



New species, new records and key to the species of the *Rhagovelia itatiaiana* group (Hemiptera, Heteroptera, Veliidae) from Brazil

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Academic editor: Jader Oliveira

Received: 27 Apr 2023 | Accepted: 05 Jun 2023 | Published: 12 Jun 2023

Citation: Magalhães OM, Floriano CFB, Moreira FFF (2023) New species, new records and key to the species of the *Rhagovelia itatiaiana* group (Hemiptera, Heteroptera, Veliidae) from Brazil. Biodiversity Data Journal 11: e105614. <https://doi.org/10.3897/BDJ.11.e105614>

ZooBank: urn:lsid:zoobank.org:pub:848A6958-4F48-4014-A2AC-6A4FE568958D

Abstract

Background

Rhagovelia Mayr, 1865 (Hemiptera, Heteroptera, Veliidae), known as riffle bugs, includes more than 400 species and is commonly found in tropical lotic environments, including coastal marine habitats, such as mangroves and estuaries. Due to the elevated number of species, the fauna from the Americas has been divided into several groups, which facilitates taxonomic studies. Amongst them, the *itatiaiana* group currently includes two species from the Greater Antilles and five from south-eastern and southern Brazil. Despite the many taxonomic studies developed during the past few decades, new species of *Rhagovelia* are still being discovered in several areas of the continent, including the Atlantic Forest of eastern Brazil.

New information

Rhagovelia bispoi sp. n. is described, illustrated and compared with similar congeners. The new species belongs to the *itatiaiana* group and can be diagnosed by the uniformly black mesonotum, the presence of a tuft of setae medially on male abdominal sternum VII, the armature of the male hind femur and the distinctive shape of the paramere. In addition, we present new records of *R. trepida* Bacon, 1948 from the States of Paraná and Santa Catarina and a key to the species of the *itatiaiana* group recorded from Brazil.

Keywords

aquatic insects, Gerromorpha, riffle bugs, South America, taxonomy

Introduction

Veliidae (Hemiptera, Heteroptera, Gerromorpha) is a worldwide distributed group of semi-aquatic bugs that is especially rich in the Neotropics (Polhemus and Polhemus 2008). The most speciose genus in the region is *Rhagovelia* Mayr, 1865, (Veliidae, Rhagoveliinae), containing almost 200 described American species and being commonly found in lotic environments, sometimes in groups of hundreds of individuals (Padilla-Gil and Moreira 2013, Moreira 2015).

American *Rhagovelia* are distributed into 18 species groups, which are further organised into one grade (non-monophyletic) and five complexes (monophyletic) (Polhemus 1997, Moreira et al. 2012, Padilla-Gil and Moreira 2013). Although not a monophyletic lineage, the *abrupta* grade can be diagnosed by the pronotum of the apterous forms longer than the dorsal length of the eye, but shorter than three times the exposed portion of the mesonotum and with the posterior margin convex (Polhemus 1997).

Five species groups are currently recognised within the *abrupta* grade, namely *cali*, *itatiaiana*, *lucida*, *secluda* and *torquata*. Amongst them, the *itatiaiana* group is recognised by the general blackish colouration with distinctively contrasting orange markings on the pronotum and abdominal laterotergites; the forewing with four closed cells, of which the distalmost two extend into the distal half of the wing (Matsuda 1956, fig. 7); the macropterous females with the dorsal abdominal carinae not evident on mediotergites II and III; and the ventral abdominal sutures simple and unmodified (Polhemus 1997).

There are seven known species in the *itatiaiana* group, namely *R. accedens* Drake, 1957, *R. itatiaiana* Drake, 1953, *R. macta* Drake & Carvalho, 1955, *R. trepida* Bacon, 1956, *R. trianguloides* Nieser & Melo, 1997, *R. mira* Drake & Harris, 1938 and *R. vegana* Drake & Maldonado-Capriles, 1956. The last two species are endemic to the Greater Antilles (Cuba and Dominican Republic), while the other five are restricted to south-eastern and southern Brazil (Polhemus 1997, Padilla-Gil and Moreira 2013, Moreira 2023). Additionally, Padilla-

Gil 2012 and Padilla-Gil 2019 described the two Colombian species *R. candelilla* Padilla-Gil, 2012 and *R. mallama* Padilla-Gil, 2019, but considering the general distribution of the group and the issues related to species described by the author in question (see Galindo-Malagón et al. (2021), Galindo-Malagón et al. (2022) for details), this assignment and even the validity of such species need to be verified.

