

Three new species of the *Rhagovelia borneensis* group (Hemiptera: Veliidae) from Borneo

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Abstract

The ten hitherto described species of the *Rhagovelia borneensis* group are distributed in the Greater Sunda Islands and the Philippines, but the majority are endemic to the island of Borneo. In fact, the river systems of Borneo are inhabited by many regionally endemic species, whose number presently cannot even be estimated. In this paper, we describe three new species, *Rhagovelia basiflava* sp.n. from Kalimantan Timur and Sarawak, *R. ibana* sp.n. from Sarawak and Kalimantan Selatan, and *R. muluana* sp.n. from Sarawak. Together with *R. incognita* POLHEMUS & POLHEMUS, 1988 they form the new *R. incognita* complex, based on an entirely black first antennomere, a blackish mesocoxa, and the lack of black spicula on juga. Within the *R. borneensis* group, the latter character is almost exclusive to these four species.

Key words. Gerromorpha, Veliidae, *Rhagovelia borneensis* group, taxonomy, new species, Southeast Asia.

Zusammenfassung

Die zehn bisher beschriebenen Arten der *Rhagovelia borneensis*-Gruppe sind auf den Großen Sunda-Inseln und auf den Philippinen verbreitet; die Mehrheit lebt jedoch endemisch auf der Insel Borneo. Tatsächlich sind die Flusssysteme Borneos von einer Vielzahl regional-endemischer Arten besiedelt, deren Zahl bei derzeitigem Kenntnisstand noch nicht abgeschätzt werden kann. Hier beschreiben wir drei Arten als neu, *Rhagovelia basiflava* sp.n. aus Kalimantan Timur und Sarawak, *R. ibana* sp.n. aus Sarawak und Kalimantan Selatan sowie *R. muluana* sp.n. aus Sarawak. Sie bilden gemeinsam mit *R. incognita* POLHEMUS & POLHEMUS, 1988 anhand folgender Merkmale den neuen *R. incognita*-Komplex: 1. Antennenglied zur Gänze schwarz, Mesocoxa schwärzlich und Juga ohne schwarze Spicula. Innerhalb der *R. borneensis*-Gruppe ist letzteres Merkmal fast exklusiv bei diesen vier Arten vertreten.

Introduction

The approximately 400 described species of *Rhagovelia* MAYR, 1865 are common inhabitants of tropical streams. Although the genus has a circumtropical distribution, the areas of the individual species are often narrowly restricted. The Sunda Archipelago, the Philippines, and New Guinea area are extremely diverse, with a high rate of island endemics (e.g., POLHEMUS & POLHEMUS 1988, LANSBURY 1993, NIESER & CHEN 1993, ZETTEL 1995, NIESER et al. 1997, ZETTEL et al. 2020, ZETTEL & LACINY 2024). For example, of the species known from Borneo, only two species were reported from surrounding areas (POLHEMUS & POLHEMUS 1988).

The *Rhagovelia borneensis* group was erected by POLHEMUS & POLHEMUS (1988) and is almost entirely restricted to Borneo. Seven endemic species were described from this island: *Rhagovelia borneensis* POLHEMUS & POLHEMUS, 1988, *R. incognita* POLHEMUS & POLHEMUS, 1988, *R. melanopsis* POLHEMUS & POLHEMUS, 1988, *R. ranau* POLHEMUS & POLHEMUS, 1988, *R. silau* POLHEMUS & POLHEMUS, 1988, *R. simulata* POLHEMUS & POLHEMUS, 1988, and *R. tawau* POLHEMUS & POLHEMUS, 1988. POLHEMUS & POLHEMUS (1988) also included *R. lugubris* LUNDBLAD, 1933 from Java and Sumatra, Indonesia, and an undescribed species from Palawan, Philippines, which was later described as *R. lansburyi* ZETTEL, 1995. The relationship of the latter species – with a very aberrant habitus – subsequently became a matter of discussion. While ZETTEL (1995) placed it in the *R. caesia* group, considering the strong sexual dimorphism with phoretic males, it was later placed in its own group (*R. lansburyi* group: ZETTEL 2003, ZETTEL et al. 2020). Only the knowledge of another, more recently discovered and still undescribed species from Palawan (unpublished material), taking a morphologically intermediate position between *R. lansburyi* and *R. borneensis*, supports the original thesis by POLHEMUS & POLHEMUS (1988) that these species belong to the same clade. Another, typical species of the *Rhagovelia borneensis* group, *R. fischeri* ZETTEL, 1999, was discovered on Luzon Island (ZETTEL 1999). No further species were described during the past quarter of a century.

Material and methods

Specimens are dry mounted on squared paper cards. They were originally deposited in the Natural History Museum Vienna (NHMW) and in the first author's collection (ZCW). Some type specimens were transferred from CZW to NHMW, and some paratypes of NHMW will be given to the Lee Kong Chian Natural History Museum, National University of Singapore (LKCNCNHM) on an exchange base.

Stacked digital images were created with a Keyence VHX-7000 Digital Microscope and processed with Adobe Photoshop 2025. All photos were taken by the second author for the NHMW Hemiptera Image Collection.

