leg. 邱垂生 & 藍艷秋/ 21°57'48.6"N, 120°48'47.9"E/ #372" [LAN].

Type Locality. Maolin District, Kaohshiung City, Taiwan.

Diagnosis. This species is readily distinguished from other *Dromoceryx* species by the combination of: head and pronotum piceous to black and lateral margins with foveae of umbilical setae piceous. Individuals of this species also have an elytral macula pattern that is less variable when compared to specimens of *D. dorsalis* (Mateu 1984).

Description. OBL 3.52–4.08 mm. Length (n = 10 males, 10 females): head 0.32–0.44, pronotum 0.60–0.72, elytra 2.10–2.42, metepisternum 0.56–0.60 mm; width of head 0.82–0.96, of pronotum 1.04–1.20, of elytra 1.66–1.92, of metepisternum 0.32–0.40 mm.



Figure 2. Digital images of male genitalia of *Dromoceryx nigrofovealis*, new species **A** Right lateral aspect **B** Ventral aspect **C** Left lateral aspect **D** Right lateral aspect with endophallus everted. Scale bars: 0.5 mm.

Body proportions. HW/HL 2.10–2.56; PWM/PL 1.63–1.77; EL/EW 1.25–1.33; ML/MW 1.50–1.75 mm.

Color. Fig. 1. Dorsum of head piceous, clypeus with base piceous, apical margin brunneous, labrum brunneo-piceous to brunneous, darker centrally; palpi and antennae brunneo-testaceous to brunneous; elytral disc piceous to black, margins brunneous, paler; elytral disc testaceous, lateral margins with foveae of several umbilical setae piceous, disc with two large piceous macula, joined along suture to appear as one large macula, macula long, extending from base to apical 1/6th of elytra. At base of elytra, from suture to stria 6, narrowing to stria 4 in basal 1/3rd and then expanding to interval 8 medially, constricting again just beyond 2/3^{rds} length to stria 5; ventral surface distinctive, apex of prosternal and mesosternal coxal process testaceous, metepisternum and pregentinal sterna III and IV testaceous medially, apical margin of pregenital sternum VII brunneous to testaceous, proepipleuron testaceous, legs testaceous, all other surfaces brunneo-piceous to piceous.



Figure 3. Line drawing of the female reproductive tract of *Dromoceryx nigrofovealis*, new species. Legend: **bc** bursa copulatrix; **co** common oviduct; **gc1** gonocoxite 1; **gc2** gonocoxite 2; **les** lateral ensiform setae; **lt** lateral tergite; **ns** nematiform setae; **sg** spermathecal gland; **sgd** spermathecal gland duct; **sp** spermatheca. Scale bar: 0.5 mm.

Microsculpture. Dorsum of head with mesh pattern isodiametric to slightly stretched longitudinally; pronotum with microsculpture almost isodiametric medially to somewhat transverse laterally, cells 1.5–2× wider that long; elytra with sculpticells transverse; ventral surfaces with microsculpture transverse.

Macrosculpture and pilosity. Dorsum of head smooth, with a few very fine punctures, hardly visible at $50\times$. Pronotum smooth, with very fine, randomly scattered setigerous punctures, hardly visible at $50\times$; elytral intervals with ± single row of very fine, setigerous punctures along length, hardly visible at $50\times$; stria with few faint punctations, setae not visible at $50\times$; ventral surface with very fine, randomly scattered setigerous punctures.

Fixed setae. Two pairs of supraorbital setae; clypeus with two lateral setae; labrum with six setae along apical margin; pronotum with two setae along each margin, one at base of lateral margin and one on lateral margin at pronotum maximal width; elytra with two setae in interval 3, one seta just before mid-length, one seta in apical 1/3rd; 11–12 lateral (umbilical) setae in interval 9; two setae on each of abdominal sterna III to VI; two setae along apical margin of sternum VII in males, females with four setae near apical margin of sternum VII, medially setae much shorter and finer than outer setae.

Luster. Dorsum of head and pronotum moderately dull; elytra moderately glossy; ventral surface moderately glossy.



Figure 4. Map showing known localities for Dromoceryx nigrofovealis, new species, in Taiwan.

Head. Mandibles short, with wide base; labrum wider than long, rectangular; mentum with shallow tooth; eyes somewhat convex.

Pronotum. Anterior transverse impression very shallow; posterior transverse impression very shallow; median longitudinal impression moderately shallow; disc moderately flat, basal angles obtuse, lateral margins broadly rounded, margins narrow.

Elytra. Intervals moderately flat, striae moderately impressed; elytral apices truncate. *Hind wings.* Macropterous.

Legs. Claws pectinate, 4 or 5 denticles per claw. Male protarsi with adhesive vestiture ventrally, two rows of squamo-setae on tarsomeres 1–3 of fore-leg.

Male genitalia. Fig. 2A–D. Length 0.84–0.92 mm. Ostium catopic, long, slightly more to left side in ventral view; phallus cylindrical, left side narrowing from mid-length to apex, right side relatively straight in ventral view, apex narrow, rounded, sharply pointed in lateral view; endophallus short and wide, several patches with microtrichia slightly enlarged and more sclerotized than remaining surface, visible in non-everted specimens.

Female genitalia. Fig. 3. Width 0.56–0.64 mm. Gonocoxite 2 (gc2) slightly spatulate, broadly rounded at apex; two lateral ensiform setae (les), one on each side, seta-like as opposed to spine-like, two nematiform setae (ns) at apex; one spermatheca (sp1), cylindrical and elongate, right angled at mid-length, ribbed texture from midlength to apex; one spermathecal accessory gland (sg), spermathecal gland duct (sgd) with irregular width along length, attachment site at base of spermatheca.

Habitat, habits and seasonal occurrence. The known elevational range of *D. ni-grofovealis* is from 240 to 670 m. Adults of this species live in mixed primary and secondary forests. Adults are crepuscular or nocturnal and readily come to light. All known specimens have been collected from February to May. Collecting methods include ultraviolet light, mercury vapour light sheet, incandescent light, and hand collecting.

Geographical distribution. To date, this species is known from a few localities in the southern third portion of Taiwan (Fig. 4).

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RESEARCH ARTICLE



A new species of *Gaurax* from the Czech Republic (Diptera, Chloropidae)

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Abstract

Gaurax siostrzoneki **sp. n.** (Diptera, Chloropidae) is described from the Czech Republic and the main differential characters are illustrated. A key to the European species of the genus is provided.

Keywords

Acalyptratae, diversity, frit flies, new species

Introduction

The genus *Gaurax* was erected by Loew (1863) for an American species *G. festivus* Loew. Species of the genus *Gaurax* are small black or yellow flies with black markings and with or without ommatrichia, shiny or slightly dusted ocellar triangle, and a rounded scutellum. The gena are usually covered with a silvery dust. The first flagelomere is oval or reniform. The arista are usually densely pubescent, but not thickened. The costal cell of the wing is unusually broad. Legs of males are without a femoral comb. Species of the genus *Gaurax* are variable in body colouration and size, and genitalia examination is usually necessary for species identification.

