Foveavelia, a new South American genus of Veliinae (Hemiptera: Heteroptera: Veliidae) (#91453)

First submission

Guidance from your Editor

Please submit by **19 Oct 2023** for the benefit of the authors (and your token reward) .

Structure and Criteria
Please read the 'Structure and Criteria' page for general guidance.

Custom checks
Make sure you include the custom checks shown below, in your review.

Author notes
Have you read the author notes on the guidance page?

Raw data check
Review the raw data.

Image check
Check that figures and images have not been inappropriately manipulated.

If this article is published your review will be made public. You can choose whether to sign your review. If uploading a PDF please remove any identifiable information (if you want to remain anonymous).

Files

Download and review all files from the materials page.

8 Figure file(s)
1 Table file(s)
8 Other file(s)

Custom checks

New species checks

- Have you checked our new species policies?
- Do you agree that it is a new species?
- Is it correctly described e.g. meets ICZN standard?

Structure and Criteria

Structure your review

The review form is divided into 5 sections. Please consider these when composing your review:

1. **BASIC REPORTING**
2. **EXPERIMENTAL DESIGN**
3. **VALIDITY OF THE FINDINGS**
4. General comments
5. Confidential notes to the editor

You can also annotate this PDF and upload it as part of your review

When ready submit online.

Editorial Criteria

Use these criteria points to structure your review. The full detailed editorial criteria is on your guidance page.

BASIC REPORTING

- Clear, unambiguous, professional English language used throughout.
- Intro & background to show context. Literature well referenced & relevant.
- Structure conforms to PeerJ standards, discipline norm, or improved for clarity.
- Figures are relevant, high quality, well labelled & described.
- Raw data supplied (see PeerJ policy).

EXPERIMENTAL DESIGN

- Original primary research within Scope of the journal.
- Research question well defined, relevant & meaningful. It is stated how the research fills an identified knowledge gap.
- Rigorous investigation performed to a high technical & ethical standard.
- Methods described with sufficient detail & information to replicate.

VALIDITY OF THE FINDINGS

- Impact and novelty not assessed. *Meaningful* replication encouraged where rationale & benefit to literature is clearly stated.
- All underlying data have been provided; they are robust, statistically sound, & controlled.
- Conclusions are well stated, linked to original research question & limited to supporting results.

Standout reviewing tips

The best reviewers use these techniques

Tip	*Example*
Support criticisms with evidence from the text or from other sources	*Smith et al (J of Methodology, 2005, V3, pp 123) have shown that the analysis you use in Lines 241-250 is not the most appropriate for this situation. Please explain why you used this method.*
Give specific suggestions on how to improve the manuscript	*Your introduction needs more detail. I suggest that you improve the description at lines 57- 86 to provide more justification for your study (specifically, you should expand upon the knowledge gap being filled).*
Comment on language and grammar issues	*The English language should be improved to ensure that an international audience can clearly understand your text. Some examples where the language could be improved include lines 23, 77, 121, 128 – the current phrasing makes comprehension difficult. I suggest you have a colleague who is proficient in English and familiar with the subject matter review your manuscript, or contact a professional editing service.*
Organize by importance of the issues, and number your points	*1. Your most important issue* *2. The next most important item* *3. …* *4. The least important points*
Please provide constructive criticism, and avoid personal opinions	*I thank you for providing the raw data, however your supplemental files need more descriptive metadata identifiers to be useful to future readers. Although your results are compelling, the data analysis should be improved in the following ways: AA, BB, CC*
Comment on strengths (as well as weaknesses) of the manuscript	*I commend the authors for their extensive data set, compiled over many years of detailed fieldwork. In addition, the manuscript is clearly written in professional, unambiguous language. If there is a weakness, it is in the statistical analysis (as I have noted above) which should be improved upon before Acceptance.*

Foveavelia, a new South American genus of Veliinae (Hemiptera: Heteroptera: Veliidae)

Higor D. D. Rodrigues [Corresp., 1], **Felipe F. F. Moreira** [1]

[1] Laboratório de Entomologia, Instituto Oswaldo Cruz, Fundação Oswaldo Cruz, Rio de Janeiro, Rio de Janeiro, Brazil

Corresponding Author: Higor D. D. Rodrigues
Email address: higorddr@gmail.com

Background. Semiaquatic bugs (Hemiptera: Heteroptera: Gerromorpha) are worldwide distributed and play fundamental roles in limnic ecosystems. They are the most successful group of organisms to occupy the air-water interface, are important models to study ecology and evolution, and can be relevant tools in biomonitoring. Veliidae is the second most speciose family of semiaquatic bugs, but it and some of the included subfamilies and genera are artificial sets based on plesiomorphies. One of these non-monophyletic entities is *Paravelia* Breddin, 1898, the largest genus in the subfamily Veliinae. **Results.** In an effort to better classify the Veliinae, we describe *Foveavelia* to hold five South American species previously placed in *Paravelia*. The new genus is characterized by the following combination of features: ~~the~~ unusual coarse cuticular punctures throughout the thorax and abdomen; ~~the~~ pair of small, frosty, pubescent areas formed by a very dense layer of short setae on the anterior lobe of the pronotum; ~~the~~ fore tibial grasping comb present only in males; ~~the~~ middle tibia with a row of elongate dark-brown trichobothria-like setae on the posterior third, decreasing in size distally; ~~the~~ macropterous specimens with the apical macula of the forewings elongate and ~~slightly~~ constricted at mid-length, reaching the wing apex; and the male proctiger with a pair of anterodorsal projections. Besides the description, a key to the species of *Foveavelia* is provided, accompanied by illustrations and a distribution map.

Foveavelia, a new South American genus of Veliinae (Hemiptera: Heteroptera: Veliidae)

Higor D. D. Rodrigues[1] and Felipe Ferraz Figueiredo Moreira[1]

[1] Laboratório de Entomologia, Instituto Oswaldo Cruz, Fundação Oswaldo Cruz, Rio de Janeiro, Rio de Janeiro, Brazil

Corresponding Author:
Higor D. D. Rodrigues

Email address: higorddr@gmail.com

Abstract

Background. Semiaquatic bugs (Hemiptera: Heteroptera: Gerromorpha) are worldwide distributed and play fundamental roles in limnic ecosystems. They are the most successful group of organisms to occupy the air-water interface, are important models to study ecology and evolution, and can be relevant tools in biomonitoring. Veliidae is the second most speciose family of semiaquatic bugs, but it and some of the included subfamilies and genera are artificial sets based on plesiomorphies. One of these non-monophyletic entities is *Paravelia* Breddin, 1898, the largest genus in the subfamily Veliinae.

Results. In an effort to better classify the Veliinae, we describe *Foveavelia* to hold five South American species previously placed in *Paravelia*. The new genus is characterized by the following combination of features: the unusual coarse cuticular punctures throughout the thorax and abdomen; the pair of small, frosty, pubescent areas formed by a very dense layer of short setae on the anterior lobe of the pronotum; the fore tibial grasping comb present only in males; the middle tibia with a row of elongate dark-brown trichobothria-like setae on the posterior third, decreasing in size distally; the macropterous specimens with the apical macula of the forewings elongate and slightly constricted at mid-length, reaching the wing apex; and the male proctiger with a pair of anterodorsal projections. Besides the description, a key to the species of *Foveavelia* is provided, accompanied by illustrations and a distribution map.

Introduction

Veliidae (Hemiptera: Heteroptera: Gerromorpha) is a family of small to medium-sized insects that live essentially on the surface of the water. Some of them occur on stagnant waters, such as lakes and puddles, while others occupy rivers and streams, and a few can be found in terrestrial environments relatively far from the water (Schuh & Slater, 1995). Andersen (1982) established a phylogeny for Veliidae based on morphology and proposed the division into six subfamilies: ~~Ocelllloveliinae,~~ Haloveliinae, Microveliinae, Perittopinae, Rhagoveliinae and Veliinae. Subsequently, Damgaard (2008) proposed a phylogeny for Gerromorpha based on morphological and molecular data. He demonstrated that the subfamilies Microveliinae and Haloveliinae were actually closer to Gerridae than to Veliidae, and found low support for other clades of Veliidae, such as the subfamily Veliinae.