For verbal descriptions and measurements of paratypes, a Leica Wild M10 binocular microscope (max. 128× magnification) was used. Measurements of holotypes were performed with a Nikon SMZ1500 binocular microscope at magnifications from 51.2× to 256×.

Measurements refer to the maximum length or width of the respective structure and were taken in dorsal or lateral view of card-mounted specimens. All measurements are given in millimetres. Width of metafemur does not include length of spines.

Terminology largely follows POLHEMUS & POLHEMUS (1988) and subsequent publications on the taxonomy of Oriental *Rhagovelia* (see also ZETTEL & LACINY 2024).

Taxonomy

The *Rhagovelia borneensis* group

Diagnosis (expanded from POLHEMUS & POLHEMUS 1988). Body medium-sized (body length 2.3–3.5 mm, usually above 2.5 mm), mostly stocky species (e.g., Figs 6, 10). Body black, except a transverse orange or brown stripe anteriorly on pronotum; legs and often antennae partly yellow. Pilosity in most species rich, dorsally and laterally with many long black setae, especially in males. Pronotum of apterous morph short, mid-length along

midline usually subequally long or shorter than eye, and one third to three fifths as long as mesonotum. Forewing (in some species unknown) usually with only two closed cells in basal third. Metatibia straight, usually denticulate in both sexes (e.g., Figs 1, 5). Paired abdominal carinae of macropterous morph reaching posterior margin of mediotergite 3 or base of mediotergite 4. – Male. Metafemur with (dense) basal row of teeth in most species (lacking in *R. lansburyi* from Palawan Island and reduced in *R. ibana* sp.n.) and a usually prominent posterior distal row, while the anterior distal row is reduced or absent. Sternum 7 modified, with paired hair tufts or tumescences (e.g., Figs 3, 8, 11) (except in *R. incognita*). Proctiger with a sharply delimited hairy distal section (Fig. 9). Parameres usually broad and apically hooked (e.g., Fig. 4). – Females of most species broad and short (e.g., Fig. 10), rarely more slender (Fig. 5), without significant modifications of abdomen. Mediotergite 8 directed posteriad. Gonocoxa not retracted in sternum 7.

Notes. The species of the *R. borneensis* group are very similar to each other, and often their slight structural differences cannot be properly used to propose closer relationships among species. In the past (POLHEMUS & POLHEMUS 1988), colour characters of legs were frequently used for species identification.

The *Rhagovelia incognita* complex (new)

Diagnosis. Antennomere 1 entirely black (also at base) (Figs 1, 6, 11, 16). Mesocoxa black or dark brown (Figs 3, 8, 12, 17), (not yellow or brownish yellow). Jugal without black spicula (Figs 2, 7, 12, 16). Anterior distal row of teeth on metafemur absent.

Notes. While the colour of antennae and legs often shows variations in other species, this is not the case in this group. The presence or absence of spicula on jugs is often a diagnostic character of other species groups or subgroups of *Rhagovelia*. Their absence suggests a close relationship of the four species treated in this paper. However, according to POLHEMUS & POLHEMUS (1988) this character is variable in one species (*R. borneensis*).

Key to species of the *Rhagovelia incognita* complex (apterous specimens)

- 1 Antennomere 1 entirely black. Jugum without spicula. **2**
- Antennomere 1 with yellow base or entirely yellow. Jugum usually with spicula. ... **other species**
- 2 Metafemur with yellow base (Figs 1, 5). Hind margin of pronotum convex. ***R. basiflava* sp.n.**
- Metafemur entirely black. Hind margin of pronotum straight (e.g., Fig. 6). **3**
- 3 Basal row of teeth on metafemur of male strongly reduced, consisting of 0–3 minute granules (0 in Fig. 8). In apterous female, all mediotergites with long standing setae. ***R. ibana* sp.n.**
- Basal row of teeth on metafemur of male distinct, consisting of 5 or more distinct granules (Fig. 13). In apterous female, mediotergites 5–7 bare or with short standing setae at hind margin. **4**
- 4 Basal row of teeth on metafemur of male sparse (Fig. 13). In apterous female, abdomen slightly slenderer (Fig. 15) and mediotergites with longer standing setae at hind margin. ***R. muluana* sp.n.**
- Basal row of teeth on metafemur of male dense (POLHEMUS & POLHEMUS 1988: fig. 60), but difficult to see between pilosity (Fig. 17). In apterous female, abdomen slightly wider (Fig. 18) and mediotergites with shorter standing setae. ***R. incognita***