The larvae of several species are associated with bracket fungi, other fungi, decaying wood infested by insects and decaying vegetable matter, as well as in bird's nests (Komonen et al. 2004, Nartshuk and Andersson 2013, Nartshuk and Kurina 2014) and several authors before them observed the same. Other species have been reared

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from cones of *Larix decidua*, *Picea abies*, and from a twig of *Pinus silvestris* (Karps 1981; Nordlander and Grijpma 1991).

Gaurax is one of the larger genera of the family Chloropidae [for example Chlorops includes 343 valid species, Tricimba includes 170 valid species, Gaurax includes 152 valid species, all from the World database Chloropidae of M. von Tschirnhaus, Bielefeld, cited as von Tschirnhaus in litt.]. It is distributed in all zoogeographical regions. Altogether, 13 described and valid species occur in Europe: Gaurax borealis (Duda, 1933), Gaurax dubius (Macquart, 1835), Gaurax ephippium (Zetterstedt, 1848 [= G. strobilum Karps, 1981]), Gaurax fascipes Becker, 1910, Gaurax flavomaculatus (Duda, 1933 [= G. britannicus Deeming, 1980]), Gaurax flavoscutellatus (Stackelberg, 1955), Gaurax fungivorus Nartshuk & Andersson, 2013, Gaurax gauracicornis (Duda, 1933), Gaurax leucarista Nartshuk, 1962, Gaurax maculipennis (Zetterstedt, 1848), Gaurax macrocerus (Nartshuk, 1962), Gaurax niger Czerny, 1906, Gaurax polonicus Nartshuk, 1980, and Gaurax suecicus Nartshuk & Andersson, 2013. Duda (1932-1933) described one more species, G. gauracicornis, from Spain. The species was described based on a female only; the male remains unknown and elucidation of the status of this species will be possible only after examination of male genitalia. We did not check if Oscinella kuntzei Becker, 1910 is possibly identical with our new species; Nartshuk (1984) lists it as a synonym of G. maculipennis, while Duda (1932-1933) treats it as a synonym of G. dubius. The male genitalia had never been investigated. Becker (1910) mentioned only one type specimen without sex determination. But Kramer (1917) mentioned a series of both sexes reared from beech mushrooms. A male from this series, not being paratypes, should be studied in the future to confirm the synonymy. One additional species of this genus is described here as new.

Materials and methods

The studied material was collected in 2010 and 2014 by the authors in Vráž (near Písek), and it is deposited in the collections of the Czech University of Life Sciences, Prague. The specimens were collected by pyramidal traps as illustrated in Fig. 1 (described by Barták and Roháček 2011) and by sawdust traps baited with oak sawdust (Fig. 2). Most of the specimens were originally preserved in alcohol and were dried and mounted using the method described by Barták (1997). The genitalia of the described species were macerated in 10 % KOH (24 hours, room temperature) and later stored together with the specimens on plastic tags and fixed with butyl-methacrylate copolymer of methyl-methacrylate, xylene. The genitalia and individual species were photographed using a Nikon D300 digital camera mounted on a Nikon SMZ-U microscope and images were edited with the computer software NIS-Elements 3.0. On average, each final image is from a stack of 15 layers. Images were improved using the software Adobe Photoshop. The genitalia served as models for the outline of the hand drawn illustrations; details were added by direct observation of the genitalia. The morphological terms used here and distribution follow Nartshuk and Andersson (2013). The length of the ocellar triangle was measured from the posterior margin of the posterior



Figure 1. Pyramidal trap.



Figure 2. Sawdust trap baited with oak sawdust.

ocelli to the apex of the main part of the ocellar triangle. The depth of the head was expressed as the distance between the uppermost part of the head and the lowest part of the gena (in lateral view). The head length was measured from the level of the posterior of the head horizontally to the level of the foremost extension of the anterior margin of frons or eye, excluding the antenna. All measurements (including body length) were taken from dry specimens (therefore the actual length may differ). The body lengths of males were measured from the antennal base to the hind end of the epandrium.

Results

Genus Gaurax Loew, 1863

Gaurax Loew, 1863, Berl. ent. Ztschr., 7: 35.

Type species. *Gaurax festivus* Loew. By monotypy. = *Botanobia* Lioy, 1864, Atti 1st. Veneto Sci. (3) 9: 1125. = *Neogaurax* Malloch, 1914, Canad. Ent., 46 (4): 119.

Gaurax siostrzoneki sp. n.

http://zoobank.org/27B76064-6140-429F-A3B8-BAC34BC13305 Figures 3–6

Holotype male. Czech Republic, Bohemia, Vráž nr. Písek, alder forest, 430 m, PyrT [= pyramidal trap], 49°24'8"N/14°7'8"E, 25.vi–19.vii.2010, Barták leg. Holotype is in good condition, abdomen on plastic tag together with the specimen. **Paratypes.** 3 males, same data as the holotype, 4 males and 4 females: Vráž nr. Písek, 400 m, Sawdust trap, 49°24'12"N/14°7'3"E, 12.vi–30.ix.2014, Barták leg.

Diagnosis. Species with head 1.25× as deep as long, first flagellomere 1.3× as deep as long, body yellow with three black partly fused stripes, central stripe reaching scutellum and scutellum often dark. *Gaurax siostrzoneki* sp. n. is similar to *G. flavoscutellatus*. The main characters distinguishing these two species are as follows: *Gaurax siostrzoneki* has surstylus with two long curved extensions, one long, strong seta growing from the lower projection, and cercus short and enlarged at apical part. In *G. flavoscutellatus* surstylus is without spurs and cercus is short and narrowed.

Description. *Male* (Figs 3, 4). *Body* length 1.3–1.5 mm. Ground colour yellow. Head 1.25× as deep as long (lateral view), yellow with black occiput. Ocellar triangle occupying two-thirds of frons, yellow, shiny, and black on ocellar tubercle only, with one row of dark interfrontal setulae along sides. All setae and setulae on head black. First flagellomere 1.3× as deep as long, yellow, often darkened on outer margin (variable). Arista black. Eyes with ommatrichia. Depth of gena in front equal to the length of first flagellomere, gena with one row of dark setulae. Palpus yellow.



Figure 3. Gaurax siostrzoneki sp. n. (paratype): body, dorsal view.



Figure 4. Gaurax siostrzoneki sp. n. (paratype): body, lateral view.



Figure 5. Gaurax siostrzoneki sp. n. (holotype): epandrium posterior view.



Figure 6. Gaurax siostrzoneki sp. n. (holotype): epandrium lateral view.

Thorax. Scutum shiny yellow with three black partly fused stripes, central stripe reaching scutellum, sometimes scutum completely dark. Scutellum yellow or dark, apical scutellar setae longer than lateral setae. Anepisternum, katepisternum, katepimeron, and meron shiny yellow with 1-4 small dark spots. Notopleural setae 1+1. Setae of thorax black. Wings not coloured. Haltere yellow. Legs completely yellow.