More recently, Armisén *et al*. (2022) obtained a phylogeny of the Gerromorpha based on transcriptomes and corroborated ~~with~~ Haloveliinae + Microveliinae forming a clade sister to other Gerridae, leaving Veliidae with only four subfamilies. Within Veliidae, the same authors did not recover the monophyly of Veliinae. Currently, this subfamily includes 11 valid genera, eight of which occur in America: *Altavelia* D. Polhemus & Moreira, 2019; *Callivelia* D. Polhemus, 2021; *Oiovelia* Drake & Maldonado-Capriles, 1952; *Paravelia* Breddin, 1898; *Platyvelia* J. Polhemus & D. Polhemus, 1993; *Steinovelia* J. Polhemus & D. Polhemus, 1993; *Stridulivelia* Hungerford, 1929; and *Veloidea* Gould, 1934. The other three genera that occur in the Palearctic, Afrotropical, and Indo-Malay regions are *Angilia* Stål, 1865; *Angilovelia* Andersen, 1981; and *Velia Latreille*, 1804.

The Neotropical genus *Paravelia* is the most speciose of the Veliinae, with 51 valid species (Rodrigues & Moreira, 2022; Rodrigues, Moreira & Morales, 2022). The paraphyly of this genus was hypothesized by different authors (*e.g.*, J. Polhemus & D. Polhemus, 1993; Rodrigues *et al*., 2014; Rodrigues & Moreira, 2016; D. Polhemus, 2021), but without a phylogenetic basis. Armisén *et al*. (2022) recovered the genus as polyphyletic, but assessing the relationships among its species ~~is~~ still premature, because only a few representatives were included in ~~their~~ analysis.

The study of Veliinae species and their respective type specimens allowed us to define a distinct group of five species within *Paravelia* that share unique characteristics. The new genus *Foveavelia* is here proposed for this group, based mainly in a distinct feature: the coarse cuticular punctures found throughout the body. We also present an illustrated taxonomic key and a distribution map for the included species.

Materials & Methods

Museum visits. Pinned specimens were examined at the following public collections: **DPIC** - Departamento de Parasitologia, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil; **INPA** - Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil; **MZUSP** - Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil; **NMNH** - National Museum of Natural History, Smithsonian Institution, Washington D.C., United States.

Morphological study. All measurements are given in millimeters. Antennomeres and abdominal segments numbers are expressed as Roman numerals. We used standard entomological

techniques to examine the morphology of the specimens used in this study. Abdominal segment VIII and genital capsule of the males were removed using forceps and an entomological pin, without the need for clarification. Photographs have been obtained using a Leica DFC420 camera attached to a LeicaM165C binocular microscope, processed with the Leica Application Suite V3.7.0, and stacked using Auto-Montage. Scanning electron microscopy photographs (~~Figs. 5–10~~) have been provided by Dr. Silvia Mazzucconi. All final figures have been prepared using Adobe Photoshop CS6.

Nomenclatural acts. The electronic version of this article in Portable Document Format (PDF) will represent a published work according to the International Commission on Zoological Nomenclature (ICZN), and hence the new names contained in the electronic version are effectively published under that Code from the electronic edition alone. This published work and the nomenclatural acts it contains have been registered in ZooBank, the online registration system for the ICZN. The ZooBank LSIDs (Life Science Identifiers) can be resolved and the associated information viewed through any standard web browser by appending the LSID to the prefix http://zoobank.org/. The LSID for this publication is: [urn:lsid:zoobank.org:pub:DAAB68B0-7AB5-4D92-AAE8-A9051CD9EC11]. The online version of this work is archived and available from the following digital repositories: PeerJ, PubMed Central SCIE and CLOCKSS.

Results

Foveavelia Rodrigues & Moreira, **new genus**

(Figs. 1–6, 8)

Type species. *Velia hungerfordi* Drake & Harris, 1933, by present designation.

Diagnosis. Body length 4.80–6.50 mm; body vestiture composed of moderately dense, erect, thin, brown setae (Figs. 1, 4, 6); anterior lobe of pronotum with a pair of small, frosty, pubescent areas formed by a very dense layer of short setae (sometimes indistinct~~) (~~as in Fig. 1A); macropterous specimens with apical macula ~~of forewings elongate and slightly constricted~~ at mid-length (Figs. 1A–C, 4E, 6A, 6C); meso- and metasterna each with a pair of tubercles, these tubercles meeting at suture, forming a cavity between them; abdominal mediotergites and sterna

(except sternum VII) with numerous suboval, coarse cuticular punctures (Fig. 2); male proctiger with a pair of anterodorsal projections (Figs. 3E–H, 5H).

Description

Medium-sized veliids; macropterous or brachypterous (micropterous and apterous forms unknown ~~so far~~); ground color brown, covered by golden pubescence, with weak yellowish annulations on femora. Body moderately robust, length 4.80–6.50 ~~mm~~; general characteristics and size not sexually dimorphic (Figs. 1, 6), except for *F. dilatata* (Fig. 4).

Head: Declivant anteriorly, not recessed into pronotum, with usual three pairs of trichobothria and impressed median line; posterodorsal region with a pair of narrow, convergent, impressed lines between impressed median line and a pair of elliptical indentations (Fig. 2A); gula and bucculae with several suboval, coarse punctures; gular region visible (Figs. 6B, 6D–E). Eyes globose, separated by more than an eye width, slightly removed from anterior margin of pronotum; ocular setae present. Labium extending onto anterior region of metasternum; segment I almost reaching posterior margin of bucculae; segments I and IV subequal in length, longer than segment II; segment III about 7 times as long as II (Fig. 1D). Antennae densely covered by golden pubescence and long brown setae; antennomere I thickest, curved laterally; II slightly thicker than III–IV; III–IV subequal in width; IV filiform (as in Fig. 1).

Thorax: Pronotum long, completely covering meso- and metanota; covered by fine pubescence intermixed with elongate brown setae; collar distinct, delineated by coarse punctures; anterior lobe with pair of small, frosty, pubescent areas formed by a very dense layer of short setae (Figs. 1C, 4A–B, 4D–E, 6C) (sometimes indistinct, as in Figs. 1A–B, 6A); humeri raised, prominent; posterior lobe with numerous punctures, without rounded or finger-like process at posterior margin. Forewing with four closed cells, brown, with white macula at basal cells adjacent to costal margin and at wing apex, without other marks centrally (Figs. 1A–C, 4E, 6A, 6C); some brachypterous specimens lacking basal macula (Fig. 4C). Thoracic pleura with numerous suboval, coarse punctures (Figs. 6B, 6D–E). Meso- and metasterna each with a pair of tubercles; tubercles meeting at suture, forming a cavity between them. Metasternum with posterior margin convex; metasternal scent gland opening (= omphalium) obscure. Legs moderaly stout, lacking prominent spines or teeth, light-brown at base, brown distally, with a faint light-brown annulus on femora; hind femur slightly incrassate; grasping comb occupying approximately half or less

of male fore tibial length, absent in female; middle tibia with a distally decreasing row of elongate dark-brown trichobothria-like setae on posterior third; all tarsi three segmented; segment I shortest; fore leg with segment III longer than II; middle and hind legs with segment II longer than III; claws long, slender, slightly curved.

Abdomen: Numerous suboval, coarse punctures, except for laterotergites, sterna II–VI adjacent to lateral margins, and whole sternum VII (Figs. 2C, 2F) and segment VIII; prominent paired longitudinal carinae present along mediotergites II–III and basally on mediotergite IV (visible with wings open or removed) (Fig. 2C). Sides of abdominal sterna with narrow, roughly ovate (sometimes longitudinal) impressed furrows (= striae *sensu* D. Polhemus 2021) (Figs. 6D–E). Male terminalia of moderate size; black denticles absent; proctiger with a pair of anterodorsal projections (Figs. 3E–H, 5H), lateral lobes without angular projections (Fig. 5F); parameres symmetrical, slender, curved (Figs. 3E–H, 5E). Female abdominal segment VIII on same plane as VII; first gonocoxae exposed, plate-like; black denticles absent; proctiger globose, button-like, longer than wide (Figs. 6B, 6D).