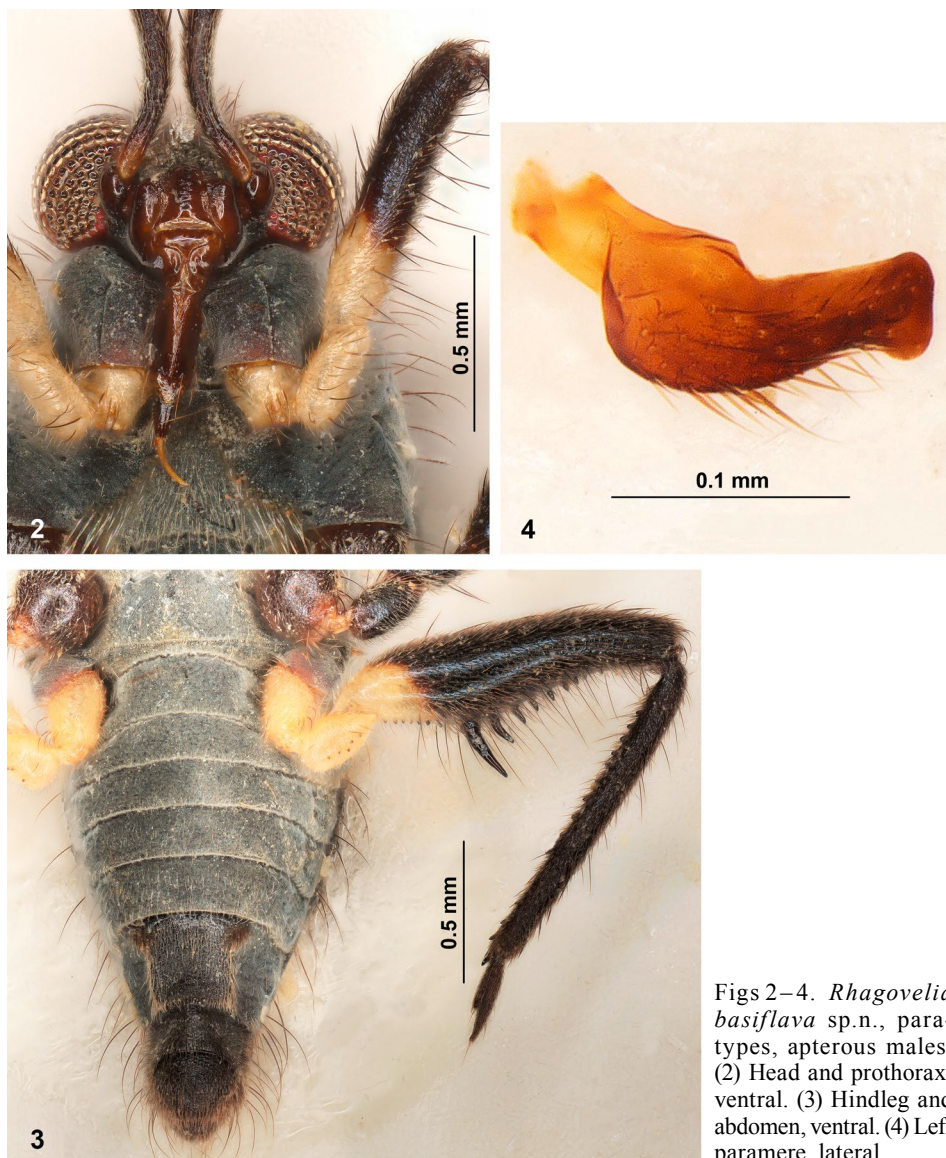
Fig. 1. *Rhagovelia basiflava* sp.n., habitus of apterous male (holotype), dorsal.

***Rhagovelia basiflava* sp.n. (Figs 1–5)**

Type material. Holotype (apterous male, NHMW): Indonesia, Kalimantan, Apokayan, Nurai Dian, Sungai Barang, 850 m a.s.l., 29.VII.1998, leg. P. Mazzoldi (#9). Paratypes (NHMW, ZCW, LKCNHM): 11 ♂♂, 8 ♀♀ (apterous), with same locality data as holotype; 2 ♂♂, 2 ♀♀ (apterous), same locality, except site #10a; 3 ♀♀, 5 ♂♂ (apterous), Malaysia, Sarawak, ca. 40 km SE Kapit, III.1994, leg. J. Kodada.

Apterous male (Fig. 1). Measurements of holotype: body length, 2.88. Head width, 0.78. Pronotum width, 0.88. Mesonotum width, 0.91. Length of antennomeres I–IV, 0.72, 0.37, 0.44, 0.44. Length of leg segments: profemur, 0.75, protibia, 0.91; protarsus (combined), 0.25; mesofemur, 1.44, mesotibia, 1.19, mesotarsus (combined), 1.16; metafemur, 1.06, metatibia 1.09, metatarsus (combined), 0.06. Measurements of paratypes (n = 10): body length, 2.8–3.1; mesonotum width, 0.89–1.00.

Colour. Black; pronotum with orange transverse stripe. On legs, pro- and metacoxa, pro- and metatrochanter, ca. basal fourth of profemur, and base of metafemur yellow. Rostrum brown.



Figs 2–4. *Rhagovelia basiflava* sp.n., paratypes, apterous males. (2) Head and prothorax, ventral. (3) Hindleg and abdomen, ventral. (4) Left paramere, lateral.

