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New species, new record, and key to the species of *Rhagovelia* in the *robusta* group (Hemiptera: Heteroptera: Veliidae) from Venezuela

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Abstract

Rhagovelia kmenti Magalhães & Moreira, **sp. nov.** is described, illustrated, and compared with congeners. The new species belongs to the *robusta* group and its males can be distinguished from group congeners by the dark-brown general coloration, the armature of the hind trochanter, femur, and tibia, and by the distinctive shape of the paramere. In addition, *Rhagovelia brunae* Magalhães & Moreira, 2016 is newly recorded from Venezuela and a key to the species of the *robusta* group from the country is presented.

Key words: Aquatic insects, Neotropical Region, riffle bugs, taxonomy

Introduction

The family Veliidae (Hemiptera: Heteroptera: Gerromorpha) is distributed worldwide and contains more than 900 described species (Polhemus & Polhemus 2008). Among these insects, some of the most easily recognized belong to the genus *Rhagovelia* Mayr, 1865, due to the presence of a unique propelling fan on the middle tarsus (Polhemus 1997, Santos *et al.* 2017).

The following species and groups of *Rhagovelia* occur in Venezuela: *R. angustipes* Uhler, 1894, *R. calopa* Drake & Harris, 1927, *R. culebrana* Drake & Maldonado-Capriles, 1952, and *R. tenuipes* Champion, 1898 (*bisignata* group); *R. plumbea* Uhler, 1894 (*salina* group); *R. citata* Drake, 1953 and *R. yanomamo* Polhemus, 1997 (*armata* group); *R. elegans* Uhler, 1894 (*elegans* group); *R. castanea* Gould, 1931, *R. equatoria* Polhemus, 1997, *R. guianana* Polhemus, 1997, *R. sinuata* Gould, 1931, *R. traili* (White, 1879), and *R. venezuelana* Polhemus, 1997 (*robusta* group); and *R. humboldti* Polhemus, 1997 (*varipes* group) (Padilla-Gil & Moreira 2013). In addition to these 15 species and six groups, Moreira *et al.* (2016) reported the presence of *R. evidis* Bacon, 1948 of the *angustipes* group in Venezuela. We present here the description of *R. kmenti* Magalhães & Moreira, **sp. nov.**, a member of the *robusta* group, and also provide the first record of *Rhagovelia brunae* Magalhães & Moreira, 2016 from Venezuela, accompanied by a key to the species of the *robusta* group recorded from the country.

Materials and methods

The material examined was collected as part of the project "Biodiversity of river corridors of tropical forests: current status, impact of anthropogenic activity and the prospect of recovery" (Slovak Research and Development Agency, APVV-0213-10). The specimens were preserved in ethanol and deposited in the Entomological Collection of the Oswaldo Cruz Institute, Rio de Janeiro, Brazil (CEIOC). Geographical coordinates of the collecting sites were obtained with the use of a GPS receiver and photographs of the sampling stations have been published by Moreira

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et al. (2016). The description follows the format in the latest revision of the genus for the Neotropical Region (Polhemus 1997). Measurements were taken from five males and five females using a Leica MS5 stereomicroscope and are given in millimeters. Drawings of the male proctiger and paramere were made using a camera lucida attached to this same microscope. Digital photographs of the new species were obtained using a camera attached to a Leica S8 APO stereomicroscope and edited with Adobe Photoshop CS6.

Results and discussion

Rhagovelia kmenti Magalhães & Moreira, sp. nov.