Etymology. The generic name *Foveavelia* is derived from *fovea* (Latin), meaning pit, referring to the coarse cuticular punctures present throughout the body, and *Velia*, the nominate genus of the family. Gender feminine.

Distribution. The genus is distributed throughout South America east of the Andes, with published records from Guyana, Suriname, French Guiana, Brazil, Paraguay and Argentina (Fig. 8).

Natural history. Three of the five species here included in *Foveavelia* are known by one of the sexes ~~only~~, and two of them by just one specimen. Thus, it is a relatively rare genus in collections and not many details are known about its habitat and biology.

***Foveavelia amapaensis* (Rodrigues, Moreira, Nieser, Chen & Melo, 2014) n. comb.**

(Figs. 1A, 3A, 3E, 6E, 8)

Paravelia amapaensis Rodrigues, Moreira, Nieser, Chen & Melo in Rodrigues *et al*., 2014: 5–6 (original description).

Diagnosis. Body length 4.80. Distance between basal and apical forewing maculae greater than length of basal macula (Fig. 1A). Pair of rounded lobes on male abdominal sternum VII almost at

same level of posterior margin (Fig. 3A). Male proctiger with a pair of non-bilobed projections anterodorsally. Male paramere not widened on distal half (Fig. 3E).

Type locality. Brazil: Amapá: Santana, Porto Santana, I.C.O.M.I.

Repository. The male holotype was deposited at the Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil. However, it was destroyed together with most of the entomological collection of the institution in the 2018 fire (Kury *et al.,* 2018).

Published records. Brazil: Amapá (Rodrigues *et al*., 2014).

Distribution. This species is known only from the type-locality (Fig. 8). The acronym I.C.O.M.I. refers to "Indústria e Comércio de Minérios S/A", a mining company that was contracted by the government of the state of Amapá in the 1950s to build an ore loading dock at Porto Santana, on the estuary of the Amazon River (Bastos, Valente & Oliveira, 2021).

Discussion. This species was described based solely on the male holotype and some structures were not examined~~, either~~ because the specimen was glued to a paper card ~~or because~~ it was no possible to dissect the male abdominal segment VIII. The diagnostic features used here to separate it from congeners need to be better studied when more specimens become available, since variations are expected. In the original description, the authors neglected the pair of small lobes present near the posterior margin of male abdominal sternum VII (Fig. 3A), which are similar to those of *P. bilobata* (Fig. 3B).

***Foveavelia anta* (Mazzucconi, 2000) n. comb.**

(Figs. 2, 3F, 8)

Paravelia anta Mazzucconi, 2000: 130–134 (original description).

Diagnosis [based on original description]. Body length 5.40–5.70. Distance between basal and apical forewing maculae greater than length of basal macula. Male fore tibial grasping comb occupying 1/6 of the tibial length. Male abdominal sternum VII with a pair of medial gibbosities (see Mazzucconi 2000, page 131, fig. 10). Male proctiger with a pair of distinct, divergent, spinose projections anterodorsally (Fig. 3F).

Type locality. Argentina: Salta: Anta, 50 km East of Las Lajitas.

Repository. Museo Argentino de Ciências Naturales "Bernardino Rivadavia", Buenos Aires, Argentina.

Published records. Argentina: Salta (Mazzucconi, 2000). Paraguay: Concepción (Mazzucconi, 2000).

Distribution. The two records of this species are located in the Río de La Plata basin, in southern South America (Fig. 8).

***Foveavelia bilobata* (Rodrigues, Moreira, Nieser, Chen & Melo, 2014) n. comb.**

(Figs. 1B–D, 3B–D, 3G, 8)

Paravelia bilobata Rodrigues, Moreira, Nieser, Chen & Melo in Rodrigues *et al*., 2014: 8–10 (original description).

Diagnosis. Body length 5.03–5.07. Distance between basal and apical forewing maculae greater than length of basal macula (Figs. 1B–C). Male fore tibial grasping comb occupying 1/4 of tibial length. Pair of rounded lobes on male abdominal sternum VII extended posteriorly (Fig. 3B). Male proctiger with a pair of bilobed projections anterodorsally. Male paramere slightly widened on distal half (Fig. 3G).

Type locality. Brazil: Mato Grosso: Nova Xavantina, Reserva Biológica Municipal Mário Viana (Parque Municipal do Bacaba), Córrego Bacaba.

Repository. DPIC.

Published records. Brazil: Ceará and Mato Grosso (Rodrigues *et al*., 2014; Rodrigues & Moreira, 2022).

Distribution. This species has been recorded from the Caatinga and Cerrado biomes in northeastern and central-western Brazil, respectively. Here, we extend its distribution considerably to the west, based on material from the Colombian Amazon (Fig. 8).

Discussion. We examined a macropterous female (Figs. 6C–D) from northeastern Brazil deposited in the NMNH that most likely belongs to this species. However, because the sample lacked a male for studying the terminalia and given that *F. amapaensis* and *F. bilobata* are very similar, we refrained from definitely assigning such female to the latter species.

Type material examined. HOLOTYPE: BRAZIL, **Mato Grosso**, Nova Xavantina, Parque Municipal do Bacaba, Córrego Bacaba, 14°43’14.80”S, 52°21’35.63”W, 11.X.2003, S.O. Pagioro col. (macropterous ♂, DPIC). PARATYPE: **Mato Grosso**, Córrego da Mata, quarta

ordem, 15°01'32"S, 52°26'29"W, 17.XI.2005, H.S.R. Cabette *et al*. col. (1 macropterous ♂, MZUSP).

Additional material examined. COLOMBIA, Amaz. [=**Amazonas**], Leticia, III-12–15-1969, P. & P. Spangler (1 macropterous ♂, NMNH).

***Foveavelia dilatata* (J. Polhemus & D. Polhemus, 1984) n. comb.**

(Figs. 3H, 4–5, 8)

Paravelia dilatata J. Polhemus & D. Polhemus, 1984: 498 (original description).

Diagnosis. Body length 5.35–6.50. Sexually dimorphic; pronotum distinctly widened anteriorly in the male (Figs. 4D–E), ~~but not~~ in the female (Figs. 4A–B). Male fore tibial grasping comb ~~male~~ occupying almost half of tibial length. Forewing basal macula of macropterous specimens short, roughly ovate (Fig. 4E). Male abdominal segment VIII poorly sclerotized; posterodorsal margin almost straight medially; posterolateral corners rounded, slightly extended posteriorly; posterolateral margin excavated; posteroventral margin narrowed centrally, rounded (Figs. 5A–C). Male abdominal sternum VII with a weak median carina extending along segment, without rounded lobes posteriorly. Male proctiger with a pair of spinose anterodorsal projections, directed laterally (Figs. 3H, 5H).

Type locality. Suriname: Para: Coesewijneproject, 12 km West of Saramacca-brug.

Repository. Zoölogisch Museum, Rijksuniversiteit te Utrecht, Utrecht, The Netherlands.

Published records. Brazil: Amazonas, Pará (J. Polhemus & D. Polhemus, 1984; Pereira & Melo, 2007; D. Polhemus, 2014; Rodrigues *et al*., 2014; Rodrigues & Moreira, 2016; dos Santos *et al.*, 2021). French Guiana: Saint-Georges (Armisén *et al.*, 2022). Guyana: Upper Demerara-Berbice (D. Polhemus, 2014). Suriname: Para (J. Polhemus & D. Polhemus, 1984).

Distribution. This species is distributed from the Guianas to the northern portion of the Brazilian Amazon (Fig. 8).