Abdomen: black dorsally and yellow ventrally. Male genitalia (Figs 5, 6): epandrium yellow with dark, wide, medial stripe, surstylus with two long curved extensions, one long, strong seta growing from the lower projection, cercus short and enlarged at apical part.

Etymology. Named in honour of Archbishop of Břevnov Monastery Petr Prokop Siostrzonek, a supporter of natural science and our friend.

The key of European species of *Gaurax* Loew (modified from Nartshuk and Andersson 2013)

1	First flagellomere black with white pubescence; arista white, slightly thick- ened
_	First flagellomere and arista different.
2	Head depth equal to length (Fig. 7)
_	Head 1 25x as deep as long (Fig. 8)
3	First flagellomere rounded nearly as deep as long 4
_	First flagellomere reniform 1 3x as deep as long
4	First flagellomere large nearly as deep as height of face
т	<i>C. macrocarus</i> (Nortchuk)
_	First flagellomere smaller, parrower than beight of face 5
- 5	Male genitalia, carcus parrow, rather long, surstylus strongly elongated widened
)	anically (Fig. 0). Body mainly comparing antiraly black (Duda)
	Aple conjelies converse charter and wider supervise charter (Fig. 10). Colour of
-	Male genialia: cercus shorter and wider, surstylus shorter (Fig. 10). Colour of
	body variable, but thorax usually yellow with black stripes fused on anterior
	part of scutum, scutelium yellow, pleuron with four black spots
(G. aubius (Macquart)
6	Apical part of wing slightly darkened especially in male
	G. maculipennis (Letterstedt)
_	Wing without any darkening
1	Ocellar triangle yellow, shiny, only on ocellar tubercle black
_	Ocellar triangle mainly or entirely black, shiny or dusted9
8	All legs yellow. Dark band on hind tibia equals one quarter of tibia length
	G. fascipes Becker
-	All legs yellow. Dark band on hind tibia equals one halfr of tibia length
	<i>G. polonicus</i> Nartshuk
9	Body mainly black except yellow front margin of frons and gena, or also
	scutellum, notopleuron, and hind part of postpronotum yellow, legs dark-
	ened or yellow with black mark10
-	Body usually yellow with dark stripes on scutum. Frons, genae, and scutellum
	yellow. Legs yellow11
10	Body mainly black except yellow front margin of frons and gena. All legs
	darkened G. suecicus Nartshuk & Andersson
_	Body black, notopleuron, hind part of postpronotum and upper part of an-
	episternum yellow. Legs yellow with black mark on all femora and mid and
	hind tibiae
11	Male genitalia: cerci tapering, close to each other, surstylus with acute process
	directed medially G. fungivorus Nartshuk & Andersson
_	Male genitalia: cerci broader and wider apart, surstylus with several processes
	on lower margin (Fig. 11)

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12	Body completely black	G. niger Czerny
_	Body yellow with three black stripes on scutum,	often partly or completely
	fused	
13	Ocellar triangle mostly black with yellow edge and	d partly dusted, male geni-
	talia as in Fig. 12 Gaurax flav	oscutellatus (Stackelberg)
_	Ocellar triangle yellow, shiny and black on ocellar	tubercle only, male genita-
	lia as in Figs. 5, 6	G. siostrzoneki sp. n.



Figure 7. Couplet 2a of key, head, lateral view (after Nartshuk and Andersson 2012).



Figure 8. Couplet 2b of key, head, lateral view (after Nartshuk et al. 1970).



Figure 9. Gaurax borealis: epandrium lateral view (after Nartshuk and Andersson 2013).



Figure 10. Gaurax dubius: epandrium lateral view (after Nartshuk and Andersson 2013).



Figure 11. Gaurax ephippium: epandrium posterior view (after Nartshuk and Andersson 2013).



Figure 12. Gaurax flavoscutellatus: epandrium lateral view.

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RESEARCH ARTICLE



The immatures of Bezzia chilensis Spinelli & Ronderos, 2001 (Diptera, Ceratopogonidae)

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Abstract

The fourth instar larva and the pupa of *Bezzia chilensis* Spinelli & Ronderos, 2001 are described for the first time. The immature stages were collected from macrophytes and filamentous algae in streams of the Patagonian steppe, in the provinces of Neuquén and Chubut, Argentina. The described stages were photographed and illustrated with a phase-contrast microscope and scanning electron microscope. Data on the bionomics of the species, new records and tables for characters of the known larvae and pupae of *Bezzia* Kieffer, 1899 from the Neotropical region are provided.

Keywords

Aquatic, biting midges, immature stages, Neotropical region, Palpomyiini

Introduction

Bezzia Kieffer, 1899, a worldwide genus of the tribe Palpomyiini, includes 322 species of which 48 inhabit the Neotropical region, 46 of them recorded by Borkent and Spinelli (2007), and two more recently described: *B. ventanensis* Spinelli, 2012 (Spinelli et al. 2012) and *B. galesa* Spinelli, 2013 (Spinelli et al. 2013). The adults are important predators of small invertebrates and the immature stages are relatively common inhabitants of various kinds of freshwater environments, mainly streams, lakes and ponds, as well as other breeding habitats, such as sphagnum bogs, rice fields, footprints in sandy creek beds, and water gathered in tree holes and bromeliads (Spinelli and Ronderos 2001). The majority of the Neotropical species are known from adults, and only 12 of them are also known as immatures: *B. bivittata* (Coquillett, 1905), *B. blantoni* Spinelli & Wirth, 1989, *B. brevicornis* (Kieffer, 1917); *B. bromeliae* Spinelli, 1991; *B. galesa* Spinelli, 2013; *B. gibbera* (Coquillett, 1905); *B. glabra* (Coquillett, 1902), *B. nobilis* (Winnertz, 1852), *B. pulchripes* Kieffer, 1917; *B. roldani* Spinelli & Wirth, 1981, *B. snowi* Lane, 1958; and *B. ventanensis* Spinelli, 2012.

Bezzia chilensis Spinelli & Ronderos, 2001 is a member of the *venustula* species group in the subgenus *Homobezzia* Macfie, 1932, distributed in Valparaiso Province (Chile), and Salta and Río Negro provinces (Argentina) (Spinelli and Cazorla 2003). During a recent survey carried out in the northwestern Argentine Patagonia, larvae and pupae of *B. chilensis* were collected. The purpose of this paper is to describe the fourth instar larva and pupa of this species, with phase-contrast and scanning electron microscopy (SEM) and to provide tables for characters of the known larvae and pupae of *Bezzia* from the Neotropical region.