Structures. Jugal and proepisterna without black spicula (Fig. 2). Pronotum slightly extended, with convex hind margin, at midline 0.8 times as long as eye and 0.6 times as long as mesonotum. Sides of pronotum at hind margin with a row of fine pits, meso- and metapleuron with few very small punctures. Meso- and metacoxa without black spicula. Metatrochanter with ca. 3–7 small, black granules (Fig. 3). Hindleg of holotype: Metafemur wide, 3.4 times as long as wide; basal row consisting of 7–8 short, black teeth; posterior distal row consisting of 8–9 teeth that strongly decrease in length; anterior distal row lacking. Metatibia straight, at flexor side with regular, acute dentition, with apical



Fig. 5. *Rhagovelia basiflava* sp.n., habitus of apterous female (paratype), dorsal.

tooth. Paratypes (Fig. 3): Metafemur 3.4–3.9 times as long as wide; basal row consisting of 7–10 short teeth, posterior distal row consisting of 7–9 teeth. Laterotergites laterally rising. Mediotergite 5 about 2.7 times as wide as long; mediotergite 7 about 1.6 times as long as sixth and 0.9 times as long as wide at posterior margin. All mediotergites and laterotergites with numerous long, standing setae. Sterna 2–6 with inconspicuous pilosity, 2 and 3 medially strongly convex, 4–6 less convex. Sternum 7 with a pair of small but well-defined tubercles that bear a dense brown pilosity; a straight edge reaching from tubercle to hind margin. Space between these edges flat and sparsely pilose (Fig. 3). Paramere directed caudad, distal part relatively short, with a weak and blunt, ventrally curved hook; apex blunt (Fig. 4). Proctiger slender, with poorly developed lateral lobes; hairy distal part sharply delimited.

Apterous female (Fig. 5). Measurements of paratypes ($n = 10$): Body length, 2.8–3.1; mesonotum width, 1.00–1.11. Colour as in male.

Structures. Metatrochanter without black spinules. Metafemur more slender than in male, 4.1–4.5 times as long as wide, posterior distal row consisting of 5–7 teeth; basal row absent. Metatibia sharply dentate. Abdomen relatively slender. Connexival margin almost straightly convergent from base to apex; posterior sterna narrowly visible in dorsal view (Fig. 5). Laterotergites evenly and moderately raised (horizontal in females with more parallel connexival margins). Apex of connexival margin with small, acute tip, bearing a tuft of black setae. Mediotergites 1–4 slightly convex, 5–8 flat. Mediotergites 1–4 and 8 with sparse, short and fine pilosity, mediotergites 5–7 bare or with widely dispersed short hairs; mediotergite 1 (or also 2 and 3) with transverse rows of setae of different length (quite variable). Laterotergite 2 with rich pilosity. Connexival margin with row of setae (length variable), on segment 6 without modification, also without dense pilosity. Mediotergite 5 about 2.4 times as long wide; mediotergite 7 about 1.1 times as long as wide and 1.3 times as long as mediotergite 6; mediotergite 8 directed caudad, wider than long (Fig. 5). Sterna without modifications. Gonocoxa weakly convex, bearing fine, yellow pilosity.

Macropterous morphs. Unknown.

Comparative notes. The pronotum of *R. basiflava* sp.n. (Figs 1, 5) is slightly extended and shows a more convex hind margin than in other species of the *R. borneensis* group, but less than in the two species of the *R. problematica* group (compare ZETTEL 2006). However, the morphological definition of the *R. problematica* group is incomplete as long as macropterous specimens are unknown. In both sexes of *R. basiflava* sp.n. the base of the metafemur is yellow, which easily distinguishes *R. basiflava* sp.n. from all other species with black first antennomere. The paramere is relatively short and weakly curved (Fig. 4). In females, the abdomen (Fig. 5) is more slender than in *R. muluana* sp.n. and *R. ibana* sp.n., and raised setae are restricted to mediotergites 1–3. Specimens from Sarawak, especially males, are smaller and more slender than those from Kalimantan, and also possess more slender metafemora (in both sexes). Minute differences exist also in the shape of the paramere and in the length of pilosity on medio- and laterotergites of females. Chiefly because some variability of the mentioned characters was also observed within populations, a taxonomic splitting of these two populations was rejected.

Distribution. *Rhagovelia basiflava* sp.n. has been found in the Apokayan area in Kalimantan Utara and in Sarawak southeast of Kapit.

Etymology. The species epithet refers to the yellow base of the metafemur.

***Rhagovelia ibana* sp.n. (Figs 6–10)**

Type material. Holotype (apterous male, NHMW): Malaysia, Sarawak, Batang Ai, Engkari River east of Bandar Sri Aman, ca. 15 m wide, rapidly flowing stream, 19–20.II.1993, leg. H. Zettel (#7a). Paratypes (NHMW, ZCW, LKCNHM): 1 ♂, 4 ♀♀ (apterous), with same locality data as holotype; 4 ♂♂, 1 ♀ (apterous), Malaysia, Sarawak, 20 km west of Kuching, Gunung Serapi (ca. N 1°36', E 110°12'), ca. 10–15 m wide stream with boulders, 6.III.1993, leg. H. Zettel (#15a); 8 ♂♂, 16 ♀♀ (apterous), 1 ♀ (macropterous), Malaysia, Sarawak, 80 km S Kuching, Gunung Penrissen ca. N 1°07', E 110°13'), 18.II.1993, leg. H. Zettel (#4); 2 ♂♂, 3 ♀♀ (apterous), Malaysia, Sarawak, ca 40 km SE Kapit, III.1994, leg. J. Kodada. Indonesia: 8 ♂♂, 11 ♀♀ (apterous), Kalimantan Utara, Apokayan, Lidung Payau, Sungan River, 720 m a.s.l., 29.XII.1997, leg. P. Mazzoldi; 1 ♂, 6 ♀♀ (apterous), Kalimantan Utara, Apokayan, Long Ampung, Kayan River, 600 m a.s.l., 4.I.1998, leg. P. Mazzoldi; 8 ♂♂, 8 ♀♀ (apterous), 3 ♂♂, 1 ♀ (macropterous, fully winged), Kalimantan Utara, Apokayan, Lidung Payau, Kayan River, 700 m a.s.l., 25.VII.1998, leg. P. Mazzoldi (#1); 2 ♀♀ (apterous), Kalimantan Utara, Apokayan, Lidung Payau, Jincang River, 750 m a.s.l., 29.VII.1998, leg.