(Figs. 1–8, 14, 22; Table 1)

Description. Apterous male (Figs. 1, 3–4, 6–7, 14, 22; Table 1). General color dark-brown (Fig. 1). Head with longitudinal midline impressed, a pair of oblique indentations on base, and trichobothria inserted in pits with black borders. Antenniferous tubercles dark brown. Proximal portion of antennomere I yellow, remainder of antenna brown to black. Eye brown to black. Clypeus, buccula, and jugum yellow. Labium yellowish brown, black at apex. Pronotum brown, lighter and yellowish on longitudinal midline and posterior angle, with transverse reddish-orange band adjacent to head (Fig. 1); yellow color extending over propleuron. Metanotum brown to dark brown. Mesopleuron with anterior 2/3 yellow and posterior 1/3 brown; metapleuron light brown. Proepisternum and proacetabulum light yellow. Pro-, meso-, and metasterna yellow, with central area brown. Meso- and metacetabula yellow. Coxae light yellow. Fore and hind trochanters light yellow; middle trochanter brown, darker laterally. Fore and hind femora dorsally yellow on base, brown to black toward apex; ventrally yellow through most of length. Middle femur brown, with yellow stripe on dorsum and venter. Tibiae and tarsi dark brown to black. Abdominal mediotergites I–VII orange-brown, reddish brown, or brown; tergum VIII orange to light brown proximally, then dark brown to black. Abdominal laterotergites orange-brown mesally; yellow with narrow black margin laterally. Abdominal sterna orange-brown, with posterior margins and longitudinal median carina yellow (Fig. 6).

Head short, with long, black setae anterior to eyes and adjacent to mesal eye margin. Antenna covered by short brown setae; antennomeres I–II with longer, thicker, black setae. Antennomeres I–III cylindrical; I curved laterally; IV fusiform (Fig. 1). Labium thick, reaching base of mesosternum. Jugum and anterior portion of proepisternum with black denticles (Fig. 3). Thorax dorsally covered by short shiny setae, with longer setae on margins. Pronotum long, with posterior margin convex, completely covering mesonotum. Exposed portion of metanotum short and sinuous. Thoracic sterna and acetabula without black denticles. Legs covered by brown setae, more densely on trochanters, femora, and tibiae; femora and tibiae also with rows of longer, thicker, black setae. Fore tibia slightly widened distally, weakly concave near apex. Hind trochanter with 0–2 short spines. Hind femur with two rows of spines throughout length that approach each other proximally and distally; dorsalmost row with 3 short spines, followed by 2 long, robust spines, and 6 subequal medium spines; ventralmost row more regular, with about 12 subequal spines (Figs. 4, 7). Hind tibia with two parallel rows of about 14 subequal short spines, a longer subapical spine, and straight apical spur. Dorsum of abdomen covered by short shiny setae, with longer setae on margins. Abdominal laterotergites elevated, tapering toward apex. Abdominal sterna I–VI with black denticles; posterior margins concave; longitudinal median carina weak, more evident posteriorly; sternum VII with a pair of depressions adjacent to midline. Proctiger oval, with a pair of lateral lobes on base and another at about 2/3 of its length; apex covered by setae (Fig. 22). Parameres symmetrical, shape as in Fig. 14.

Apterous female (Figs. 2, 5, 8; Table 1). Coloration similar to apterous male, except for the following: proximal portion of antennomere I yellow to light brown, rest of antenna dark brown; eyes brown or golden; clypeus, buccula, and jugum light brown; labium brown, black on apex; pronotum orange-brown with transverse orange to light brown band adjacent to head (Fig. 2); metanotum brown; propleuron brown, orange anteriorly; mesopleuron with anterior 1/3 light brown and posterior 2/3 dark brown; proepisternum, proacetabulum, meso- and metasterna yellow to orange; coxae and trochanters yellow to light brown; tibiae and tarsi dark brown; abdominal mediotergite VIII black with dark brown center; abdominal laterotergites light brown to dark brown (Fig. 2).