Material and methods

Larvae and pupae were collected on the bordering vegetation in three streams on the Patagonian steppe in the provinces of Neuquén and Chubut. The substrate was removed with the aid of a strainer and transferred to a white tray where larvae and pupae were collected with a pipette. Further substrate samples were carried to the laboratory to search for more specimens. Larvae were placed in individual containers with water and substrate from their natural environment. Pupae were isolated in a vial with a drop of water, and observed daily until adult emergence. Adults were allowed to harden for 24 h before being preserved in ethanol to ensure their complete pigmentation. For detailed examination with a phase-contrast microscope, larval and pupal exuviae and adults were mounted in Canada balsam following the technique described by Borkent and Spinelli (2007). Mounted larval exuviae were oriented ventral side up to facilitate examination of the epipharyngeal combs within the head capsule. Pupal exuviae were mounted dorsoventrally. Photomicrographs were taken with a Micrometrics SE Premium digital camera, through a Nikon Eclipse E200 microscope and a Leica EC3 digital camera, through a Leica DM 500 microscope. Illustrations were drawn with a camera lucida and Adobe

illustrator CC. The map was drawn in QGIS v. 2.14. Larvae were also examined using scanning electron microscopy (SEM) (JOEL 2000) following the technique of Ronderos et al. (2000, 2008). Measurements were taken with a (BCM) Leitz Wetzlar binocular compound microscope. The temperature of the water and air were measured with an alcohol thermometer in degrees Celsius. For larval terms and abbreviations of measurements, see Anjos-Santos et al. (2017); for pupal terms, see Borkent (2014). Studied specimens are deposited in the collection of the Museo de La Plata, La Plata, Argentina (MLPA).

Results

Bezzia chilensis Spinelli & Ronderos, 2001

Figs 1a-f, 2a-d, 3a-g, 4a-f

Bezzia chilensis: Spinelli and Ronderos 2001: 752 (male, female; Chile); Spinelli and Cazorla 2003: 47 (Argentina records); Borkent and Spinelli 2007: 93 (in Neotropical catalogue); Spinelli and Marino 2009: 205 (species list from Patagonia); Borkent 2016: 160 (in online world catalog).

Description of fourth instar larva (Figs 1a–f, 2a–d). Head capsule (Figs 1a–c, 2a) pale brown, about 2 times longer than wide, apex slightly bent ventrally, HL 0.30–0.32 (0.31, n = 7) mm; HW 0.12–0.19 (0.16, n = 7) mm, HR 1.70–2.41 (2.00, n = 6); SGW 0.083– 0.116 (0.098, n = 6) mm; SGR 1.29–1.82 (1.66, n = 6). Setae simple, thin, medium to long sized, chaetotaxy as in Figure 1a–c. Antenna bottom-shaped, small, length 0.01 (n =3) mm. Labrum (Fig. 1c) longer than wide, not extending beyond hypostoma, with three pairs of anterolateral sensilla styloconica; palatum (Fig. 1d) with two pairs of closely spaced sensilla, one trichoidea, one campaniform sensillum; messors (Figs 1d, 2a) small, gently sclerotized, curved structures, situated away from mandibles, without scopae; palatal bar present (Fig. 1d), triangular, situated immediately posterior to messors. Mandible (Figs 1cf, 2a, d) hooked, curved, strongly sclerotized, apical tooth long, deep fossa mandibularis on ectal surface; MDL 0.045–0.073 (0.052, *n* = 6) mm, MDW 0.02 (*n* = 6) mm. Maxilla (Fig. 1c-e) with pyriform sensillum, galeolacinia with lacinial sclerite 1 (Fig. 1e) and lacinial sclerite 2 (Fig. 1c-f) with 2 setae, one medium-sized stout, other short; maxillary palpus (Fig. 1c–f) cylindrical, with 4 subapical papillae, three medium-sized, one elongate. Hypostoma (Fig. 1c–f) finely toothed, with 6 or 7 stout lateral teeth. Epipharynx (Fig. 2a, c) less massive, with 2 combs: ventral comb with 5 stout, short teeth, dorsal comb with 7 or 8 long, pointed teeth on posterior edge; lateral arms elongate; LAW 0.048–0.050 (0.049, n = 4) mm, DCW 0.025–0.038 (0.028, n = 4) mm. Hypopharynx (Fig. 2a) elongate, thin, gently sclerotized, arms slender, without fringe. Thoracic pigmentation uniformly pale yellowish. Caudal segment (Fig. 2b) about 2.7 times as long as wide, with one pair of long, stout setae "o", one medium-sized, thin setae "i", one pair of short, thin setae "l,". CSL 0.51-0.57 (0.55, n = 5) mm, CSW 0.21-0.28 (0.25, n = 5) mm, CSR 1.88-2.71 (2.7, n = 5) = 5), OL 0.20–0.30 (0.27, n = 6) mm, OD 0.020–0.072 (0.049, n = 5) mm.



Figure 1. *Bezzia chilensis* Spinelli & Ronderos, 2001, fourth instar larva (SEM) **a** Head chaetotaxy, ventrolateral view **b** Head chaetotaxy, dorsolateral view **c** Head capsule detail, oblique anteroventral view **d** Head capsule detail, ventral view **e** Mouthpart, ventral view **f** Hypostoma and mouthparts, ventral view. Antennae (AN); collar (CO); fossa mandibularis (MF); galeolacinea (GL); hypostoma (HY); labrum (LB); lacinial sclerite 1 (LC1); lacinial sclerite 2 (LC2); mandible (MD); messors (MS); maxilla (MX); maxillary palpus (MP); palatal bar (PB); palatum (PL); sensilla campaniformia (SCa); sensilla styloconica (SS); sensilla trichoidea (ST); Head capsule chaetotaxy: o, parahypostomal setae; p, posterior perifrontal setae; q, postfrontal setae; s, anteroperifrontal setae; t, prefrontal setae; u, mesolateral setae; v, posterolateral setae; w, anterolateral setae; x, parantennal setae; y, ventral setae.


Figure 2. *Bezzia chilensis* Spinelli & Ronderos, 2001, fourth instar larva **a** Head capsule detail, ventral view **b** Caudal segment, ventral view **c** Epipharynx, ventral view **d** Left mandible, ventral view. Dorsal comb (DC); epipharynx (epy); fossa mandibularis (MF); hypopharynx (hyp); mandible (MD); messors (MS); ventral comb (VC). Caudal segment chaetotaxy: i, inner setae; l_1 , first lateral seta; o, outer setae. Scale bars: 0.05 mm (**a–c**), 0.01 mm (**d**).

Description of pupa. Female (Figs 3e–g, 4a–f). Habitus as male pupa (Fig. 3a). Exuviae brownish. Total length 3.14-3.91 (3.48, n = 13) mm. *Head*: Dorsal apotome (Fig. 3f) with disc surface bearing rounded small tubercle mesally, anterior margin slightly rounded, covered with stout, rounded spinules; posterior margin slightly concave, mesal portion with pair of raised areas; antenna extending posteriorly to midleg; mouthparts (Fig. 4a) with mandible well developed; palpus extending to posterolateral margin of labium; labium separated medially by labrum; apex of labrum slightly rounded; sensilla: dorsal apotomals (Fig. 3f): DA-1-H elongate, stout seta, located on rounded small tubercle, DA-2-H campaniform sensillum; DAL 0.08–0.10 (0.09, n = 10) mm;



Figure 3. *Bezzia chilensis* Spinelli & Ronderos, 2001, male pupa (**a–d**), female pupa (**e–g**) **a** Habitus, ventral view **b**, **f** Dorsal apotome, dorsal view **c**, **g** Segment 9, ventral view **d** Respiratory organ, anterodorsal view (SEM) **e** Respiratory organ ventral view. Antenna (AN); dorsal apotome sensilla (DA-1-H, DA-2-H); genital lobe (GL); pore (p); pedicel (P); respiratory organ (RO); segment 1 (1st seg.); segment 4 (4th seg.); segment 9 (Seg. 9); terminal process (TP). Scale bar: 0.05 mm.