Discussion. This species was described based on brachypterous specimens from Suriname and Brazil (J. Polhemus & D. Polhemus, 1984). Rodrigues *et al*. (2014) illustrated the macropterous male, and Rodrigues & Moreira (2016) illustrated the brachypterous female. The size and shape of the forewing maculae change according to the wing condition. In macropterous specimens, the basal and apical maculae are larger; the basal macula is roughly ovate and the apical macula is

elongate and slightly constricted at mid-length (Fig. 4E). The maculae can be smaller and fainter in brachypterous specimens (Figs. 4A–B, 4D); the basal macula, when present, is oval, and the apical macula can be small and rounded (Fig. 4B, 4D) or display the typical shape seen in macropterous specimens (Fig. 4C).

Type material examined. PARATYPES: BRAZIL, **Amazonas**, Reserva Ducke, 25 km NNE Manaus, 120 m, July 21, 1973, R.T. Schuh / impounded area in forest stream / Paratype Paravelia digitata J.T. & D.A. Polhemus / J.T. Polhemus Collection 2014 C.J. Drake Accession (1 brachypterous ♀, NMNH).

Additional material examined. BRAZIL, **Amazonas**: Igarape [=Igarapé] da Anta, Reserva Ducke, 25 km NE of Manaus, 60 m, 24.5°C, 25 August 1989, CL2472, D.A. & J.T. Polhemus (4 brachypterous ♂, 3 brachypterous ♀, NMNH); Manaus, Reserva Florestal Adolpho Ducke, poça temporária na trilha para o igarapé Barro Branco, 02˚53'S, 59˚58'W, 27.XI.2012, U.G. Neiss col. (1 brachypterous ♀, MZUSP); Barcelos, Serra do Aracá, Igarapé Ataiana, tributário do Rio Negro, 00°88'56.57"S, 62°54'13.90"W, 10.VIII.2009, N. Hamada, R.L. Ferreira-Keppler, A.M.O. Pes & C.A.S. Azevêdo col. (1 macropterous ♂, INPA).

***Foveavelia hungerfordi* (Drake & Harris, 1933) n. comb.**

(Figs. 6A–B, 8)

Velia hungerfordi Drake & Harris, 1933: 46 (original description).

Paravelia hungerfordi: J. Polhemus 1976: 512 (changed combination).

Diagnosis. Body length 4.80. Distance between basal and apical forewing maculae smaller than the length of the basal macula (Fig. 6A).

Type locality. In the original description, the authors mentioned only "Chapada, Brazil", without additional data. The locality very likely corresponds to Chapada do Guimarães, state of Mato Grosso, and the type material was probably collected by Herbert Huntington Smith (Moreira *et al.*, 2011).

Repository. Carnegie Museum of Natural History, Pittsburgh, United States.

Published record. Brazil: Mato Grosso (Drake & Harris, 1933).

Distribution. Known only from the type-locality in central-western Brazil (Fig. 8).

Discussion. Drake & Harris (1933) described this species based on two female specimens. Because only the type series is known, the comparison with males of other species is not possible. Mazzucconi (2000) provided a redescription of this species and compared it with *F. anta*. She distinguished the two based mainly on the length and width of the body, the shape of the anterolateral margin of the pronotum, and the size of the forewing maculae. Female *Foveavelia* are very similar ~~to each other,~~ and the condition of the forewing maculae is the only viable character to identify *F. hungerfordi*.

Type material examined. PARATYPE: BRAZIL, **Mato Grosso**: Chapada, Brazil, Acc. No. 2966, Paratype Velia hungerfordi D&H, CJ Drake Coll. 1956, Velia hungerfordi D&H. (1♀ macropterous NMNH).

Key to the species of *Foveavelia*

Foveavelia amapaensis and *F. bilobata* are known only from the male, whereas *F. hungerfordi* is known only from the female. As in other Neotropical Veliinae genera, males should be prioritized for identification purposes, as they usually display the most informative diagnostic features.

1. Distance between basal and apical forewing maculae in macropterous specimens smaller than length of basal macula (Fig. 6A).....***F. hungerfordi***
- Distance between basal and apical forewing maculae in macropterous specimens greater than length of basal macula (Figs. 1A–C, 4E).....2
2. Pronotum sexually dimorphic, widened anteriorly in the male (Figs. 4D–E) but not in the female (Fig. 4A–B); male fore tibial grasping comb occupying almost half of tibial length; male proctiger with a pair of small, spinose, laterally directed, anterodorsal projections (Figs. 3H, 5H).....***F. dilatata***
- Pronotum not sexually dimorphic, not widened anteriorly (Figs. 1A–C); male fore tibial grasping comb occupying 1/6–1/4 of tibial length; male proctiger with pair of distinct, upward directed, anterodorsal projections, (Figs. 3E–G).....3
3. Male abdominal sternum VII with a pair of medial gibbosities, without rounded lobes at posterior margin; male proctiger with a pair of long, lateral, divergent spines on anterodorsal region (Fig. 3F).....***F. anta***

- Male abdominal sternum VII without pair of medial gibbosities, with a pair of rounded lobes at or near posterior margin (Figs. 3A–B); male proctiger with a pair of lateral, almost parallel projections on anterodorsal region (Figs. 3E, 3G).....4

4. Pair of rounded lobes on male abdominal sternum VII almost at same level of posterior margin (Fig. 3A); projections of male proctiger ~~not bilobed~~ (Fig. 3E); paramere not widened on distal half (Fig. 3E).....***F. amapaensis***

- Pair of rounded lobes on male abdominal sternum VII extended posteriorly (Fig. 3B); projections of male proctiger bilobed (Fig. 3G); paramere slightly widened on distal half (Fig. 3G).....***F. bilobata***

Discussion

After examining all described Veliinae from the Neotropical region to study the phylogenetic relationships of *Paravelia*, it was possible to define a set of features shared by only five species here included in the new genus *Foveavelia*: *F. amapaensis* (Rodrigues, Moreira, Nieser, Chen & Melo, 2014) **n. comb.**, *F. anta* (Mazzucconi, 2000) **n. comb.**, *F. bilobata* (Rodrigues, Moreira, Nieser, Chen & Melo, 2014) **n. comb.**, *F. dilatata* (J. Polhemus & D. Polhemus, 1984) **n. comb.**, and *F. hungerfordi* (Drake & Harris, 1933) **n. comb.** (see Table 1). *Foveavelia* is defined by the following combination of characteristics: (1) the unusual coarse cuticular punctures found throughout the thorax and abdomen (Fig. 2); (2) the pair of small, frosty pubescent areas formed by a very dense layer of short setae on anterior lobe of the pronotum (Figs. 1A, 4A–B, 4D–E); (3) the fore tibial grasping comb present only in males, occupying 1/4 (Fig. 1D) to half of the fore tibial length; (4) the middle tibia with a row of elongate dark-brown trichobothria-like setae on the posterior third, decreasing in size distally; (5) the macropterous specimens with the apical macula of the forewings elongate and slightly constricted at mid-length, reaching the wing apex; (Figs. 1A–C, 4E, 6A, 6C); (6) the meso- and metasterna each with a pair of tubercles, these tubercles meeting at suture, forming a cavity between them (Fig. 1D); (7) the metasternum with the posterior margin convex (Fig. 1D); (8) the male abdominal segment VIII acuminating posteroventrally (Figs. 2F, 3C–D, 5A–B); and (9) the male proctiger with a pair of anterodorsal projections (Figs. 3E–H, 5H).

Rodrigues *et al*. (2014) and Rodrigues & Moreira (2016) had already indicated the similarities shared by these species, but did not propose any taxonomic changes. The main

diagnostic feature of *Foveavelia* is the presence of coarse cuticular punctures along the body (Fig. 2). As described by Mazzucconi (2000), these structures are cuticular depressions with deep, transverse grooves, and a sensilla-like seta placed eccentrically to these grooves, or sometimes centrally. Although the arrangement of this seta varies, its size is similar among different punctures. Unlike the structure described above, the pronotal punctures typical of most Veliidae, including *Foveavelia*, are rounded and covered by a cluster of centrally directed microtrichia along the puncture rim, making the transverse grooves and sensilla-like seta difficult to see (Figs. 2A–B). On the other hand, the distinctive punctures of *Foveavelia* lack clusters of microtrichia along the puncture rim (Figs. 2D–E). These punctures usually do not touch each other (Figs. 2C, 2F), although in some regions of the body, such as on the sides of abdominal mediotergites I–III, they are conjoined, forming larger, flower-like structures (Figs. 2A, 2D).