Based on material collected in south-eastern and southern Brazil during the past decade, we present here the description of a new species of the *itatiaiana* group, new records from the States of Paraná and Santa Catarina and a key to the species occurring in the country.

Materials and methods

The material examined is deposited in the following institutions: Coleção Entomológica do Instituto Oswaldo Cruz, Fundação Oswaldo Cruz, Rio de Janeiro, Brazil (CEIOC); Laboratório de Biologia Aquática, Universidade Estadual Paulista Júlio de Mesquita Filho, Assis, Brazil (LABIA); Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ, entomological collection destroyed in 2018); Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (MZUSP); and National Museum of Natural History, Smithsonian Institution, Washington D.C., USA (NMNH). Methods and terminology follow the standards set in the latest revision of the genus (Polhemus 1997) and subsequent species descriptions. All measurements are given in millimetres.

Digital photographs of the specimens deposited in the CEIOC were obtained using a Leica M205 C stereomicroscope coupled with a Leica DFC450 C digital camera, using the software Leica LAS 4.8.0 for capturing and stacking images. Specimens deposited in the NMNH were photographed with a Cannon EOS 5D digital camera and combined into multi-focal images using Visionary Digital Software. Maps were produced using the software Qgis 2.6.1.

Taxon treatments

Rhagovelia bispoi, sp. n.

- ZooBank [090D3712-A5EB-4E20-A8A9-035805C091CE](https://doi.org/10.21203/rs.3.rs-10903712/v1)

Materials

Holotype:

- a. scientificNameID: *Rhagovelia bispoi*; order: Hemiptera; family: Veliidae; continent: South America; country: Brazil; stateProvince: São Paulo; municipality: Iporanga; locality: Parque Estadual Intervales, Riacho Roda D'Água; decimalLatitude: -24.2714; decimalLongitude: -48.4222; geodeticDatum: WGS84; verbatimEventDate: 14.XII.2014; eventRemarks: P.C. Bispo leg.; individualCount: 1; sex: apterous male; type: PhysicalObject; collectionCode: CEIOC 82833; basisOfRecord: PreservedSpecimen; occurrenceID: 74FA7FE9-7843-5F2B-AB9A-B0CD6C8FB338

Paratype:

- a. scientificNameID: *Rhagovelia bispoi*; order: Hemiptera; family: Veliidae; continent: South America; country: Brazil; stateProvince: São Paulo; municipality: Iporanga; locality: Parque Estadual Intervalos, Riacho Roda D'Água; decimalLatitude: -24.2714; decimalLongitude: -48.4222; geodeticDatum: WGS84; verbatimEventDate: 14.XII.2014; eventRemarks: P.C. Bispo leg.; individualCount: 18; sex: 7 apterous males, 11 apterous females; type: PhysicalObject; collectionCode: CEIOC 82834; basisOfRecord: PreservedSpecimen; occurrenceID: DEBD6A2D-8E0E-54AF-852E-FDCE4CE6459C

Description**Measurements.** See Table 1.

Table 1.		Paratypes					
Measurements obtained from the holotype and five male and five female paratypes of <i>Rhagovelia bispoi</i> , sp. n.		Males			Females		
Structure	Male holotype	Min	Mean	Max	Min	Mean	Max
Body length	3.58	3.58	3.70	3.83	3.63	3.67	3.79
Head length	0.36	0.32	0.35	0.39	0.32	0.32	0.32
Head width through eyes	0.84	0.89	0.96	1.00	0.95	0.95	0.95
Length of antennomere I	0.63	0.63	0.68	0.74	0.58	0.59	0.63
Length of antennomere II	0.42	0.42	0.49	0.56	0.37	0.39	0.42
Length of antennomere III	0.58	0.49	0.53	0.58	0.51	0.52	0.53
Length of antennomere IV	0.47	0.47	0.51	0.53	0.42	0.49	0.53
Maximum eye width	0.37	0.29	0.32	0.39	0.26	0.27	0.29
Pronotum length at mid-line	0.50	0.53	0.52	0.56	0.47	0.51	0.58
Pronotum width	1.05	1.05	1.12	1.21	1.05	1.09	1.16
Length of fore femur	1.16	0.95	1.00	1.06	0.89	0.93	1.00
Length of fore tibia	1.00	1.00	1.04	1.06	0.95	0.98	1.05
Maximum width of fore tibia	0.21	0.13	0.20	0.24	0.11	0.12	0.13
Length of fore tarsomere I	0.05	0.05	0.05	0.05	0.05	0.06	0.07
Length of fore tarsomere II	0.05	0.05	0.05	0.05	0.05	0.06	0.06
Length of fore tarsomere III	0.58	0.52	0.57	0.63	0.58	0.61	0.68
Length of middle femur	1.84	1.74	1.79	1.84	1.53	1.59	1.68
Length of middle tibia	1.47	1.37	1.42	1.48	1.31	1.34	1.37
Length of middle tarsomere I	0.05	0.04	0.05	0.07	0.05	0.05	0.05