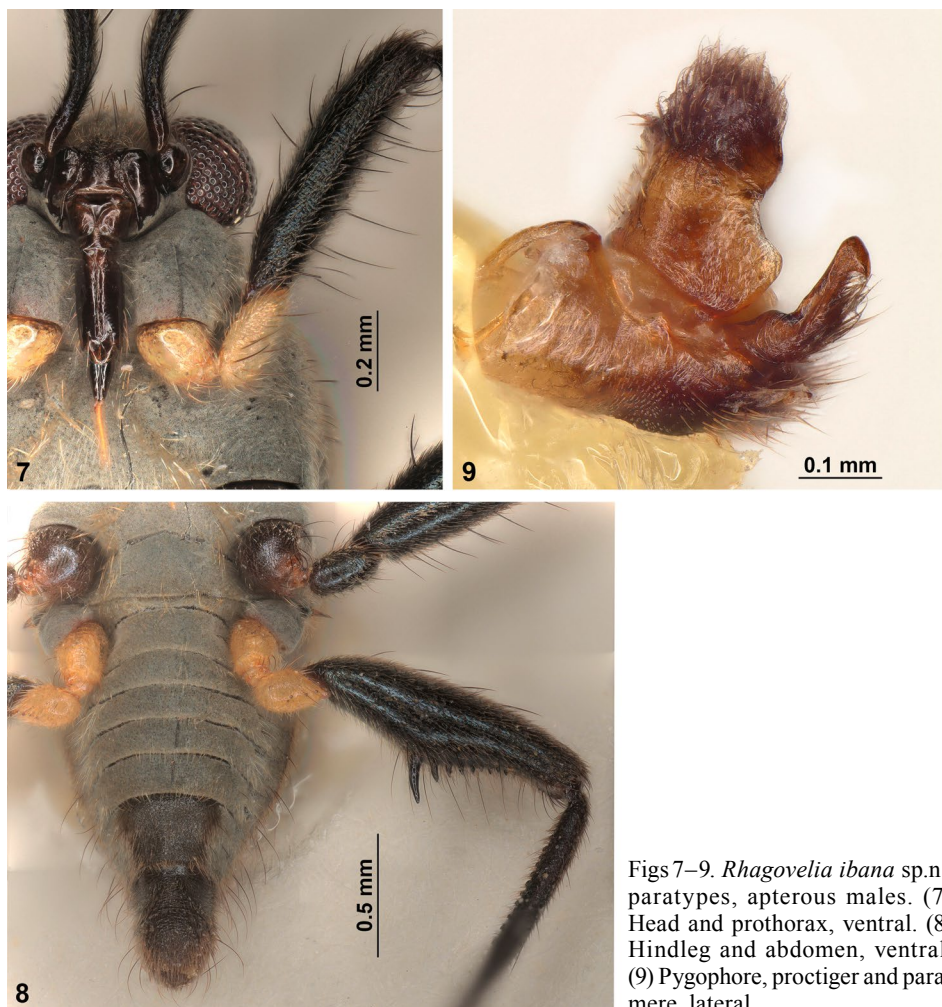


Fig. 6. *Rhagovelia ibana* sp.n., habitus of apterous male (holotype), dorsal.

P. Mazzoldi (#4); 1 ♂, 1 ♀ (apterous), Kalimantan Utara, Apokayan, Nurai Diam, Sungai Barang, 850 m a.s.l., 27.VII.1998, leg. *P. Mazzoldi* (#9); 10 ♂♂, 7 ♀♀ (apterous), 1 ♂, 2 ♀♀ (macropterous, dealate), Kalimantan Utara, Apokayan, Danum River, Sungai Barang, 31.VII.1998, leg. *P. Mazzoldi* (#15); 2 ♂♂, 2 ♀♀ (apterous), Kalimantan Selatan, Meratus Mountains, Loksado, Sungai Tanuhi, 31.XII.2000, leg. *P. Mazzoldi*; 3 ♂♂, 6 ♀♀ (apterous), Kalimantan Selatan, Meratus Mountains, Loksado, Sungai Loksado, 250 m a.s.l., 26.XII.2000, leg. *P. Mazzoldi*.

Apterous male (Fig. 6). Measurements of holotype: body length, 2.69. Head width, 0.75. Pronotum width, 0.84. Mesonotum width, 0.97. Length of antennomeres I–IV, 0.77, 0.40, 0.46, 0.49. Length of leg segments: profemur, 0.88, protibia, 0.94; protarsus (combined), 0.28; mesofemur, 1.41, mesotibia, 1.06, mesotarsus (combined), 1.13; metafemur, 1.16, metatibia, 1.16, metatarsus (combined) 0.07. Measurements of paratypes (n = 10): body length, 2.6–2.8; mesonotum width, 1.00–1.03.