Structure similar to apterous male, except for the following: black denticles present in small numbers laterally on abdominal sterna II–VI; sternum VII without depressions; trochanters without spines; hind femur rarely with an isolated short spine on proximal half, distal half with two parallel decreasing rows of spines, dorsalmost with 6–7

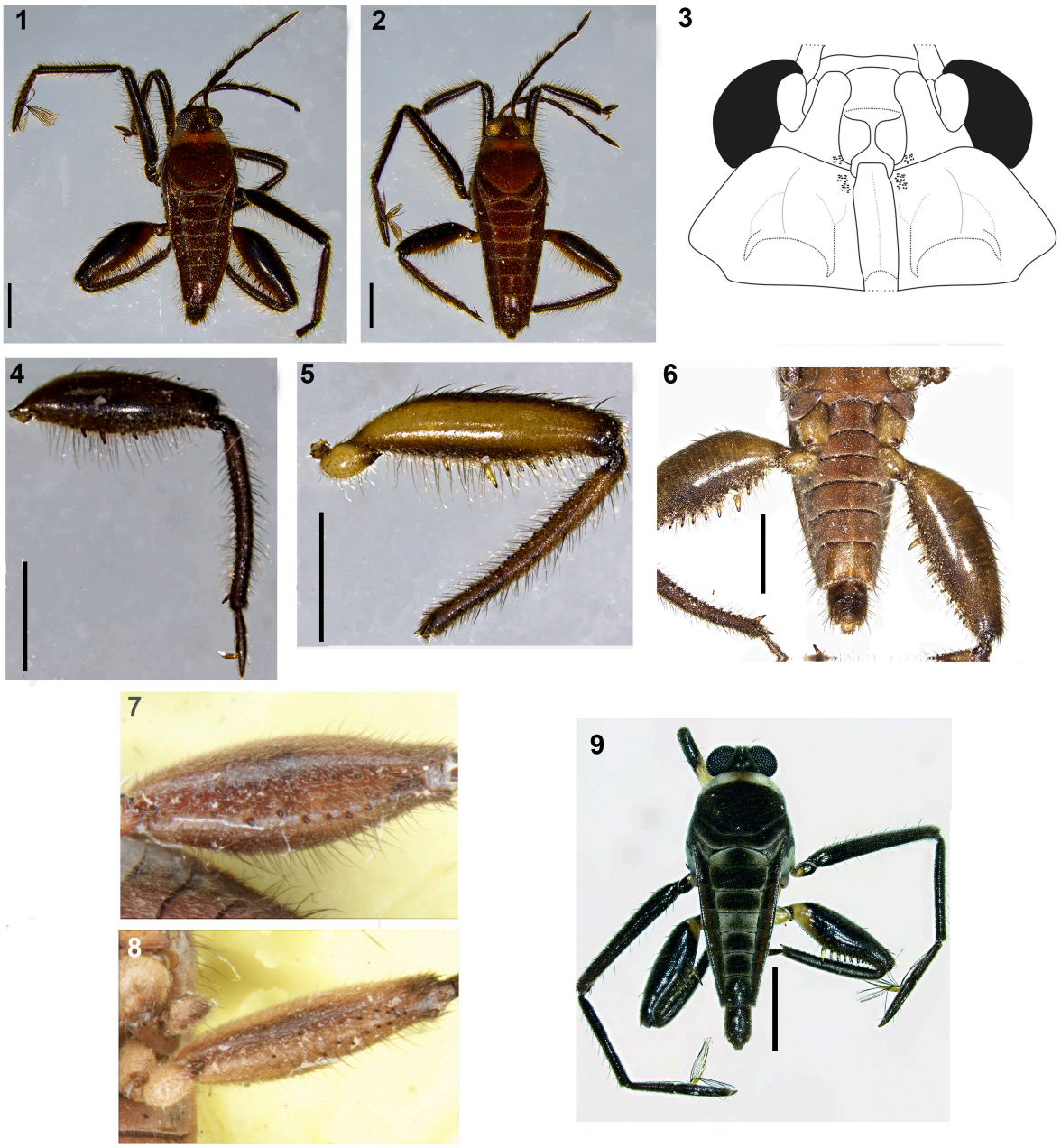
spines and ventralmost with 3–5 spines (Figs. 5, 8); hind tibia with two parallel rows of 10–14 short subequal spines, without longer preapical spine, with straight apical spur.