		Paratypes					
		Males			Females		
Structure	Male holotype	Min	Mean	Max	Min	Mean	Max
Length of middle tarsomere II	0.64	0.64	0.65	0.66	0.52	0.53	0.53
Length of middle tarsomere III	0.82	0.80	0.82	0.83	0.74	0.76	0.84
Length of hind femur	1.63	1.58	1.61	1.67	1.11	1.18	1.32
Maximum width of hind femur	0.74	0.46	0.65	0.74	0.42	0.43	0.45
Length of hind tibia	1.21	1.11	1.21	1.28	1.16	1.21	1.32
Maximum width of hind tibia	0.15	0.07	0.13	0.17	0.07	0.08	0.10
Length of hind tarsomere I	0.06	0.05	0.06	0.07	0.03	0.05	0.06
Length of hind tarsomere II	0.16	0.14	0.15	0.16	0.10	0.11	0.15
Length of hind tarsomere III	0.37	0.33	0.35	0.37	0.31	0.33	0.35

Apterous male (Figs 1, 3a, 4b). General colour black. Head with shiny impressed mid-line and a pair of shiny oblique indentations at base. Antenniferous tubercle brown. Proximal portion of antennomere I yellow; rest of antenna brown. Eye dark reddish-brown. Clypeus, buccula and jugum yellow to yellowish-brown. Labium yellowish-brown, dark-brown at apex. Pronotum black, with transverse yellow band adjacent to head; band at mid-line about 1/3 as long as pronotum, extending over propleuron laterally. Meso- and metanota black (Fig. 1a, c). Meso- and metapleura black, with a small brown mark ventrally on mesopleuron and a larger brown mark dorsally on metapleuron. Proepisternum and proacetabulum light-yellow. Pro-, meso- and metasterna black. Meso- and metacetabula yellow. All coxae yellow. Fore and hind trochanters light-yellow; fore trochanter with a small brown mark distally; middle trochanter yellow to brown proximally, dark-brown to black distally. Fore femur with proximal 1/2 yellow, distal 1/2 dark-brown to black. Middle femur dark-brown to black, darker dorsally. Hind femur dark-brown to black; dorsum with a yellowish-brown mark at base and posterior surface; venter with a large mark, yellow proximally, becoming narrower and brownish distally. All tibiae and tarsi brown to dark-brown. Abdominal mediotergites I–VII brownish-black; V–VII with shiny black spot centrally. Abdominal laterotergites black mesally, yellow laterally. Abdominal sterna II–VI mostly black, orange-brown laterally; VII black, with two yellow spots submesally. Abdominal segment VIII brown, lighter ventrally; pygophore and proctiger brown.