Colour. Black; pronotum with orange transverse stripe. On legs, pro- and metacoxa, pro- and metatrochanter yellow. Rostrum brownish.



Figs 7–9. *Rhagovelia ibana* sp.n., paratypes, apterous males. (7) Head and prothorax, ventral. (8) Hindleg and abdomen, ventral. (9) Pygophore, proctiger and paramere, lateral.

Structures. Jugal and propodeum without black spicula (Fig. 7). Pronotum short, at midline 0.75 times as long as eye and 0.35 times as long as mesonotum. Sides of pronotum at hind margin with a row of pits; meso- and metapleuron with few very small punctures. Coxae without black spicula. Metatrochanter with ca. 1–5 black granules (Fig. 7). Hindleg of holotype: metafemur moderately wide, in holotype 3.5 times as long as wide; basal row lacking; posterior distal row consisting of 11–12 teeth that strongly decrease in length. Metatibia hardly curved, at flexor side distinctly dentate, basally more bluntly and densely than distally; apically with terminal tooth. Paratypes (Fig. 8): metafemur 3.5–3.8 times as long as wide; in some specimens, basal row weakly indicated, consisting of 1–2 small granules; posterior distal row consisting of 9–12 teeth. Laterotergites steeply rising. Mediotergite 5 about 3.5 times as wide as long; mediotergite 7 about 1.8 times as long as sixth and 0.9 times as long as wide at posterior margin. All mediotergites and laterotergites with numerous long, standing setae. Sterna 3–6 slightly convex, 2 slightly more convex,



Fig. 10. *Rhagovelia ibana* sp.n., habitus of apterous female (paratype), dorsal.

but without carina; sterna 2–6 with distinct, semi-erect pilosity of medium length. Sternum 7 weakly modified, anteriorly with a pair of small, shiny, hardly elevated swellings bearing yellow pilosity; space between swellings convex and medially bluntly carinate (Fig. 8). Paramere directed caudad, distally slender, with a ventrally curved hook, apically rounded (Fig. 9). Proctiger slender, with poorly developed lateral lobes; hairy distal part sharply delimited.

Apterous female (Fig. 10). Measurements of paratypes ($n = 10$): Body length, 3.0–3.2; mesonotum width, 1.10–1.13. Colour as in male. Proctiger and gonocoxa black.

Structures. Metatrochanter without black granules. Metafemur more slender than in male, 4.1–4.4 times as long as wide; basal row lacking; posterior distal row consisting of 6–9 teeth, the longest one usually noticeably straight. Metatibia hardly less dentate than in male. Abdomen very broad. Connexival margins anteriorly slightly, posteriorly strongly

converging (Fig. 10). All laterotergites strongly sloping. Apex of connexival margin 7 in lateral aspect rectangular, with inconspicuous dark pilosity. Mediotergites 1–7 slightly convex; 8 flat. All mediotergites with erect, short pilosity; mediotergites 1–7 with rows of medium-long setae (of similar length). Laterotergites with many long setae, otherwise without modifications. Connexival margins without swellings, with one long seta at posterior corner of each segment. Mediotergite 5 about 4.0 times as wide as long; mediotergite 7 about 0.75 times as long as wide and 1.5 times as long as mediotergite 6. Mediotergite 8 directed horizontally caudad, clearly wider than long. Sterna without special modifications. Gonocoxa slightly convex, bearing fine dark pilosity.

Macropterous male. Measurements of paratypes ($n = 5$): Body length, 2.9–3.0; pronotum width, 1.30–1.37. Similar to apterous male. Forewing blackish brown, with two closed cells in basal third. In dealate specimen wing broken at midlength. Metafemur relatively slender, 3.9–4.0 times as long as wide, similarly toothed as in apterous morph (basal row consisting of 0–4 minute granules, distal row consisting of 10–12 teeth). Dorsal setae on abdomen reduced, however, lateral margins of sterna 2–6 with many long setae.

Macropterous female. Measurements of paratypes ($n = 3$): Body length, 3.0–3.1; pronotum width, 1.36–1.43. Similar to apterous female, pronotum and wing similar to macropterous male. Metafemur slender, 4.6–4.8 times as long as wide, distal row consisting of 7–8 teeth. Mediotergites 5–7 with narrow shiny midline.

Comparative notes. The paramere shape (Fig. 9) is more slender in *R. ibana* sp.n. than in *R. incognita*. In contrast to this species, the basal tooth row of the metafemur is strongly reduced (usually 0–2, exceptionally up to 4 minute granules). The apterous female can be recognized by the evenly long setae on mediotergites 1–6; these setae are much shorter posteriorly in *R. incognita* and are often only well-developed on mediotergites 1–2 (3).

Distribution. Widely distributed on Borneo, recorded from several localities in Sarawak, from the Apokayan area in Kalimantan Utara, and the Meratus Mountains in Kalimantan Selatan.

Etymology. This species epithet is derived from the Iban people who live around the type locality in Sarawak. Used as a Latinized adjective.