Type material. HOLOTYPE (apterous ♂) VENEZUELA, Bolívar, Gran Sabana: left side tributary below Salto del Danto, 1100 m a.s.l., VEN 4/2011, 05º57'51.6'' N 61º22'57.5'' W, 19.XI.2011, M. Svitok leg (CEIOC-21242). PARATYPES same data as holotype (4♂, 4♀, apterous, CEIOC-21243); Canaima National Park, BIOCOR 11 KVALITA. 5.03656/-61.07594, 02.XII.2012, M. Svitok Leg (2♂, 2♀, apterous, CEIOC-21244).

Etymology. The new species is named in honour of Dr. Petr Kment (National Museum, Czech Republic), fellow heteropterologist, for his many contributions to the study of the true bugs.

TABLE 1. Mean and standard deviation of measurements from five males and five females of *Rhagovelia kmenti* Magalhães & Moreira, **sp. nov.** All measurements are in mm.

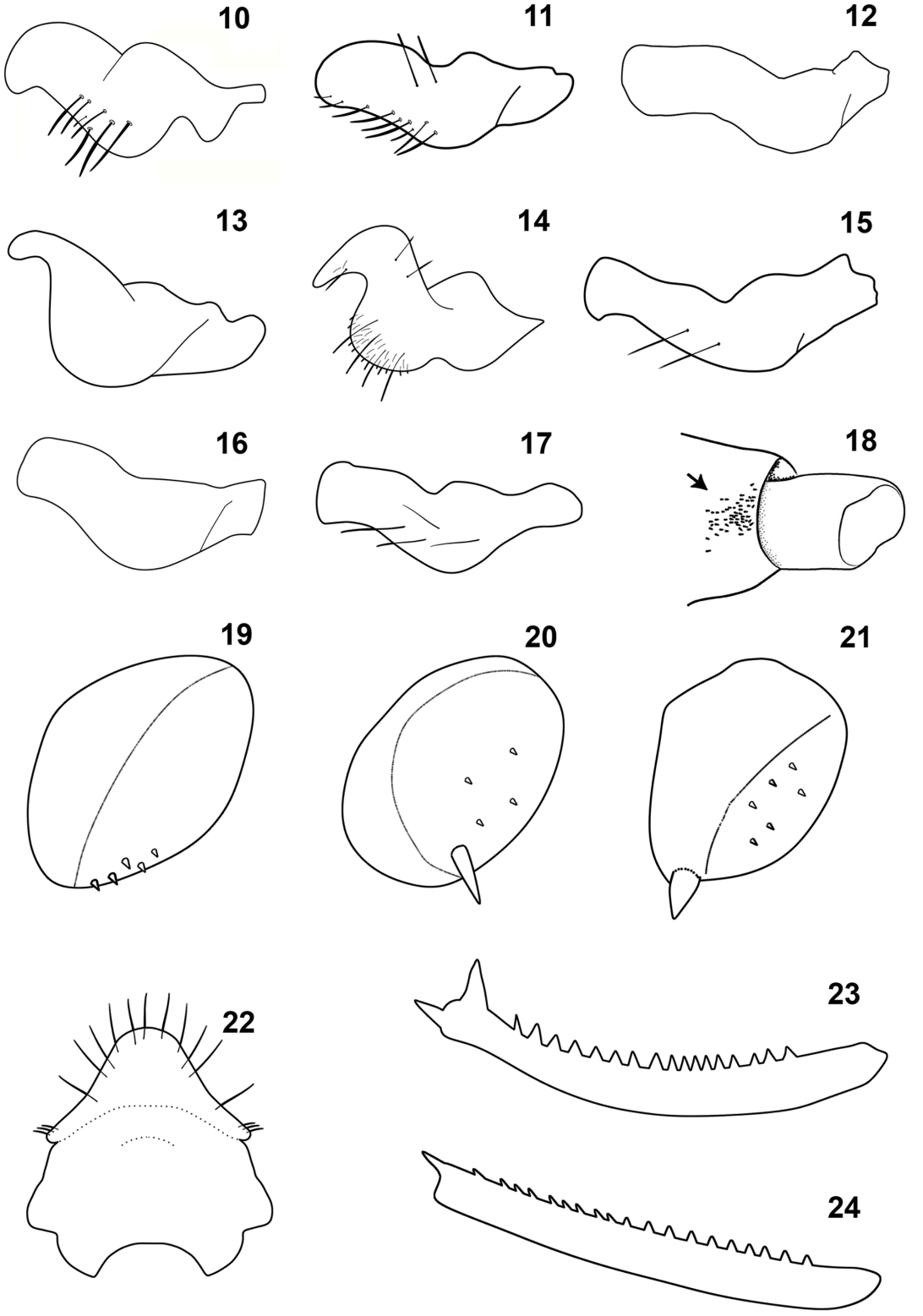
Structure	Male	Female
Body length	4.52 ± 0.29	4.50 ± 0.08
Head length	0.57 ± 0.10	0.49 ± 0.06
Head width	0.94 ± 0.06	0.93 ± 0.03
Antennomere I length	1.13 ± 0.11	0.97 ± 0.13
Antennomere II length	0.76 ± 0.08	0.64 ± 0.05
Antennomere III length	0.64 ± 0.07	0.57 ± 0.05
Antennomere IV length	0.37 ± 0.01	0.42 ± 0.09
Eye width	0.32 ± 0.04	0.34 ± 0.06