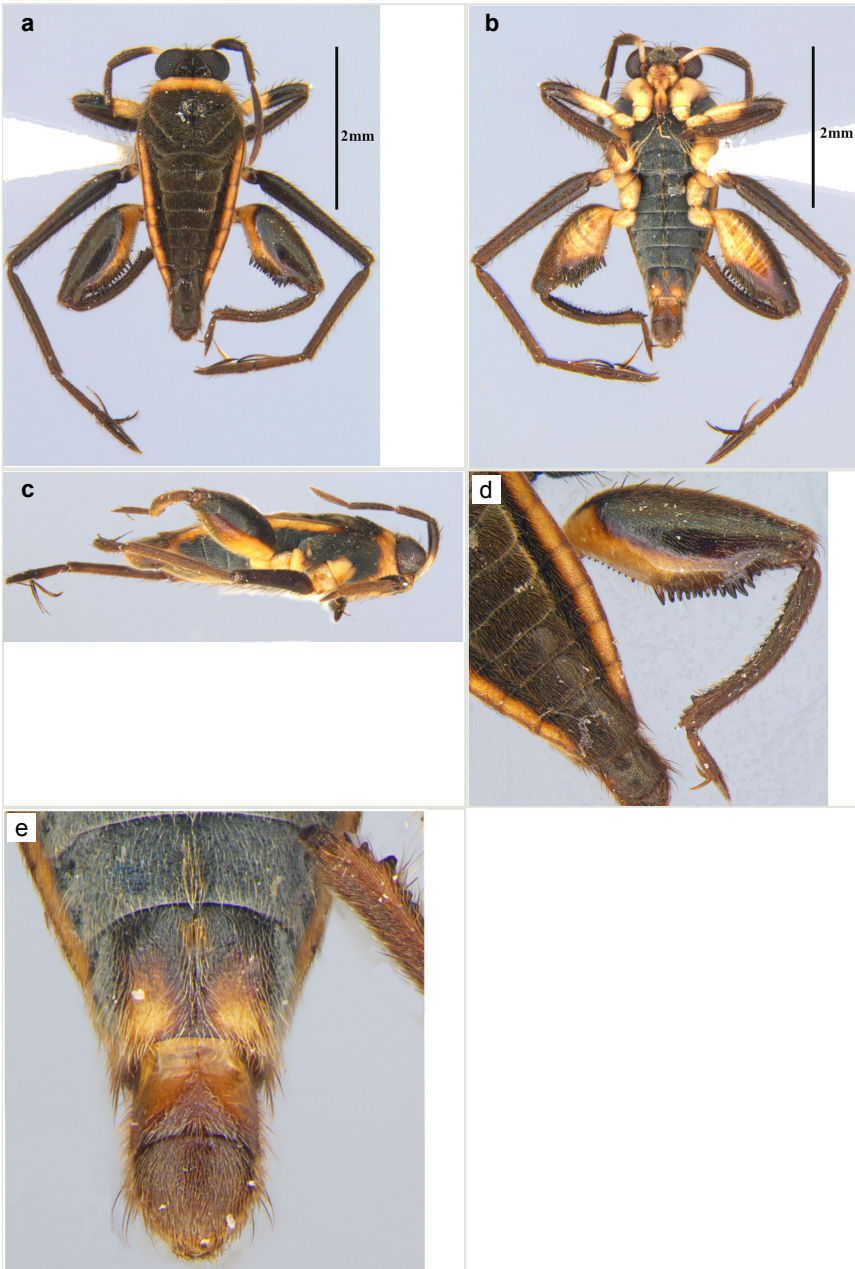


Figure 1.

Rhagovelia bispoi, sp. n., apterous male.

a: Habitus, dorsal view; [doi](#)

b: Habitus, ventral view; [doi](#)

c: Habitus, lateral view; [doi](#)

d: Detail of hind leg, dorsal view; [doi](#)

e: Apex of abdomen, ventral view. [doi](#)

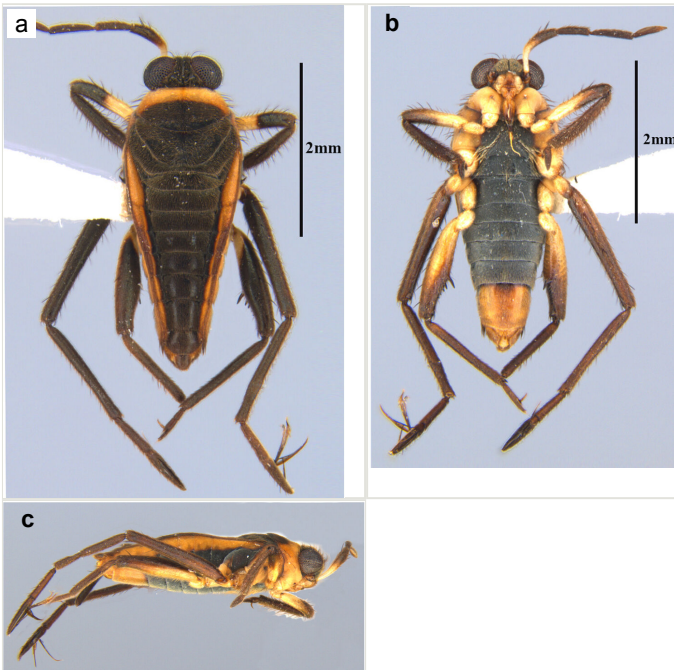


Figure 2.