Figure 4. *Bezzia chilensis* Spinelli & Ronderos, 2001, female pupa **a** Mouthparts, ventral view **b** Anterolateral, anteromedial and dorsal lateral sensilla, ventral view **c** Dorsal sensilla and supraalar sensillum, dorsal view **d** Metathoracics chaetotaxy, dorsal view **e** Tergite 1 chaetotaxy, dorsal view **f** Segment 4 chaetotaxy, dorsal and ventral view. Anterolateral sensillum (AL-1-T); anteromedial sensilla (AM-1-T, AM-2-T, AM-3-T); clypeal/labral sensilla (CL-1-H, CL-2-H); dorsal sensilla (D-1-T, D-2-T, D-3-T, D-4-T, D-5-T); dorsal sensilla of segment 1 (D-2-I, D-3-I, D-4-I, D-5-I, D-7-I, D-8-I, D-9-I); dorsal sensilla of segment 4 (D-2-IV, D-3-I, D-4-I, D-5-IV, D-8-IV, D-9-IV); dorsolateral cephalic sclerite sensilla (DL-1-H, DL-2-H); lateral sensilla of segment 1 (L-1-I, L-2-I, L-3-I); lateral sensilla of segment 4 (L-1-IV, L-2-IV, L-3-IV, L-4-IV); ocular sensilla (O-1-H, O-2-H, O-3-H); metathoracic sensillum (M-3-T); supraalar sensillum (SA-2-T); ventral sensilla of segment 4 (V-5-IV, V-6-IV, V-7-IV). Scale bar: 0.05 mm.

DAW 0.20–0.23 (0.22, n = 10) mm; DAW/DAL 2.24–2.64 (2.46, n = 10); two dorsolateral cephalic sclerites (Fig. 4b): DL-1-H short, stout seta, DL-2-H campaniform sensillum; clypeal/labrals (Fig. 4a): CL-1-H medium-sized thin seta CL-2-H long, thin seta; oculars (Fig. 4a): O-1-H short, stout seta, O-2-H campaniform sensillum, O-3-H long, stout seta. Cephalothorax rectangular, surface predominantly smooth with small spinules on mesonotum, between bases of respiratory organs. Length of cephalothorax 1.12-1.35 (1.22, n=13) mm, width 0.81-1.00 (0.92, n = 13) mm. Thorax: Respiratory organ (Fig. 3d, e) smooth, medium-sized, pale brown except distal 1/3 darker, about 3.05-5.70 (4.38, n = 13) times longer than broad, almost straight with rounded apex, with convoluted row of 30-35 (33, n = 13) pores closely abutting at apex and apicolateral 1/4 of respiratory organ; pedicel slender, P 0.024–0.040 (0.034, n = 13) mm; RO length 0.20–0.24 (0.22, n = 13) mm, RO width 0.04–0.08 (0.05, n = 13) mm; P/RO 0.10–0.18 (0.15, n=13); sensilla: three anteromedials (Fig. 4b): AM-1-T medium-sized, stout seta, AM-2-T long, thin seta, AM-3-T campaniform sensillum; one anterolateral (Fig. 4b): AL-1-T medium-sized, stout seta; dorsals (Fig. 4c): D-1-T, D-2-T, D-4-T, long, thin setae, D-3-T campaniform sensillum, D-5-T medium-sized, thin seta, all on small rounded tubercle; supraalar (SA-2-T) campaniform sensillum; metathoracic (Fig. 4d): M-3-T campaniform sensillum, near anterior margin of metathorax. Abdominal segments with dark spots, with simple setae, covered with very small spicules, segment 9 (Fig. 3g) approximately twice as long as wide, length 0.24–0.29 (0.27, n = 13) mm, width 0.14–0.20 (0.17, n = 13) mm; dorsal surface covered with pointed spicules; ventral surface smooth; terminal process moderately short, nearly straight, base wide, smooth, extreme tips darker, length 0.07-0.10 (0.09, n = 13) mm, width 0.03-0.04 (0.04, n = 13)mm; sensilla: tergite 1 (Fig. 4e) with two anteromesals: D-2-I medium-sized, thin seta, D-3-I long, thin seta; 5 posterior sensilla: D-4-I, D-7-I campaniform sensilla, D-5-I minute seta, D-8-I medium-sized, thin seta, D-9-I long, thin seta; 3 lateral sensilla: L-1-I long, thin seta, L-2-I, L-3-I medium-sized, thin setae; segment 4 (Fig. 4f): D-2-IV mediumsized, thin seta, D-3-IV long, thin seta, D-4-IV, D-7-IV campaniform sensilla, D-5-IV short, stout seta, D-8-IV medium-sized, stout seta, D-9-IV long, thin seta; L-1-IV short, stout seta, L-2-IV long, thin seta, L-3-IV, L-4-IV medium-sized, stout setae, all on bifid tubercles with wide base and pointed apex; V-5-IV, V-6-IV, V-7-IV medium-sized, stout setae, all on elongate tubercles; segment 9 (Fig. 3g) with D-5-IX campaniform sensillum.

Male (Fig. 3a–d). Similar to female with usual sexual differences: Total length 2.68–3.77 (n = 15) mm. Dorsal apotome (Fig. 3b) darker with anterior margin slightly triangular, DAL 0.07–0.10 (0.08, n = 12) mm; DAW 0.18–0.22 (0.19, n = 12) mm, DAW/DAL 2.0–3.0 (2.4, n = 12). Cephalothorax: length 0.97–1.17 (1.09, n = 15) mm, width 0.70–0.85 (0.77, n = 13) mm. Respiratory organ (Fig. 3d), about 3.36–4.90 (4.01, n = 15) times longer than broad, P 0.020–0.036 (0.031, n = 15) mm; RO length 0.168–0.244 (0.205, n = 15) mm, RO width 0.040–0.060 (0.051, n = 15) mm; P/RO 0.106–0.196 (0.156, n = 15). Segment 9 (Figs. 3a, c) darker, ventral surface covered anteriorly with pointed spicules, length 0.124–0.288 (0.241, n = 15) mm, width 0.120–0.248 (0.153, n = 15) mm; terminal process length 0.07–1.00 (0.08, n = 15) mm, width 0.032–0.044 (0.037, n = 15) mm; genital lobe short, each slightly longer than wide and apex anterior to base of terminal process.