Because *Paravelia* is not monophyletic and due to the morphological heterogeneity among its species, it is difficult to detect diagnostic characters for the entire genus. *Paravelia basalis* (Spinola, 1837) (Fig. 7A), the type species, differs from *Foveavelia* in several characteristics, including the absence of coarse cuticular punctures throughout the body, the absence of frosty pubescence on the anterior lobe of the pronotum, the different shape and color of the forewing maculae, the presence of a pair of distinct projections on male abdominal sternum VII, the different shape of male abdominal segment VIII (Figs. 7B–C), and the presence of anterodorsal and anterolateral projections on the male proctiger (Fig. 7D).

Paravelia foveata J. Polhemus & D. Polhemus, 1984 (Figs. 7F–G) displays a pattern of cuticular punctures on the body similar to *Foveavelia*. However, because this species has several characteristics that are not present in other species here assigned to *Foveavelia*, it is not included in the new genus. The following features are exclusive to *P. foveata*: (1) general body color reddish-brown, with short pubescence; (2) antennomere IV very small, fusiform; (3) anterior lobe of pronotum with a pair of yellowish-white markings; (4) forewings with differently shaped closed cells, with an additional macula basally, and apical macula crescent-shaped, not reaching wing apex (5) male fore tibial grasping comb occupying about two-thirds of the tibial length (Fig. 7G); (6) row of elongate dark-brown trichobothria-like setae on the middle tibia occupying half of the segment; (7) coarse punctures present on abdominal sternum VII; and (8) male proctiger without anterodorsal projections. The cuticular modifications found along the body of *P. foveata*, especially those present on the abdomen, are very likely not homologous to those

displayed by *Foveavelia*. Cuticular modifications similar to those of *Foveavelia*, but probably also not homologous, are found in members of Microveliinae (Gerromorpha: Gerridae), such as *Neoalardus typicus* (Distant, 1903) and *Hebrovelia singularis* Lundblad, 1939.

In terms of phylogenetic relationships, the only species of *Foveavelia* heretofore included in a study is *F. dilatata* (Armisén *et al.*, 2022). It was recovered as sister to the genus *Stridulivelia*, which displays different types of cuticular modifications on the thorax and abdomen (glabrous longitudinal striae or elongate lacunae). In the future, expanding the taxonomic scope of Veliinae in a phylogenetic analysis would be interesting to test whether all taxa with cuticular modifications, including *Stridulivelia*, *Foveavelia* and *P. foveata* are indeed closely related.

Conclusions

After examination of all american species within the subfamily Veliinae, a new Neotropical genus has been established to accommodate five species previously classified in *Paravelia*. This new genus has been characterized morphologically using SEMs and photographs. Future phylogenetic hypotheses are required to elucidate the closely related lineages of this new genus.

Acknowledgements

We are grateful to Dr. Silvia Mazzucconi (Universidad de Buenos Aires, Buenos Aires, Argentina) for permission to use the scanning electron microscopy photographs of *Foveavelia anta*. We also thank Dr. Alan L. de Melo (DPIC), Dr. Marcelo Duarte (MZUSP), Dr. Marcio Oliveira and Msc. Thiago Mahlmann (INPA), and Dr. Thomas Henry (USNM) for providing access to their institutional collections.

References

Andersen NM. 1982. The semiaquatic bugs (Hemiptera, Gerromorpha) phylogeny, adaptations, biogeography and classification. *Entomonograph* 3:1–455.

Armisén D, Viala S, Cordeiro IRS, Crumière AJJ, Hendaoui E, Le Bouquin A, Duchemin W, Santos E, Toubiana W, Vargas-Lowman A, Floriano CFB, Polhemus DA, Wang Y, Rowe L, Moreira FFF, Khila A. 2022. Transcriptome-based phylogeny of the semi-aquatic bugs (Hemiptera: Heteroptera: Gerromorpha) reveals patterns of lineage

expansion in series of new adaptative zones. *Molecular Biology and Evolution* 39(11):msac229. https://doi.org/10.1093/molbev/msac229

Bastos CMCB, Valente AKM, Oliveira KN. 2021. A ICOMI no Amapá: a empresa, os operários e suas famílias na mineração de manganês entre 1950 e 1960. *Planeta Amazônia: Revista Internacional de Direito Ambiental e Políticas Públicas* 13:1–14.

Damgaard J. 2008. Phylogeny of the semiaquatic bugs (Hemiptera-Heteroptera, Gerromorpha). *Insect Systematics & Evolution* 39:431–460. https://doi.org/10.1163/187631208788784264

dos Santos SE, Rodrigues JMS, Couceiro SRM, Moreira FFF. 2021. Gerromorpha (Hemiptera: Heteroptera) from the Metropolitan Region of Santarém, Brazil, including three new species of *Microvelia* Westwood, 1834 (Veliidae: Microveliinae). *Biodiversity Data Journal* 9:e68567. https://doi.org/10.3897/BDJ.9.e68567

Drake CJ, Harris HM. 1933. New American Veliidae (Hemiptera). *Proceedings of the Biological Society of Washington* 46:45–54.

Kury AB, Giupponi APL, Mendes AC. 2018. Immolation of Museu Nacional, Rio de Janeiro – unforgettable fire and irreplaceable loss. *Journal of Arachnology* 46:556–558. https://doi.org/10.1636/JoA-S-18-094.1

Mazzucconi SA. 2000. *Paravelia anta* sp. n. and *P. hungerfordi* (Drake and Harris) from South America (Heteroptera: Veliidae). *Aquatic Insects* 22(2):129–137. https://doi.org/10.1076/0165-0424(200004)22:2;1-P;FT129

Moreira FFF, Barbosa JF, Ribeiro JRI, Alecrim VP. 2011. Checklist and distribution of semiaquatic and aquatic Heteroptera (Gerromorpha and Nepomorpha) occurring in Brazil. *Zootaxa* 2958:1–74. https://doi.org/10.11646/zootaxa.2958.1.1

Pereira DLV, Melo AL. 2007. Aquatic and semiaquatic Heteroptera (Insecta) from Pitinga, Amazonas, Brazil. *Acta Amazonica* 37:643–648.

Polhemus DA. 2014. Two new Peruvian species of *Paravelia* (Heteroptera: Veliidae) from water-filled bamboo internodes, and distributional notes for other *Paravelia* species. *Tijdschrift voor Entomologie* 157:151–162. https://doi.org/10.1163/22119434-00002043

444 Polhemus DA. 2021. *Callivelia*, a new genus for certain Neotropical Veliinae (Heteroptera:
445 Veliidae), including description of a new species. *Zootaxa* 4950(2):345–360.
446 https://doi.org/10.11646/zootaxa.4950.2.6
447 Polhemus JT. 1976. A reconsideration of the status of the genus *Paravelia* Breddin, with other
448 notes and a check list of species (Veliidae: Heteroptera). *Journal of the Kansas*
449 *Entomological Society* 49(4):509–513.
450 Polhemus JT, Polhemus DA. 1984. Notes on Neotropical Veliidae (Hemiptera) IX: additional
451 new species of *Paravelia* from South America. *Amazoniana* 8:497–504.
452 Polhemus JT, Polhemus DA. 1993. Two new genera for New World Veliinae (Heteroptera:
453 Veliidae). *Journal of the New York Entomological Society* 101(3):391–398.
454 Rodrigues HDD, Moreira FFF. 2016. Four new species of *Paravelia* (Hemiptera: Heteroptera:
455 Veliidae) from Brazil, with notes on previously described species. *Canadian*
456 *Entomologist* 148:642–667.
457 https://doi.org/10.4039/tce.2016.18
458 Rodrigues HDD, Moreira FFF, Morales I. 2022. New species and notes on *Paravelia* Breddin,
459 1898 (Heteroptera: Veliidae) from South America. *Zootaxa* 5162(3):277–289.
460 https://doi.org/10.11646/zootaxa.5162.3.5
461 Rodrigues HDD, Moreira FFF, Nieser N, Chen PP, Melo AL, Dias-Silva K, Giehl NFS. 2014.
462 The genus *Paravelia* Breddin, 1898 (Hemiptera: Heteroptera: Veliidae) in Brazil, with
463 descriptions of eight new species. *Zootaxa* 3784:1–47.
464 https://doi.org/10.11646/zootaxa.3784.1.1
465 Rodrigues JMS, Moreira FFF. 2022. New species, new records, and updated key to the *Paravelia*
466 (Hemiptera: Heteroptera: Veliidae) from Brazil. *Insects* 13(541):1–17.
467 https://doi.org/10.3390/insects13060541
468 Schuh RT, Slater JA. 1995. *True Bugs of the World (Hemiptera: Heteroptera) Classification and*
469 *Natural History*. New York: Cornell University Press.