Rhagovelia bispoi, sp. n., apterous female, habitus.

- a: Dorsal view; [doi](#)
 b: Ventral view; [doi](#)
 c: Lateral view. [doi](#)

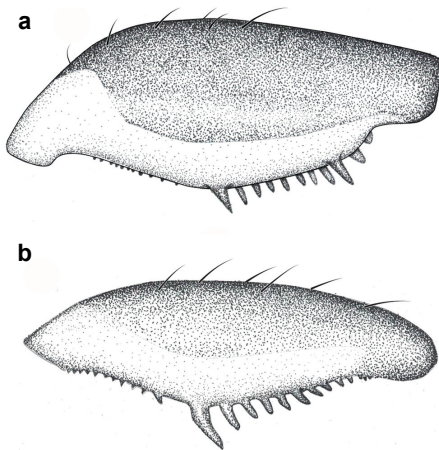


Figure 3.

Rhagovelia itatiaiana group, male, hind femur, dorsal view.

- a: *Rhagovelia bispoi*, sp. n.; [doi](#)
 b: *Rhagovelia trepida*. [doi](#)

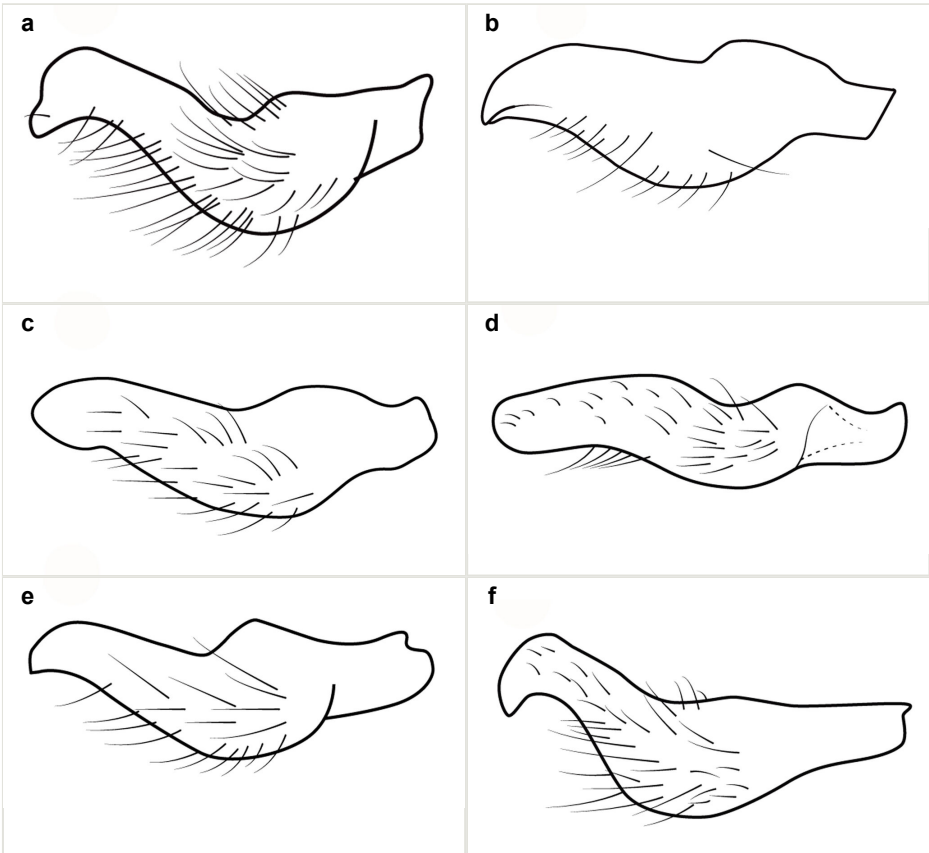


Figure 4.