***Rhagovelia muluana* sp.n. (Figs 11–15)**

Type material. Holotype (apterous male, NHMW): Malaysia, Sarawak, Gunung Mulu area, right tributary of Tutoh river at Long Iman (ca. N 4°00', E 114°49', ca. 8 m wide stream, 4.III.1993, leg. H. Zettel (#14e). Paratypes (NHMW, LKCNHM): 12 ♂♂, 10 ♀♀ (apterous), 1 ♂ (macropterous), with same locality data as holotype; 4 ♂♂, 5 ♀♀ (apterous), Gunung Mulu area, ca. 8 m wide stream Sungai Lupar, ca. 8 m wide stream on way to Deer Cave (ca. N 4°02.4', E 114°48.8'), 3.III.1993, leg. H. Zettel (#14a).

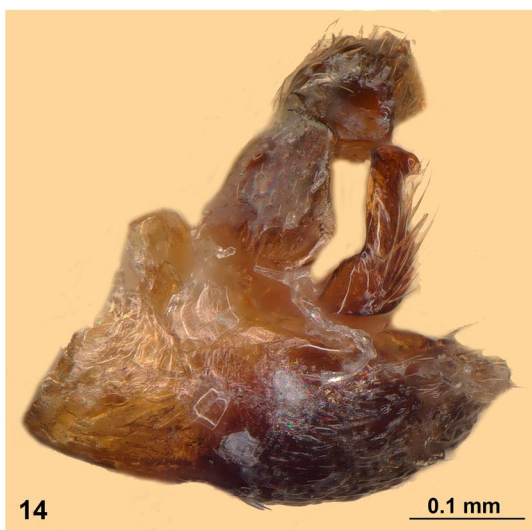
Apterous male (Fig. 11). Measurements of holotype: body length, 2.38. Head width, 0.75. Pronotum width, 0.81. Mesonotum width, 0.88. Length of antennomeres I–IV, 0.69, 0.33, 0.38, 0.42. Length of leg segments: profemur 0.72, protibia, 0.80; protarsus (combined), 0.22; mesofemur, 1.31, mesotibia, 0.97, mesotarsus (combined), 1.00; metafemur, 0.97, metatibia, 1.03, metatarsus (combined), 0.06. Measurements of paratypes ($n = 10$): Body length, 2.4–2.6; mesonotum width, 0.89–0.94.

Colour. Black; pronotum with orange transverse stripe. On legs, pro- and metacoxa, pro- and metatrochanter yellow. Rostrum brownish.



Fig. 11. *Rhagovelia muluana* sp.n., habitus of apterous male (holotype), dorsal.

Structures. Juga without black spicula; proepisterna anteromesally with a few black spicula (Fig. 12). Pronotum short, at midline 0.7 times as long as eye and 0.35 times as long as mesonotum. Sides of pronotum at hind margin with a row of pits; meso- and metapleuron with few very small punctures. Coxae without black spinules. Metatrochanter with ca. 4–7 black granules. Hindleg of holotype: Metafemur relatively wide, 3.4 times as long as wide. Basal row consisting of 5–6 small granules; posterior distal row consisting of 8 teeth that are strongly decreasing in length. Metatibia straight, on flexor side with distinct dentition, basally dense and blunt, distally sparser but more acute; apex with tooth. Paratypes (Fig. 13): Metafemur 3.2–3.6 times as long as wide; basal row consisting of 5–10 small granules, posterior distal row consisting of 8–12 teeth. Laterotergites steeply rising. Mediotergite 5 about 3.3 times as wide as long; mediotergite 7 about 1.8 times as long as sixth and 0.9 times as long as wide at posterior margin. All mediotergites and laterotergites with numerous long, standing setae. Sterna 3–6 weakly convex, 2 more, but not carinate. Sterna 2–6 with oblique, medium-long pilosity. Sternum 7 weakly modified, slightly behind anterior margin with a pair of very weakly raised, shiny swellings bearing inconspicuous yellowish pilosity; medial space between lateral edges slightly convex, not distinctly roof-like elevated (Fig. 13). Paramere directed caudad, distally slender and



Figs 12–14. *Rhagovelia muluana* sp.n., paratypes, apterous males. (12) Head and prothorax, ventral. (13) Hindleg and abdomen, ventral. (14) Pygophore, proctiger and paramere, lateral.

curved ventrally as a hook with rounded tip; apex weakly rounded (Fig. 14). Proctiger slender, with poorly developed lateral lobes; hairy distal part sharply delimited.

Apterous female (Fig. 15). Measurements of paratypes ($n = 10$): Body length, 2.7–2.9 mm; mesonotum width, 1.01–1.07. Colour as in male. Proctiger and gonocoxa black.