Material examined. Argentina, Neuquén Province, Parque Nacional Nahuel Huapi, río Cuyín Manzano, 40°44'13"S, 71°09'17"W, alt. 760 m, 06-II-2009, A. Siri, 2 females and 1 male (with pupal exuviae). Argentina, Chubut Province, Ruta Nacional 40, arroyo La Cancha, 42°45'35.9"S, 71°06'28.4"W, alt. 860 m, 13-II-2015, adults emerged in laboratory 14-II-2015, D. Anjos-Santos and P. Pessacq, 1 female, 3 males (with pupal exuviae); same data except adult emerged 15-II-2015, 1 male (with pupal exuviae); same data except adults emerged 17-II-2015, 2 females, 1 male (with pupal exuviae); same data except adults emerged 18-II-2015, 2 females, 1 male (with pupal exuviae); same data except adults emerged 17-II-2015, 1 female, 1 male (with pupal exuviae); same data except pupa emerged in laboratory 26-II-2015, adult emerged 28-II-2015, 1 female (with larval and pupal exuviae); same data except adult emerged 03-III-2015, 1 female (with pupal exuviae); Argentina, Chubut prov., Ruta Nacional 40, arroyo Madera, 42°39'57.59"S, 71°04'19.72"W, alt 930 m, 18-II-2015, pupa emerged in laboratory 23-II-2015, adult emerged 28-II-2015, D. Anjos-Santos and P. Pessacq, 1 male (with larval and pupal exuviae); same data except pupae emerged 23-II-2015, adults emerged 02-III-2015, 2 females (with larval and pupal exuviae); same data except pupa emerged 24-II-2015, 1 male (with pupal exuviae); same data except pupa emerged 26-II-2015, 1 male (with pupal exuviae); Argentina, Chubut Province, arroyo Montoso, 42°42'01.26"S; 70°48'12.36"W, alt. 630 m, 14-I-2016, pupa emerged in laboratory 16-I-2016, D. Anjos-Santos and P. Pessacq, 1 male (with pupal exuviae); same data except pupa emerged 17-I-2016, adult emerged 21-I-2016, 1 female (with larval and pupal exuviae); same data except pupa emerged 17-I-2016, adult emerged 22-I-2016, 1 male (with larval and pupal exuviae); same data except pupa emerged 20-I-2016, adult emerged 25-I-2016, 1 male (with larval and pupal exuviae).

Material examined by SEM. Argentina, Chubut Province, Ruta Nacional 40, arroyo Madera, 42°39'57.59"S, 71°04'19.72"W, alt. 930 m, 18-II-2015, D. Anjos-Santos and P. Pessacq, 3 larvae, 1 male pupa.

Distribution. Argentina (Salta, Neuquén, Río Negro and Chubut provinces); Chile (Valparaiso Province).

Bionomics

The immature described here were collected in northwestern Argentine Patagonian steppe (Fig. 5): río Cuyín Manzano, located in the Parque Nacional Nahuel Huapi in southern Neuquén Province and arroyo La Cancha, arroyo Madera and arroyo Montoso, that flow into tributaries of the Chubut river in northern Chubut Province. All sites are surrounded by shrubby steppe, composed mainly of willow tree (Salicaceae) and grass, and are used as a water source for cattle. Immatures were collected in puddles of water with a rocky or sandy bottom, on the bank of the streams, among macrophytes (*Ceratophyllum* L.), bryophytes and filamentous algae. Larvae were distributed through all the puddles, but pupae only in the bordering vegetation. In La Cancha, Madera and Montoso streams water temperature ranged between 15–19 °C, and air temperature between 16–25 °C. In Cuyín Manzano river, the air and water temperature data were



Figure 5. Collection sites of Bezzia chilensis Spinelli & Ronderos, 2001.

not measured. Under laboratory conditions, the larvae took 4–14 days to reach the pupal stage, and 2–7 days to complete its development to the adult stage. Pupae found at the site completed their development in 1–8 days. Larvae of *Bezzia chilensis* showed the same movement reported by Spinelli et al. (2013) for *B. galesa*, alternated fast undulating movements with static periods. Pupae observed on trays showed a semi-circular, slow abdominal movement typical of other ceratopogonid pupae.

Taxonomic discussion

In a series of contributions reviewing the Neotropical *Bezzia*, Spinelli and Wirth (1989a, b, 1990, 1991) recognized the subgenus *Bezzia*, including the *gibbera*, *nobilis* and *punctipennis* groups, and the subgenus *Homobezzia* including the *dentifemur*, *glabra*, *venustula* and *brevicornis* groups. These papers also present diagnoses, descriptions and keys to subgenera and species groups, the last ones based mainly on adult characters. Spinelli et al. (2012) suggested a cladistic analysis is needed to propose a phylogenetic classification of the genus *Bezzia*.

Borkent (2014) presented a generic pupal description of *Bezzia* and in his taxonomic discussion mentioned the difficulties in diagnosing the genus and affirmed that providing a key to the species in a given region is superfluous. The current knowledge of immature stages of the Neotropical *Bezzia* is incipient. The subgenus *Bezzia* has only two species known as larvae and two known as pupae and the subgenus *Homobez*-

Subgenus	species	Head capsule ratio	Head capsule setae	Hypostoma	Fossa mandibularis	Scopae	Maxillary palpus	Hypopharyngeal fringe	Caudal segment	Reference
Bezzia	bivittata	?	?	Finely toothed	Deep	Absent	3 subapical papillae	Absent	?	Hribar and Mullen (1991)
	nobilis	2.7 times as long as wide	Medium- sized to long	Finely toothed	Deep	Absent	?	Absent	2.5 times as long as wide	Wirth (1983b)
Homobezzia	blantoni	2.6–3.4 times as long as wide	Minute	Finely toothed, not flanked by stout teeth	Shallow	Present, with 5 teeth	2–3 subapical papillae	Present	4 times as long as wide	Ronderos and Spinelli (2009)
	chilensis	2 times as long as wide	Medium- sized to long	Finely toothed flanked by 6–8 stout teeth	Deep	Absent	4 subapical papillae	Absent	2 times as long as wide	This study
	galesa	2.8 times as long as wide	Minute	Finely toothed, with strong lateral teeth	Deep	Absent	4 subapical papillae	Absent	5–6 times as long as wide	Spinelli et al. (2013)
	glabra	4 times as long as wide	?	?	?	?	?	?	10 times as long as wide	Wirth (1983a)
	roldani	3.4 times as long as wide	Minute	Finely toothed, not flanked by stout teeth	Shallow	Absent	2–3 subapical papillae	Absent	5 times as long as wide	Ronderos et al. (2007)

Table 1. Main diagnostic characters for the known larvae of Neotropical species of Bezzia.

zia has five known as larvae and 10 known as pupae, with some of these immatures being poorly described and impossible to compare with their congenerics. Main diagnostic characters for larvae and pupae are given in the Tables 1 and 2, respectively.

The immatures of *Bezzia chilensis* are herein compared with four species belonging to the subgenus *Homobezzia*; these four are the only ones which have a complete description: *B. blantoni* (described by Ronderos and Spinelli 2009), *B. galesa* (described by Spinelli et al. 2013), *B. roldani* (described by Ronderos et al. 2007) and *B. ventanensis* (described by Spinelli et al. 2012).