Rhagovelia itatiaiana group, male, paramere.

a: *Rhagovelia accedens*, modified from Polhemus (1997); [doi](#)

b: *Rhagovelia bispoi*, sp. n.; [doi](#)

c: *Rhagovelia itatiaiana*, modified from Polhemus (1997); [doi](#)

d: *Rhagovelia macta*, modified from Polhemus (1997); [doi](#)

e: *Rhagovelia trepida*, modified from Polhemus (1997); [doi](#)

f: *Rhagovelia trianguloides*, modified from Nieser and Polhemus (1999). [doi](#)

Head short, velvety, with a few long setae anteriorly and adjacent to mesal eye margin. Antennae covered by short brown setae; antennomeres I–II also with a few thicker, longer setae. Antennomeres I–III cylindrical; I curved laterally; IV fusiform. Labium wide, reaching base of mesosternum. Jugum and adjacent portion of proepisternum without black denticles. Pro-, meso- and metanota densely covered by short setae, with longer setae laterally. Pronotum longer than dorsal eye length, shorter than three times exposed portion of mesonotum, with posterior margin convex. Pro-, meso- and metapleura with a few long setae. 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. Trochanters

without spines. Hind femur with row of 10–11 short spines on proximal third, the last one sometimes slightly longer than the others; distal 2/3 with two parallel rows of spines, dorsalmost row with 11–12 spines, the first and tenth or eleventh larger than the others, ventralmost row with 5 short spines (Figs 1d, 3a). Hind tibia arched, with two parallel rows of about 12–15 subequal short spines, a longer subapical spine and a straight apical spur (Fig. 1d). Dorsum of abdomen densely covered by setae, longer and more numerous on posterior segments. Abdominal sterna with faint longitudinal median carina; II–VI with long golden setae medially; sternum VII with a tuft of setae medially on anterior region (Fig. 1e). Terminalia covered by long setae. Proctiger with rounded apex and lateral projections near middle. Parameres symmetrical, shape as in Fig. 4b.

Apterous female (Fig. 2). Similar to apterous male in colour and structure, except for: hind femur much narrower (Table 1), with smaller yellowish marks; proximal half without spines, distal half with a decreasing row of about 7 spines (Fig. 2a, b). Hind tibia straight, without spines throughout length, with apical spur (Fig. 2a, b). Abdominal laterotergites more elevated than in males; last segment with a tuft of setae posteriorly (Fig. 2a). Abdominal sterna without median carina; sternum VII yellowish-brown, with a pair of longitudinal light marks, one on each side of mid-line, without tuft of setae medially on anterior region (Fig. 2b).

Variation. Fore tibia, hind femur and hind tibia less robust in some males (Table 1). Concavity near apex of male fore tibia may be incipient. Larger pre-apical spine of male hind tibia may be underdeveloped.

Diagnosis

Within the *itatiaiana* group, *Rhagovelia bispoi* sp. n. is more similar to *R. itatiaiana* Drake, 1953, *R. macta* Drake & Carvalho, 1955 and *R. trepida* Bacon, 1948, with which it shares the presence of a medial tuft of setae on the anterior portion of male abdominal sternum VII. However, males of the new species have the main row of spines on the hind femur with two large spines separated by nine or ten smaller spines (Figs 1d, 3a), whereas in *R. itatiaiana* and *R. trepida*, the row consists of a large spine followed by spines gradually decreasing in length towards the apex (as in Fig. 3b). The condition of the row of spines is similar in the new species and *R. macta*; however, they can be distinguished by the mesonotum entirely black in the former (Fig. 1a), but yellowish in the latter (Fig. 5c) and by the shapes of the parameres (compare Fig. 4b, d).

Etymology

The new species is named in honour of Dr. Pitágoras da Conceição Bispo, who collected the specimens and also advised CFBF during her doctoral studies.