Figure 1

Foveavelia species, dorsal and ventral views.

(A) *Foveavelia amapaensis* (Rodrigues, Moreira, Nieser, Chen & Melo, 2014), dorsal habitus of male holotype (specimen destroyed). (B–D) *Foveavelia bilobata* ~~*amapaensis*~~ (Rodrigues, Moreira, Nieser, Chen & Melo, 2014), (B) dorsal habitus of male from Colombia, (C) dorsal and (D) ventral habitus of male paratype from Brazil, dashed line indicates length of grasping comb. am = apical macula, bm = basal macula, fb = frosty pubescence.


fb
A
bm
B
am
C
D

Figure 2

Structures of *Foveavelia anta* (Mazzucconi, 2000). Scanning electron microscopy.

(A) Dorsal view of head, pronotum and part of abdomen (wings removed). (B) Pronotal punctures. (C) Male abdomen in dorsal view (wings and genital capsule removed). (D) Part of abdominal mediotergite II with suboval punctures. (E) Suboval puncture of abdominal mediotergite IV in detail. (F) Male abdomen in lateral view (wings and genital capsule removed), white arrow indicates posteroventral margin of abdominal segment VIII acuminating distally. mt = mediotergite, lt = laterotergite. ~~Figures~~ provided by Dr. Silvia Mazzucconi.

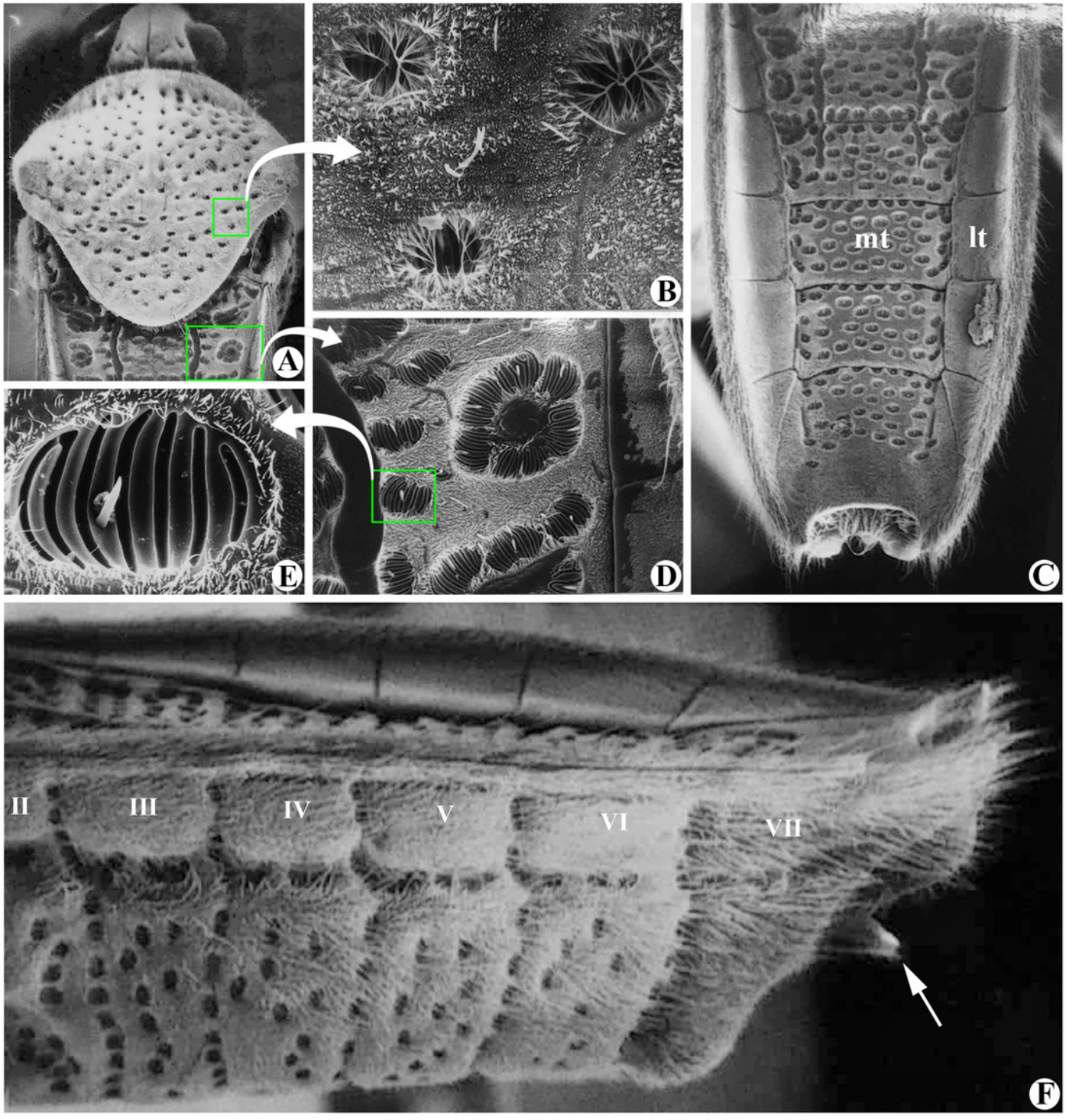
A
B
C
D
E
F
mt
lt
II
III
IV
V
VI
VII

Figure 3

Figure 3. *Foveavelia* species, male structures.

(A–B) Ventral view of abdominal apex, (A) *F. amapaensis* (Rodrigues, Moreira, Nieser, Chen & Melo, 2014), (B) *F. bilobata* (Rodrigues, Moreira, Nieser, Chen & Melo, 2014). (C–D) Abdominal segment VIII of *F. bilobata*, (C) lateral and (D) ventral views. (E–H) Genital capsule in lateral view, showing proctiger projections detailed in frontal view, (E) *F. amapaensis*, (F) *F. anta* (Mazzucconi, 2000), (G) *F. bilobata*, (H) *F. dilatata* (Polhemus & Polhemus, 1984).