Pronotum length at midline	1.13 ± 0.04	1.15 ± 0.03
Pronotum width	1.33 ± 0.12	1.28 ± 0.06
Metanotum length	0.17 ± 0.09	0.14 ± 0.04
Fore femur length	1.27 ± 0.11	1.19 ± 0.06
Fore tibia length	1.44 ± 0.12	1.27 ± 0.03
Fore tarsomere I length	0.04 ± 0.02	0.03 ± 0.01
Fore tarsomere II length	0.03 ± 0.02	0.03 ± 0.01
Fore tarsomere III length	0.39 ± 0.04	0.35 ± 0.02
Middle femur length	2.16 ± 0.14	2.04 ± 0.12
Middle tibia length	1.81 ± 0.21	1.58 ± 0.09
Middle tarsomere I length	0.08 ± 0.03	0.08 ± 0.01
Middle tarsomere II length	0.67 ± 0.07	0.64 ± 0.04
Middle tarsomere III length	0.87 ± 0.07	0.90 ± 0.01
Hind femur length	2.09 ± 0.24	1.74 ± 0.01
Hind tibia length	2.03 ± 0.23	1.69 ± 0.02
Hind tarsomere I length	0.06 ± 0.03	0.07 ± 0.01
Hind tarsomere II length	0.20 ± 0.03	0.13 ± 0.01
Hind tarsomere III length	0.44 ± 0.04	0.35 ± 0.01
Abdominal tergum I length	0.21 ± 0.03	0.22 ± 0.06
Abdominal tergum II length	0.31 ± 0.03	0.26 ± 0.02
Abdominal tergum III length	0.27 ± 0.01	0.25 ± 0.03
Abdominal tergum IV length	0.25 ± 0.01	0.28 ± 0.02
Abdominal tergum V length	0.29 ± 0.03	0.29 ± 0.02
Abdominal tergum VI length	0.31 ± 0.01	0.30 ± 0.02
Abdominal tergum VII length	0.42 ± 0.02	0.36 ± 0.01