The larva of *Bezzia chilensis* shares with *B. blantoni*, *B. galesa* and *B. roldani* features typical of predatory larvae: hooked mandibles with fossa mandibularis, epipharynx less massive with 2 combs and cylindrical maxillary palpus (Hribar and Mullen 1991). The labrum and palatum sensilla are very similar among the species. However, the larvae of these three species can be distinguished from *B. chilensis* by the features given in Table 1 and by the following additional characters: *Bezzia blantoni* by the maxilla with a blunt sensillum, epipharynx with 4–6 stout, short teeth and auxiliary sclerite shorter; *Bezzia galesa* by the maxilla with a blunt sensillum, galeolacinia with a stout, sharp, pointed and medium-sized seta, epipharynx with 6 or 7 stout and small teeth on the ventral comb; and *Bezzia roldani* by the W-shaped palatal bar and the ventral comb of the epipharynx bearing 4 or 5 stout and short teeth. The larva of *B. ventanensis* remains unknown.

With regard to the pupa, besides the features given in Table 2, these four species can be distinguished from *B. chilensis* as follows: *B. blantoni*: O-2-H absent, AL-2-T present; *B. galesa*: D-5-T, D-7-I and D-7-IV absent; *Bezzia roldani* O-2-H and V-5-IV absent; *Bezzia ventanensis* AM-3-T absent.

Subgenus	Species	Dorsal apotomals sensilla	Dorsolateral cephalic sclerite sensilla	Clypeal/labral sensilla	Oculars sensilla	Respiratory organ apex	Respiratory organ pores	Sensillum D-7-IV	Terminal process of segment 9	References
Bezzia	nobilis	1 seta, 2 campaniform	3 setae	2 setae	1 seta, 1 campaniform	Rounded	16–25 on distal 1/4	Present	Short	Borkent (2014); Wirth (1983b)
	gibbera	1 seta, 1 campaniform	۰.	۰.	۸.	۰.	~·	۰.	۰.	Borkent (2014)
Homobezzia	blantoni	1 seta, 2 campaniform	1 seta	2 setae	2 setae	Rounded	31–35 on distal apex	Absent	Long	Ronderos and Spinelli (2009); Spinelli and Wirth (1989)
	brevicornis	1 seta, 1 campaniform	<u>~</u> .	A.	۰.	Asymmetrical (outer side curved, inner side straight)	23–25 on distal 1/3	۰.	Short	Spinelli and Wirth (1989)
	bromeliae	1 seta	۰.	۰.	۰.	Asymmetrical (outer side curved, inner side straight)	4 on distal apex	۰.	Short	Spinelli and Wirth (1991)
	chilensis	1 seta, 1 campaniform	1 seta, 1 campaniform	2 setae	2 setae, 1 campaniform	Rounded	31–41 on distal apex and apicolateral 1/4	Present	Short	This study
	galesa	1 seta, 2 campaniform	l seta	2 setae	2 setae, 1 campaniform	Rounded	50–60 on distal apex, 10–11 lateral ones	Absent	Long	Spinelli et al. (2013)
	glabra	1 seta, 2 campaniform	۸.	۰.	۰.	Rounded	50–60 on distal 1/3	<i>.</i>	Long	Wirth (1983a)
	pulchripes	1 seta, 2 campaniform	۸.	۰.	۰.	Bilobed	40–52 on distal apex	Absent	Long	Mayer (1959)
	roldani	1 seta, 2 campaniform	2 setae	2–3 setae	2 setae	Rounded	50–60 on distal 1/3	Absent	Long	Ronderos et al. (2007); Spinelli and Wirth (1989)
	imous	1 seta, 1 campaniform	۰.	۰.	۰.	Rounded	1 1–12 on distal 1/4	۸.	Short	Spinelli and Wirth (1991)
	ventanensis	1 seta, 1 campaniform	2 setae	2 setae	1 seta, 1 campaniform	Asymmetrical (outer side curved, inner side straiohr)	13–15 on distal 1/3	Absent	Short	Spinelli et al. (2012)

Table 2. Main diagnostic characters for the known pupae of Neotropical species of Bezzia.

In addition, a detailed revision during this study revealed that D-4-T of *B. galesa* is a seta and was erroneously described as campaniform sensillum by Spinelli et al. (2013) and D-5-T and D-8-I of *B. ventanensis* described by Spinelli et al. (2012) as campaniform sensilla are long, a thin seta and a medium-sized seta, respectively.

The pupae of *Bezzia chilensis* and the other Neotropical known pupae of *Bezzia* share the features of the generic description given by Borkent (2014). However, we agree on the need of a revision of the genus within a phylogenetic analysis and the redescription of the incompletely described immatures, emphasizing as well the importance of describing immatures for a better knowledge of the genus.

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A new species of Austrocodrus Ogloblin (Hymenoptera, Proctotrupidae, Austroserphinae), a Gondwanic relict from southernmost South America

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Abstract

Austrocodrus gladiogeminus **sp. n.** is described from southernmost South America. It is a member of the primitive subfamily Austroserphinae (Hymenoptera, Proctotrupidae), which is distributed in Oceania and South America, and is characterized from other *Austrocodrus* species by its relatively larger body size, the presence of long and sword-shaped ovipositor sheaths, M arising very close and distal to 1cu-a, and Cu and m-cu joining at a distance equivalent to the length of 2cu-a. We consider this species to be a Gondwanan relict. It has southernmost distribution of any proctotrupid.

Keywords

Chile, endemism, morphology, Patagonia, Subantarctic Forest, taxonomy

Introduction

The parasitic wasp family Proctotrupidae includes about 600 species and 30 genera in two subfamilies: Proctotrupinae and Austroserphinae (= Acanthoserphinae; Townes and Townes 1981). These subfamilies show a strong imbalance in their diversity. The subfamily Austroserphinae, from continental Australia, New Guinea, Tasmania, and southern South America, has three genera with four species, but Proctotrupinae has cosmopolitan distribution and the vast majority part of the family's diversity (Townes and Townes 1981; Johnson 1992). The first described species of Austroserphinae was Acanthoserphus albicoxa (Dodd 1915), which was described from material collected in Queensland, Australia, and subsequently, Masner in Townes and Townes (1981) described Acanthoserphus bidens from Papua New Guinea. Dodd (1933) also described Austroserphus albofasciatus, in a new genus, from material collected in Victoria, Australia. In his revision of Australian proctotrupids, Riek (1955) reported new records for Austroserphus albofasciatus from Tasmania. Ogloblin (1960) described the only South American species known to the date for the subfamily, Austrocodrus patagonicus. Austrocodrus was originally placed as a subgenus of Austroserphus but later raised to the status of genus by Townes and Townes (1981). Ogloblin (1960) described A. patagonicus based on specimens collected at Estación Forestal de Pucará, near Lago Lácar, Neuquén, Argentina (40°10'S, 71°27'W). In a revision of material from southernmost Chilean Patagonia, roughly 1700 km south of the type locality of A. patagonicus, one specimen belonging to the genus Austrocodrus was collected which could not be ascribed to A. patagonicus. Based on this material, we describe a second species of Austrocodrus, which is the southernmost known proctotrupid.