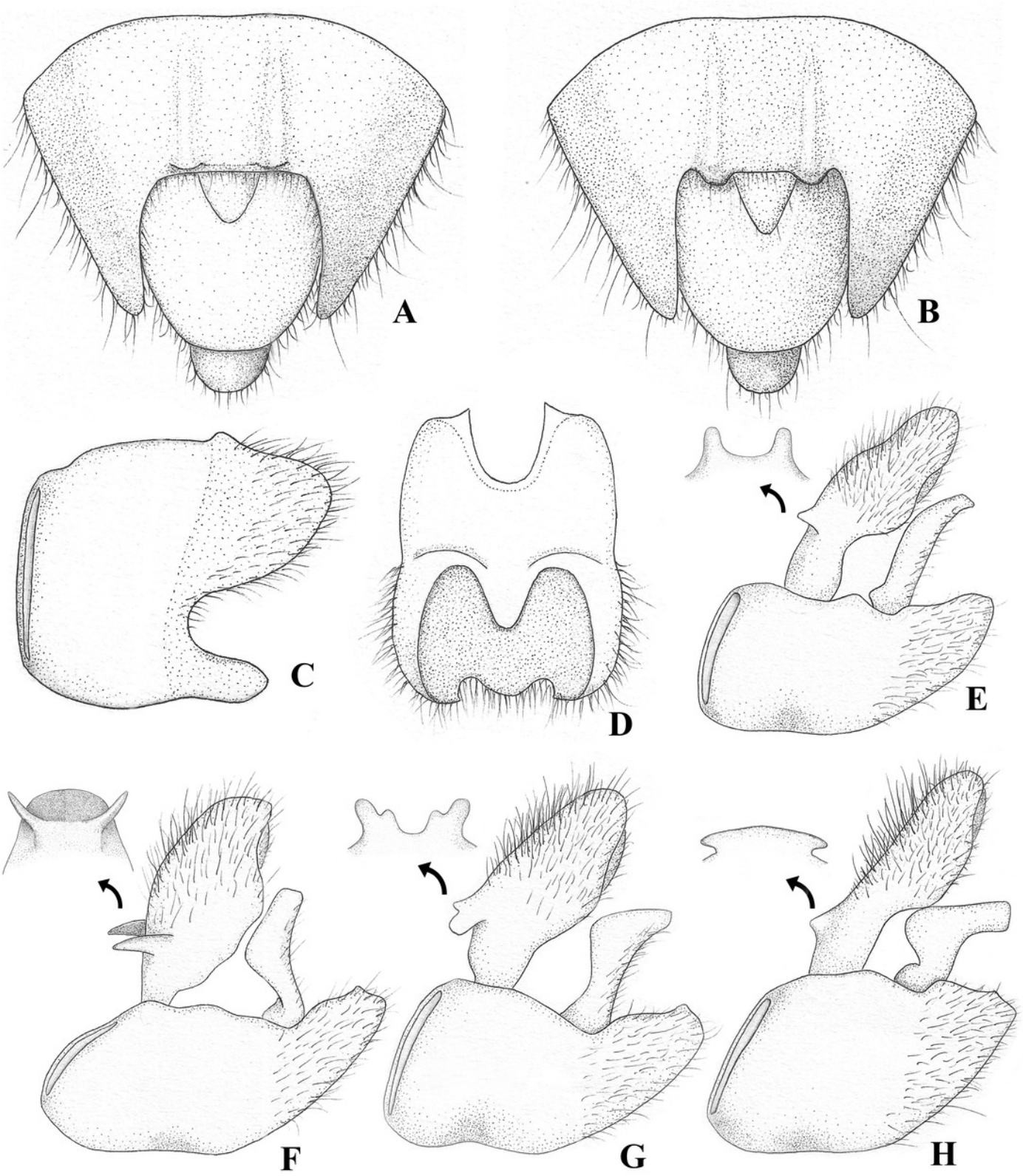
A
B
C
D
E
F
G
H

Figure 4

Foveavelia dilatata (Polhemus & Polhemus, 1984), dorsal views of female and male.

(A–B) Dorsal habitus of brachypterous females, (A) paratype from Brazil, (B) specimen from Brazil. (C) Dorsal view of abdomen of brachypterous female, specimen from Brazil. (D) Dorsal habitus of brachypterous male, paratype from Brazil. (E) Dorsal habitus of macropterous male, specimen from Brazil.

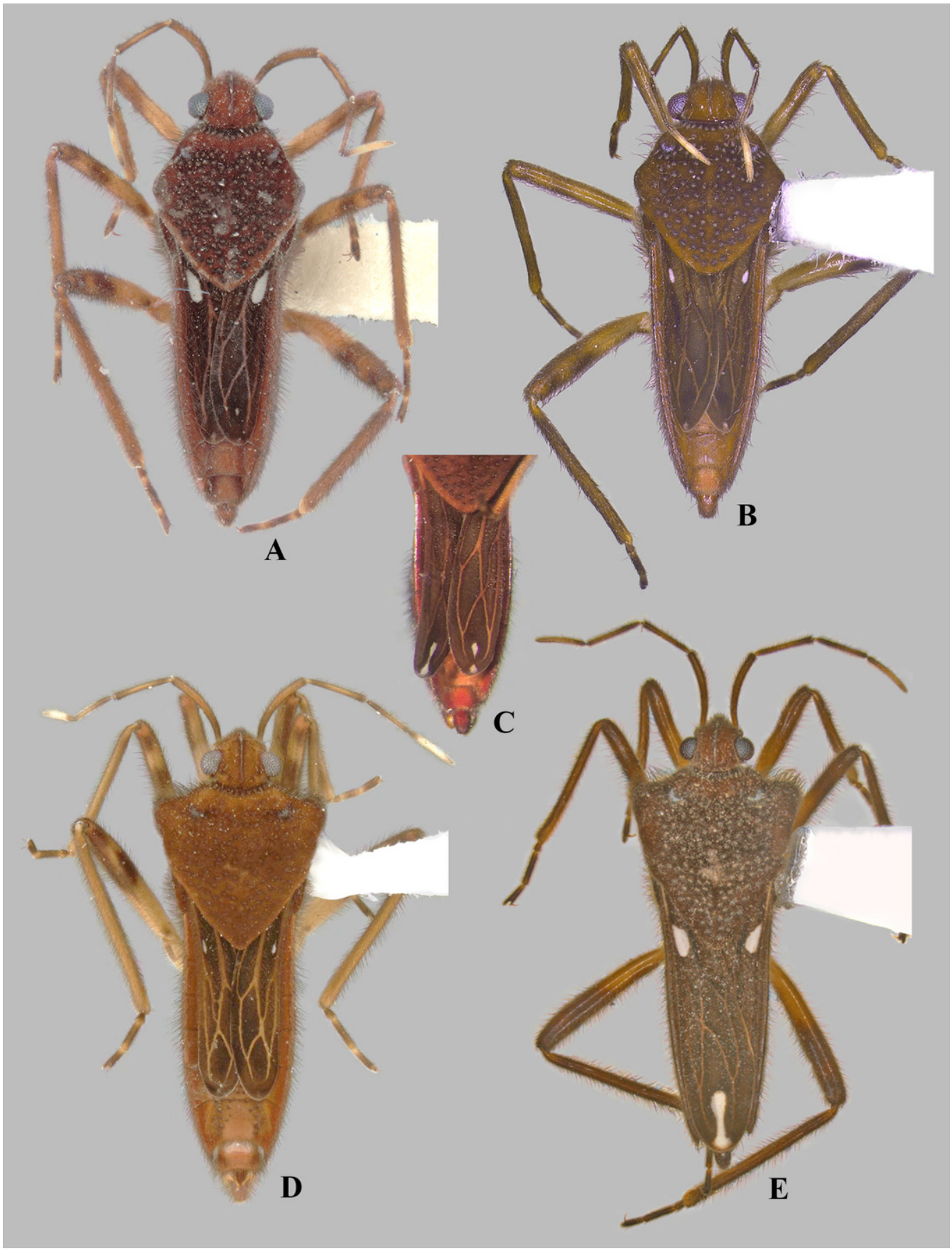
A
B
C
D
E

Figure 5

Figure 5. Male structures of *Foveavelia dilatata* (Polhemus & Polhemus, 1984), paratype from Brazil.

(A–C) Abdominal segment VIII, (A) lateral, (B) ventral and (C) dorsal views. (D) Genital capsule in lateral view. (E) Left paramere in lateral view. (F–H) proctiger, (F) dorsal, (G) lateral and (H) frontal views, white arrow indicates pair of anterodorsal projections.