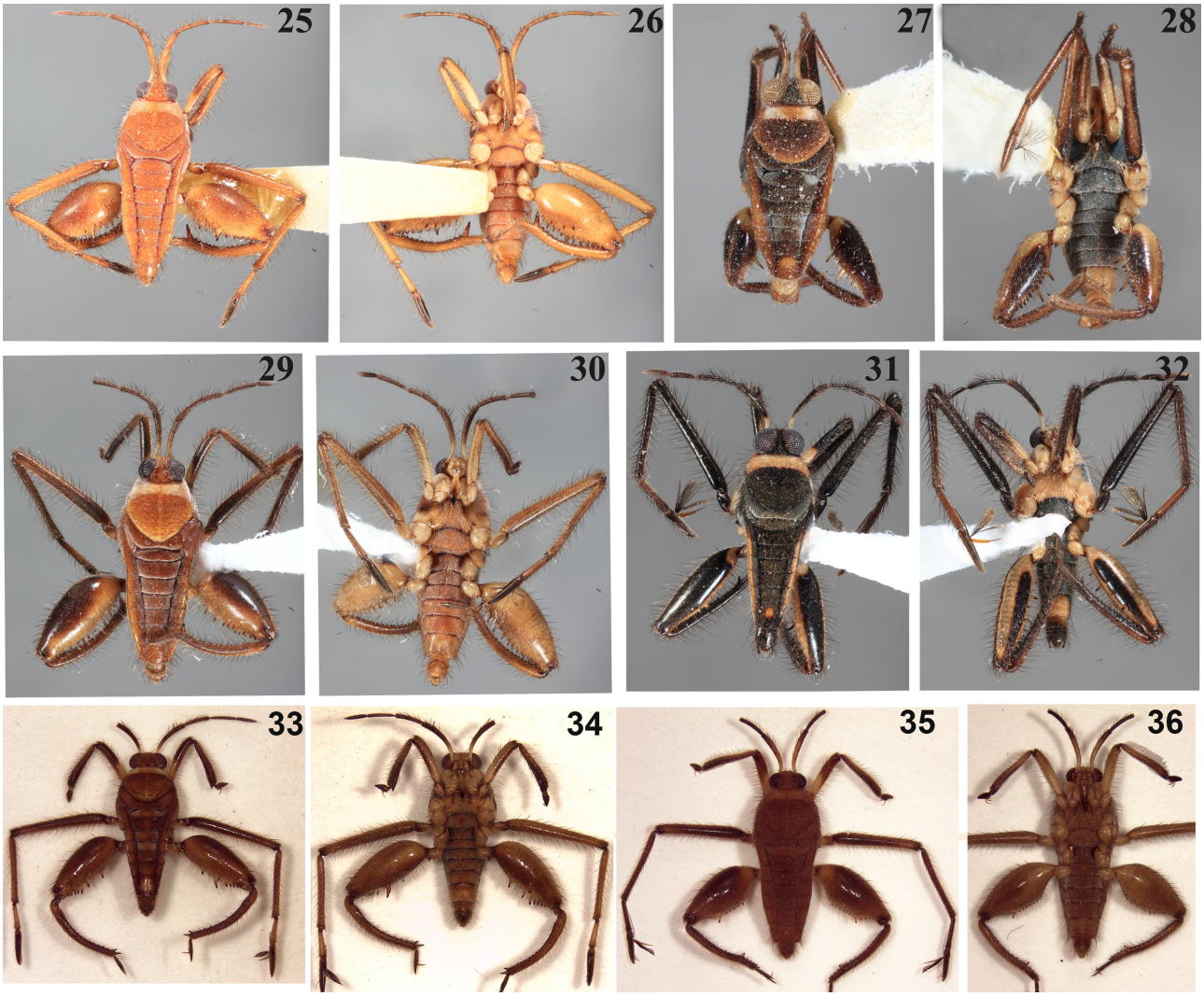
FIGURES 1–9. 1–8) *Rhagovelia kmenti* Magalhães & Moreira, **sp. nov.**, paratypes. 1) Male, dorsal view. 2) Female, dorsal view. 3) Male, head and prothorax, ventral view. 4) Male, hind femur, tibia, and tarsus, lateral view. 5) Female, hind trochanter, femur, and tibia, lateral view. 6) Male, part of thorax, abdomen, and part of hind legs, ventral view. 7) Male, part of hind leg and abdomen, ventral view. 8) Female, part of thorax, hind leg, and abdomen ventral view. 9) *Rhagovelia brunae*, male, dorsal view [scale bars = 1.00 mm].