Material and methods

The material examined is deposited in the Museo de Zoología de la Universidad de Concepción, Concepción, Chile (MZUCCC 45974). Photographs were made with a Nikon SMZ 745T stereomicroscope and a Nikon D5100 camera using a NII-LED Nikon illuminator. Individual images were stacked with Zerene Stacker Software (2017). The habitus photograph was taken with an AF-S Micro Nikkor 105 mm 1:2.8 G ED lens, and illuminated with Nikon Speedlight SB-800.

The morphological terms and characters follow Townes and Townes (1981), Yoder et al. (2010), and the system of Comstock and Needham (1918) for wing veins and cells and Mason (1986) for vein types. Comparisons between *Austrocodrus gladiogeminus* sp. nov. and *A. patagonicus* were made by reviewing Ogloblin's (1960) original description, the comments by Townes and Townes (1981), and photographs available at the Proctotrupidae (Hymenoptera) of the World web page (http://proctotrupidae. myspecies.info/taxonomy/term/16), which is managed by Dr Victor Kolyada.

Results

Family Proctotrupidae Latreille, 1802 Subfamily Austroserphinae Dodd, 1915 Genus *Austrocodrus* Ogloblin, 1960

Austrocodrus gladiogeminus sp. n. http://zoobank.org/4BE0E7D9-63B5-4A79-AF29-C90DD8B43287 Figures 1, 2

Type locality. Chile, Magallanes y de la Antártica Chilena Region, Antártica Chilena Province, Cabo de Hornos County, Puerto Williams City, Parque Etnobotánico Omora (54°56'38"S, 67°39'25"W).

Type material. Holotype: 1 \bigcirc , from the type locality, February 2003. leg. A. Zúńiga. (MZUCCC 45974)

Description. Female. Fore wing length 5.84 mm.

Head. Frons with dense pilosity; ocelli globular, translucent. Area between toruli with a marked "Y" shaped carina; the arms of the Y are strongly projected anteriorly. Distance between toruli 0.5 × their diameter (Fig. 2A). Occipital carina absent. Postoccipital carina visible. Maxillary palpus with 4 segments; 2 distalmost segments very elongated. Labial palpus very short, 3-segmented. Mandibles small, not touching each other. Labrum extremely reduced, triangular. Clypeus sharply convex, triangular. Gena in frontal view equal to eye height, strongly excavated to give head a triangular appearance. Scape with conspicuous apical spine, 2× pedicel length. Antenna long, filiform, with 11 antennomeres. The first 2 antennomeres > 10 × as long as wide (Fig. 2C). Eye bare, globular.

Mesosoma. Pronotum dorsally occluded by mesoscutum and not visible in dorsal view. Epomium strong, which are connected dorsally by carina. First anterodorsal portion of pronotum shiny, smooth, the remainder strongly reticulated, sparsely pilose. Mesoscutum with notauli narrow, deep, originating from the anterior margin not reaching mesoscutellum. Groove in front of mesoscutellum with 7 foveae (Fig. 2D). Scutellum 1.3 × as wide as long, with glabrous center. Axillae deep, sculptured. Metanotum well developed, $1.2 \times as$ long as mesoscutellum, with median section elevated and subtriangular. Axillary trough of metanotum sculptured. Wings hyaline, pilose, with the major part of veins tubular. Anterior portion of M nebulous. Also, M arising close and apical to 1cu-a. Cu and m-cu joining at a distance equal to the length of 2cu-a (Fig. 2B). Propodeum with a short distinct transverse carina on the anterior margin which connects with irregular lateral longitudinal carinae. Petiolar area separated from dorsal propodeum by a strong transverse carina, laterally delimited with low developed apophysis. Propodeum strongly reticulate, pilose and with a raised bare lateral area. Propodeal spiracle elongated, declined 15° from a transverse plane tangent to its ventral end. Propleura flat and strongly pilose. Mesopleuron with prepectus sparsely rugulose and pilose. Prepectal area separated from central mesopleuron by a foveate groove.



Figure 1. Austrocodrus gladiogeminus sp. n. Habitus of female. Holotype MZUCCC 45974.



Figure 2. Relevant traits to characterize *Austrocodrus gladiogeminus* sp. n. **A** Head in frontal view showing the "Y" shaped carina between toruli and the triangular outline of the head **B** Fore wing, showing the venation pattern **C** Lateral view showing details from the scape with an apical and conspicuous spine, and the pronotal epomium **D** Dorsal view of mesosoma showing the groove in front of mesoscutellum with 7 foveae.

Central mesopleuron swollen, bare and shiny. Mesopleural suture anteriorly foveate with similar size foveae. Mesepisternum narrow and bare. Mesosternum slightly swollen, strongly pilose. Mesepimeron and mesosternum separated anteriorly by delicate carina anteriorly. Petiole present, with longitudinal wrinkles, 0.3 as long as high.

Metasoma. Gaster anteriorly swollen, tapering very strongly to apically. Single synterguite visible with translucent lateral margins. Ovipositor sheaths 2× as long as metasoma and sword-shaped. Ovipositor without apical notch, pointed, only 10% exposed.

Male. Unknown.

Distribution, habitat and behavior. The type locality of *A. gladiogeminus* sp. nov. is on the northern coast of Isla Navarino, in the glacially fragmented landscape of southernmost Chile, and lies within the Magellanic Forest biogeographical province in the Subantarctic subregion of the Andean region (sensu Morrone 2015). The new species was collected from a Subantarctic *Nothofagus* forest, dominated by *Nothofagus pumilio* (Poepp. & Endl.) Reiche, and came from a microhabitat of open mixed forest with old and young *N. pumilio* trees. The specimen was collected with a net while flying during an afternoon of the austral summer.

Etymology. The epithet *gladiogeminus* refers to the exceptionally sword-shaped ovipositor sheaths. It is a composition from the Latin noun "gladius", a sword, the basic weapon of Roman legionnaires after the Punic Wars, and the adjective "geminus", double or paired.

Remarks. Austrocodrus gladiogeminus sp. nov. is the first record of an austroserphine from Chile, and only the second record of the subfamily from South America. Other than the two species of Austrocodrus, all other species of the subfamily are distributed in Australia and few southern Pacific islands, which suggests that Austrocodrus is a relict of the past connection between these land masses. Additionally, A. gladiogeminus sp. nov. has the southernmost distribution of any proctotrupid, reaching almost the 55°S.

The body size of the holotype, with a fore wing length of 5.84 mm, might be the largest among species of the subfamily; the forewing length of *A. patagonicus* is about 3.7 mm, in species of *Acanthoserphus*, between 3.1 and 3.7 mm, and in *Austroserphus* between 5.3 and 5.8 mm. Additionally, we find that the venation pattern of the genus *Austrocodrus* is not so similar to that of *Acanthoserphus* (sensu Townes and Townes 1981). The relative position of M basal to 1cu-a in *Acanthoserphus* and *Austroserphus* allows differentiating these genera from *Austrocodrus*, which has 1cu-a basal to M.

We provide a key to species of the genus *Austrocodrus* (Ogloblin 1960):

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