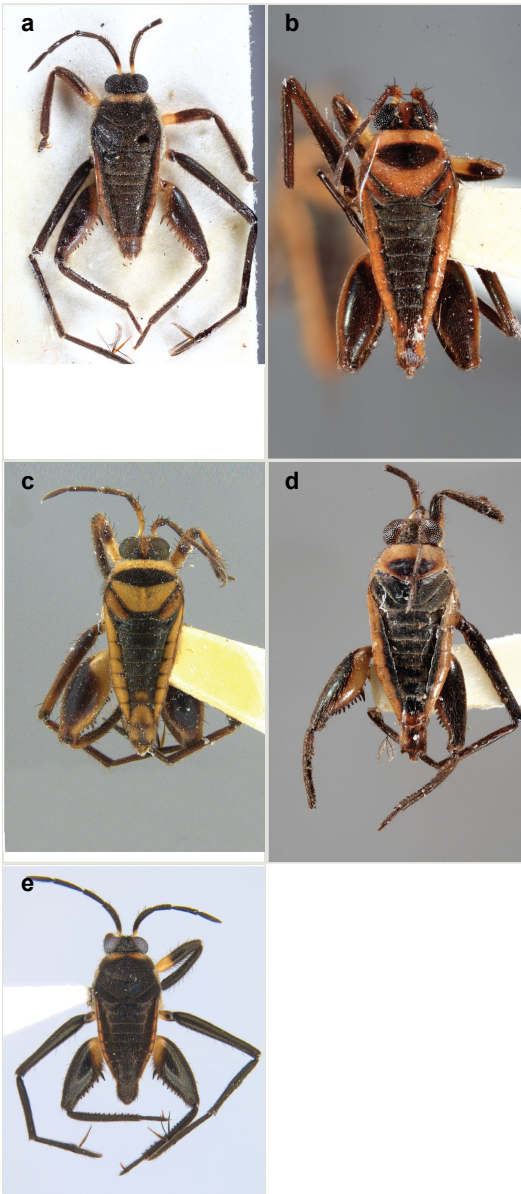


Figure 5.

Rhagovelia itatiaiana group, apterous male, habitus, dorsal view

a: *Rhagovelia accedens*, holotype deposited at the NMNH; [doi](#)

b: *Rhagovelia itatiaiana*, holotype deposited at the NMNH; [doi](#)

c: *Rhagovelia macta*, holotype deposited at the MNRJ, now destroyed; [doi](#)

d: *Rhagovelia trepida*, paratype deposited at the NMNH; [doi](#)

e: *Rhagovelia trianguloides*, specimen deposited at the CEIOC. [doi](#)

Rhagovelia trepida Bacon, 1948

Materials

- a. order: Hemiptera; family: Veliidae; continent: South America; country: Brazil; stateProvince: Paraná; municipality: Balsa Nova / Palmeira; locality: Rio das Pombas, BR-376; decimalLatitude: -25.44; decimalLongitude: -49.79; geodeticDatum: WGS84; verbatimEventDate: IV-2017; individualCount: 13; sex: 5 apterous males, 8 apterous females; type: PhysicalObject; collectionCode: LABIA; basisOfRecord: PreservedSpecimen; occurrenceID: BBB1BEF9-3300-5CBC-9427-DF9ED2759C9E
- b. order: Hemiptera; family: Veliidae; continent: South America; country: Brazil; stateProvince: Santa Catarina; municipality: Blumenau; locality: Parque Nacional da Serra de Itajaí, Parque das Nascentes, stream near Lagoa Negra; decimalLatitude: -27.058; decimalLongitude: -49.089; geodeticDatum: WGS84; verbatimEventDate: IV-2017; eventRemarks: P.C. Bispo leg.; individualCount: 10; sex: 6 apterous males, 4 apterous females; type: PhysicalObject; collectionCode: LABIA; basisOfRecord: PreservedSpecimen; occurrenceID: 37C85CD3-712B-5EC0-B380-3613CE195459
- c. order: Hemiptera; family: Veliidae; continent: South America; country: Brazil; stateProvince: Santa Catarina; municipality: Rio Negrinho; locality: Rio dos Bugres; decimalLatitude: -26.3722; decimalLongitude: -49.5200; geodeticDatum: WGS84; verbatimEventDate: 31.III.2020; eventRemarks: T. Polizei leg.; individualCount: 12; sex: 5 apterous males, 7 apterous females; type: PhysicalObject; collectionCode: MZUSP; basisOfRecord: PreservedSpecimen; occurrenceID: B21C9802-44CE-5A56-84F6-BAD4235E880A

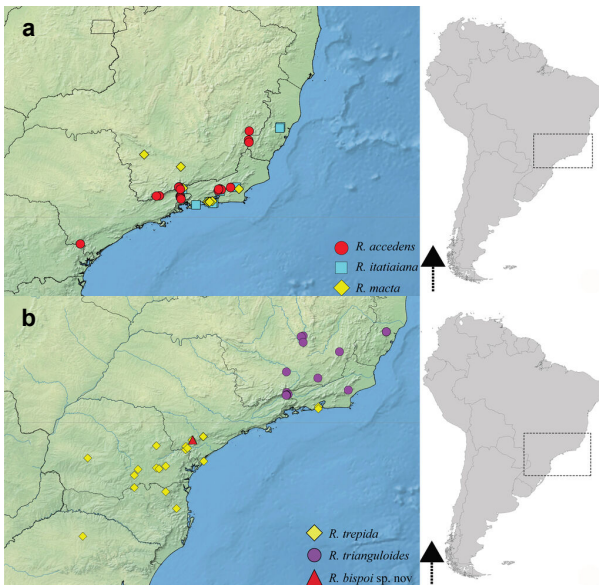


Figure 6.