Comments. The holotype and eight paratypes of *Rhagovelia kmenti* Magalhães & Moreira, **sp. nov.** were collected together with *R. tenuipes* at 1100 m above sea level. The remaining paratypes were collected in a nearby locality together with *R. brunae*, *R. elegans*, *Brachymetra lata* Shaw, 1933 (Gerridae), and *Limnocoris burmeisteri* De Carlo, 1967 (Naucoridae).

The new species is included in the *robusta* group based on the following characteristics: pronotum of the apterous form completely covering the mesonotum, abdomen of the apterous female without a dorsal median carina, lateral margins of female laterotergites not expanded, hind tibia of males and females with straight apical spur, and posterolateral margins surrounding male genital cavity without robust black denticles (Polhemus 1997, Moreira *et al.* 2012).



FIGURES 10–24. 10–17) Parameres. 10) *Rhagovelia brunae*. 11) *Rhagovelia castanea*. 12) *Rhagovelia equatoria*. 13) *Rhagovelia guianana*. 14) *Rhagovelia kmenti* Magalhães & Moreira, **sp. nov.** 15) *Rhagovelia sinuata*. 16) *Rhagovelia traili*) 17. *Rhagovelia venezuelana*. 18) *Rhagovelia sooretama*, apex of abdomen, lateral view. 19) *Rhagovelia venezuelana*, male, hind trochanter, ventral view. 20) *Rhagovelia castanea*, male, hind trochanter, ventral view. 21) *Rhagovelia traili*, male, hind trochanter, ventral view. 22) *Rhagovelia kmenti* Magalhães & Moreira, **sp. nov.**, male, proctiger. 23) *Rhagovelia traili*, male, hind tibia, lateral view. 24). *Rhagovelia calcaris*, male, hind tibia, lateral view [10 from Magalhães *et al.* (2016); 11–12, 15, and 17 from Polhemus (1997); 13, 16 and 18 from Floriano & Moreira (2015)].



FIGURES 25–36. 25–26) *Rhagovelia calcaris*, male holotype. 25) Dorsal view. 26) Ventral view. 27–28) *Rhagovelia traili*, male paratype of *R. perfidiosa* Bacon, 1948 (junior synonym). 27) Dorsal view. 28) Ventral view. 29–30) *Rhagovelia guianana*, male holotype. 29) Dorsal view. 30) Ventral view. 31–32) *Rhagovelia equatoria*, male holotype. 31) Dorsal view. 32) Ventral view. 33–34) *Rhagovelia castanea*, male. 33) Dorsal view. 34) Ventral view. 35–36) *Rhagovelia venezuelana*, male. 35) Dorsal view. 36) Ventral view.

Males of *R. kmenti* Magalhães & Moreira, **sp. nov.** can be distinguished from most others in the *robusta* group by the following combination of characters: general coloration dark-brown (Fig. 1), jugum and anterior portion of proepisternum with black denticles (Fig. 3), hind trochanter with 0–2 subequal short spines (Fig. 6), hind tibia with a subapical spine larger than the others (Figs. 4, 6), and by the distinctively sinuate shape of the male paramere with its tapering apex (Fig. 14). Specimens that lack spines on the hind trochanter could be confused with *R. equatoria* by following only the key provided by Polhemus (1997), but the latter has a strikingly different color pattern (Figs. 31–32).

The two species of the *robusta* group most similar to *R. kmenti* Magalhães & Moreira, **sp. nov.** are *R. calcaris* Drake & Harris, 1936 and *R. venezuelana*. Males of the new species differ from *R. calcaris* (Figs. 25–26) by the darker general color; the much thinner hind femur, with only two rows of spines instead of 4–5; abdominal sterna with black denticles; and by the shape of the paramere. They can be distinguished from those of *R. venezuelana* (Figs. 35–36) by the meso- and metasterna without black denticles; the hind tibia with a single clearly longer subapical spine instead of 2–3 slightly longer subapical spines; and by the shape of the paramere (compare Figs. 14 and 17).