Structures. Metatrochanter without black granules. Metafemur slightly more slender than in male, 3.8–4.0 times as long as broad; basal row lacking; posterior distal row consisting of 6–9 teeth, the longest in most specimens conspicuously straight. Metatibia with weaker dentition than in males. Abdomen broad. Connexival margins anteriorly slightly, posteriorly more strongly converging (Fig. 15). Laterotergites steeply rising. Apex of connexival margin rectangular, with inconspicuous dark pilosity. Mediotergites 1–7 slightly convex (anterior ones more than posterior ones), mediotergite 8 flat. Mediotergites 1–3 and 8 with rather short and appressed pilosity; mediotergites 1–3 with transverse rows

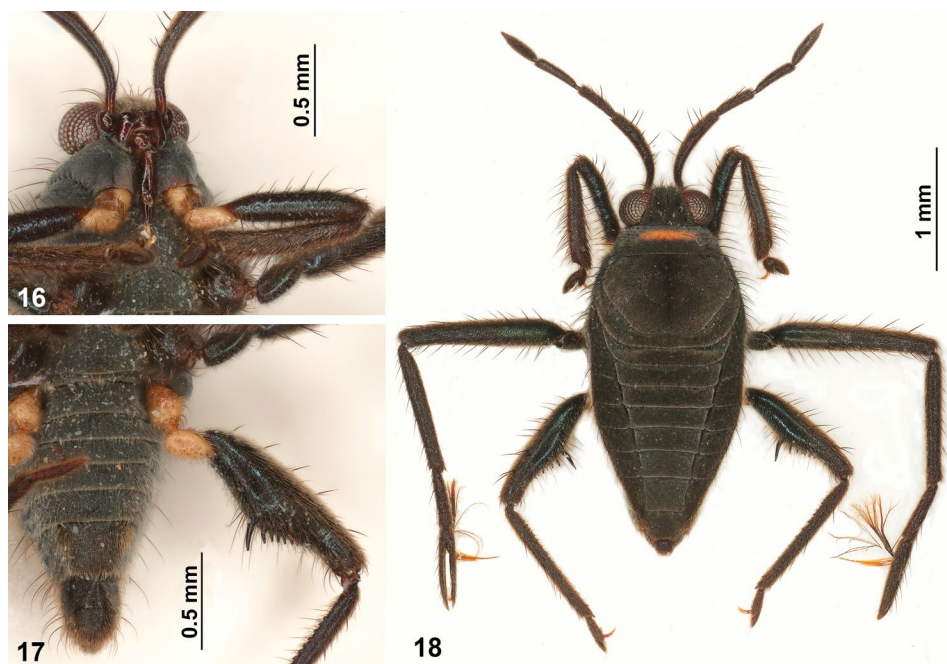


Fig. 15. *Rhagovelia muluana* sp.n., habitus of apterous female (paratype), dorsal.

of black setae, 4 occasionally with some individual short setae, 5–7 bare. Laterotergites anteriorly with long, posteriorly with sparse and rather short setae; otherwise without modifications. Connexival margin on each segment apically with one long seta, without swelling. Mediotergite 5 about 3.3 times as wide as long; mediotergite 7 about 0.9 times as long as wide and 1.3 times as long as mediotergite 6; mediotergite 8 directed caudad, wider than long (Fig. 15). Sterna without modifications. Gonocoxa weakly convex, bearing fine, pale pilosity.

Macropterous male. Measurements ($n = 1$). Body length, 2.7; pronotum width, 1.22. Similar to apterous male. Pronotum large, with pronounced humeri. Forewing blackish brown, with two closed cells in basal third and a small cell distally between them; broken distally of cells. Abdominal carinae reaching base of mediotergite 4. Metafemur relatively slender, ca 3.8 times as long as wide, with similar dentition as in apterous morph (basal row consisting of 6–7 granules, anterior distal row of 11 teeth). Dorsal pilosity of abdomen reduced, except connexival margins of segments 2–6 with numerous very long setae.

Macropterous female. Unknown.



Figs 16–18. *Rhagovelia incognita*, paratypes. (16) Head and prothorax, ventral. (17) Hindleg and abdomen of male, ventral. (18) Habitus of apterous female, dorsal.

Comparative notes. The basal row of teeth on the metafemur of males is more developed than in *R. ibana* sp.n., but weaker than in *R. incognita*. The paramere (Fig. 14) is longer than in *R. incognita*, the apex is more rounded (or slightly truncated) and with a less sharp ventral hook than in both *R. incognita* and *R. ibana* sp.n. The mediotergites of apterous females bear long setae only anteriorly (as in *R. incognita*) and differ from this species only by a slightly more slender abdomen when directly compared (Figs 15 and 18).

Distribution. This species is so far only known from the area around Gunung Mulu in Sarawak.

Etymology. The species epithet refers to the type locality. Used as a Latinized adjective.

***Rhagovelia incognita* POLHEMUS & POLHEMUS, 1988 (Figs 16–18)**

Rhagovelia incognita POLHEMUS & POLHEMUS, 1988: 179.

Type material examined. Paratypes (NHMW): 1 ♂, 2 ♀♀ (apterous) 1 ♂ (macropterous, dealate), Malaysia, Sabah, Samalang, River, 7 km S of Ranau, 3.VIII.1985, leg. J.T. & D.A. Polhemus (CL2026); 1 ♂, 1 ♀ (apterous), Sabah, Tempasuk, River, 27 km S of Kota Belud, 4.VIII.1985, leg. J.T. & D.A. Polhemus (CL2029).

Distribution. POLHEMUS & POLHEMUS (1988) have described *R. incognita* from several localities in Sabah and Sarawak, East Malaysia; the sample CL2029 is from the type locality.

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