Geographic distribution of the species in the *Rhagovelia itatiaiana* group in south-eastern and southern Brazil.

a: *Rhagovelia accedens*, *R. itatiaiana* and *R. macta*; [doi](#)

b: *Rhagovelia trepida*, *R. trianguloides* and *R. bispoi*, sp. n. [doi](#)

Distribution

This species is endemic to the Brazilian Atlantic Forest and is distributed from the coastal areas of the States of Rio de Janeiro and São Paulo to the northern portion of the State of Rio Grande do Sul. It has been seldom collected and reported in only three previous studies (Bacon 1948, Polhemus 1997, Moreira and Barbosa 2011). Above, we present new records of this species from the States of Paraná and Santa Catarina, in southern Brazil (Fig. 6b).

Identification keys

Key to the <i>Rhagovelia itatiaiana</i> group from Brazil		
Modified from Polhemus (1997); apterous males are required or recommended for several steps.		
1	Male abdominal sternum VII with a median tuft of brown setae (as in Fig. 1e)	2
–	Male abdominal sternum VII without median tuft of brown setae	5
2	Mesonotum orange or yellowish at least on central portion (Fig. 5 b, c)	3
–	Mesonotum uniformly black (Figs 1a, 2a, 5d)	4
3	Main row of spines on male hind femur with two large spines separated by about eight smaller spines (as in Fig. 3a); male paramere as in Fig. 4d	<i>Rhagovelia macta</i> (Figs 4d, 5c, 6a)
–	Main row of spines on male hind femur with one large spine followed by spines gradually decreasing in length (as in Fig. 3b); male paramere as in Fig. 4c	<i>Rhagovelia itatiaiana</i> (Figs 4c, 5b, 6a)
4	Main row of spines on male hind femur with one large spine followed by spines gradually decreasing in length (Fig. 3b); male paramere as in Fig. 4e	<i>Rhagovelia trepida</i> (Figs 3b, 4e, 5d, 6b)
–	Main row of spines on male hind femur with two large spines separated by nine or ten smaller spines (Figs 1d, 3a); male paramere as in Fig. 4b	<i>Rhagovelia bispoi</i> sp. n. (Figs 1, 2, 3a, 4b, 6b)
5	Body length 4.20–4.75 mm; male hind femur without spines on proximal 2/5; abdominal mediotergite I of apterous female elevated with mediotergites II and III; male paramere as in Fig. 4a	<i>Rhagovelia accedens</i> (Figs 4a, 5a, 6a)

–	Body length 3.30–3.60 mm; male hind femur with an irregular row of spines on proximal 2/5; abdominal mediotergite I of apterous female depressed, mediotergites II–IV elevated; male paramere as in Fig. 4f	<i>Rhagovelia trianguloides</i> (Figs 4f, 5e, 6b)
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Acknowledgements

This article benefitted from the useful comments provided by Drs. Jader Oliveira (Universidade de São Paulo, São Paulo, Brazil), Daniel Reynoso Velasco (Instituto de Ecología, Xalapa, Mexico) and an anonymous reviewer. We thank the NMNH for providing research space and Dr. Thomas J. Henry (Systematic Entomology Laboratory, ARS, USDA, c/o NMNH) for providing support; Juliana Mourão dos Santos Rodrigues (Laboratório de Entomologia, Instituto Oswaldo Cruz, Fundação Oswaldo Cruz, Rio de Janeiro, Brazil) for taking photographs of the new species and of *Rhagovelia trepida*; the Digitalization Project of the Entomological Collection of the MNRJ, funded by the Sistema de Informação sobre a Biodiversidade Brasileira and the Conselho Nacional de Desenvolvimento Científico e Tecnológico (SiBBR/CNPq, process 405588/2015-1) and Marcus Vinício Oliveira de Almeida, for providing photographs of the type of *Rhagovelia macta*; and Dr. Pitágoras da Conceição Bispo, who collected part of the specimens examined. OMM benefitted from a doctorate scholarship provided by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES, process 88882.426007/2019-01). CFBF benefitted from a postdoctoral fellowship provided by the Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ, process E-26/204.231/2021). FFFM benefitted from grants provided by the CNPq (process 301942/2019-6) and the FAPERJ (processes E-26/201.362/2021 and E-26/200.649/2023).

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