***Rhagovelia brunae* Magalhães & Moreira, 2016**
(Fig. 9)

This species was recently described based on material collected in the state of Pará, northern Brazil and later reported from nearby localities (Magalhães *et al.* 2016, Cunha & Juen 2017). Two apterous males of *R. brunae* were found among the material from eastern Venezuela, which expands the known distribution of the species more than 1500 km westward.

Material examined. VENEZUELA, Bolívar, Gran Sabana, Canaima National Park, BIOCOR 11 KVALITA, 5.03656/ -61.07594, 02.XII.2012, M. Svitok Leg (2♂, apterous, CEIOC-21245).

Key to species of *Rhagovelia* in the *robusta* group from Venezuela

[Based on apterous males; modified from Polhemus (1997) and Magalhães *et al.* (2016). Some specimens might have the normally large spines on hind tibia underdeveloped and will key incorrectly at couplet 1. If an illogical result is achieved, it is recommended to start the key from step 4.]

1. Hind tibia with several subequal spines, excluding apical spur (Figs. 9, 24, 27–28). 2
-. Hind tibia with one or more spines larger than the others, excluding apical spur (Figs. 1, 4, 6, 23, 25–26, 29–36) 4
2. Sides of abdominal segment VII bearing patches of small black denticles (Fig. 18; less visible in darker specimens); paramere as in Fig. 10 . . . . . *Rhagovelia brunae*
-. Sides of abdominal segment VII without patches of small black denticles; paramere not as above 3
3. General color uniformly orange-brown; hind trochanter with 2–4 small subequal spines; posterior margin of hind femur without long, sharp spine offset from the main rows of spines; paramere as in Fig. 15 . . . . . *Rhagovelia sinuata*
-. General color dark brown to black, contrasting with yellow band on anterior 1/5 of pronotum (Fig. 27); hind trochanter with 1–9 small subequal spines and a much longer spine (Fig. 20); posterior margin of hind femur with a long, sharp spine offset dorsally from the main rows of spines (Figs. 27–28); paramere as in Fig. 16 . . . . . *Rhagovelia traili*
4. Proepisternum lacking small black denticles 5
-. Proepisternum bearing small black denticles (sometimes in small numbers and only visible at higher magnifications) (Fig. 3) 6
5. Body length about 4.20 mm; hind trochanter with 4–5 small spines and a much longer spine (Fig. 34); paramere as in Fig. 11 . . . . . *Rhagovelia castanea*
-. Body length about 5.00 mm; hind trochanter with 2–3 small spines (Fig. 30); paramere as in Fig. 13 . . *Rhagovelia guianana*
6. Hind trochanter with 5 small subequal spines (Fig. 19); hind tibia with 2–3 subapical spines slightly larger than the remainder of the tibial spines (Figs. 35–36); paramere as in Fig. 16 . . . . . *Rhagovelia venezuelana*
-. Hind trochanter with 0–2 small subequal spines (Fig. 6); hind tibia with a single subapical spine clearly longer than the remainder of the tibial spines (Figs. 4, 6, 23, 31–32); paramere not as above 7
7. General color dark-brown (Fig. 1); body length about 4.50 mm; dorsalmost row of spines on hind femur with 3 short spines, followed by 2 long, robust spines, and 6 subequal medium spines (Figs. 4, 7); paramere as in Fig. 14 . . . . . *Rhagovelia kmenti*
-. General color black, contrasting with yellow band on anterior 1/5 of pronotum and lateral portion of abdominal laterotergites (Fig. 31); body length about 4.00 mm; dorsalmost row of spines on hind femur with 4 medium to large sharp, slender spines increasing in size, followed by 6 smaller spines decreasing in size (Fig. 31–32); paramere as in Fig. 12 . . . . . *Rhagovelia equatoria*

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