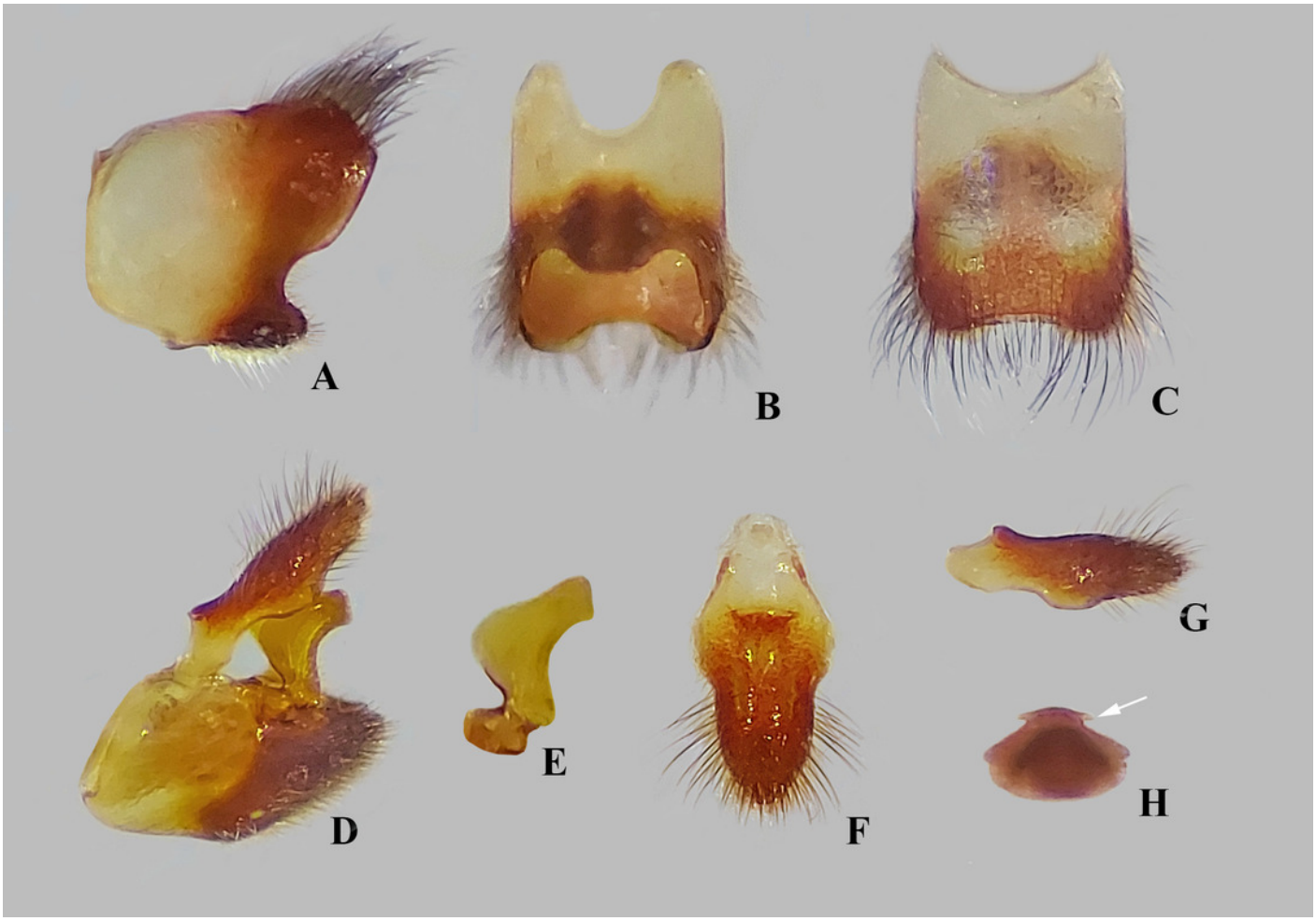

Figure 6

Foveavelia species, dorsal and lateral views.

(A–B) *Foveavelia hungerfordi*, macropterous female paratype from Brazil, (A) dorsal and (B) lateral views. (C–D) *Foveavelia* sp., macropterous female from Brazil, (C) dorsal and (D) lateral views. (E) *Foveavelia amapaensis*, macropterous male holotype in lateral view (specimen destroyed). if = impressed furrow.

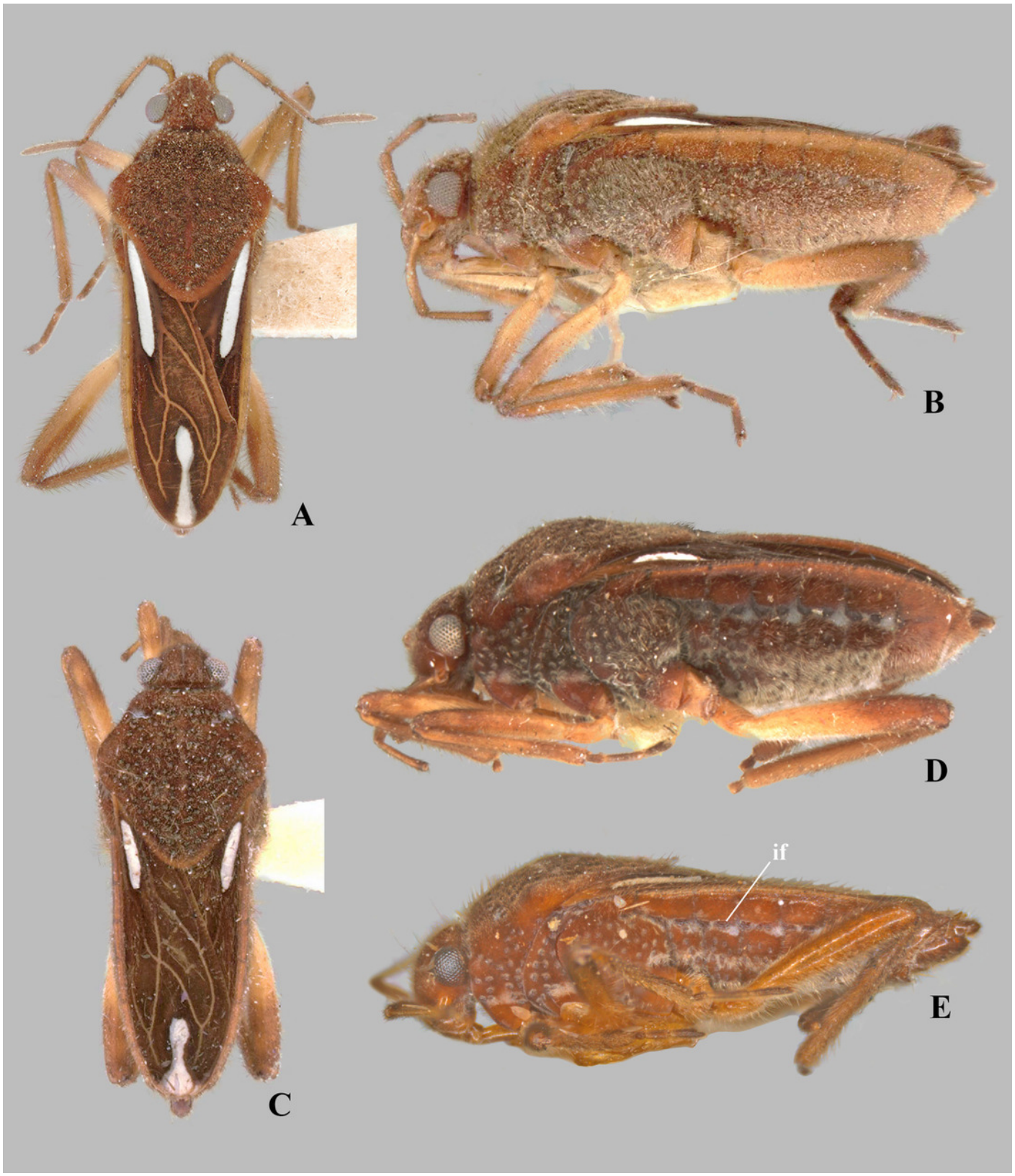
A
B
C
D
if
E

Figure 7

Paravelia species.

(A–E) *Paravelia basalis* (Spinola, 1837), (A) dorsal habitus of male from Brazil, (B–C) male abdominal segment VIII, (B) lateral and (C) dorsal views, (D) male genital capsule, white arrow indicates anterodorsal projection, black arrow indicates anterolateral projection, both in proctiger, (E) left paramere in anterolateral view. (F–G) *Paravelia foveata* Polhemus & Polhemus, 1984, (F) dorsal and (G) ventral habitus of male from Brazil, dashed line indicates length of grasping comb.

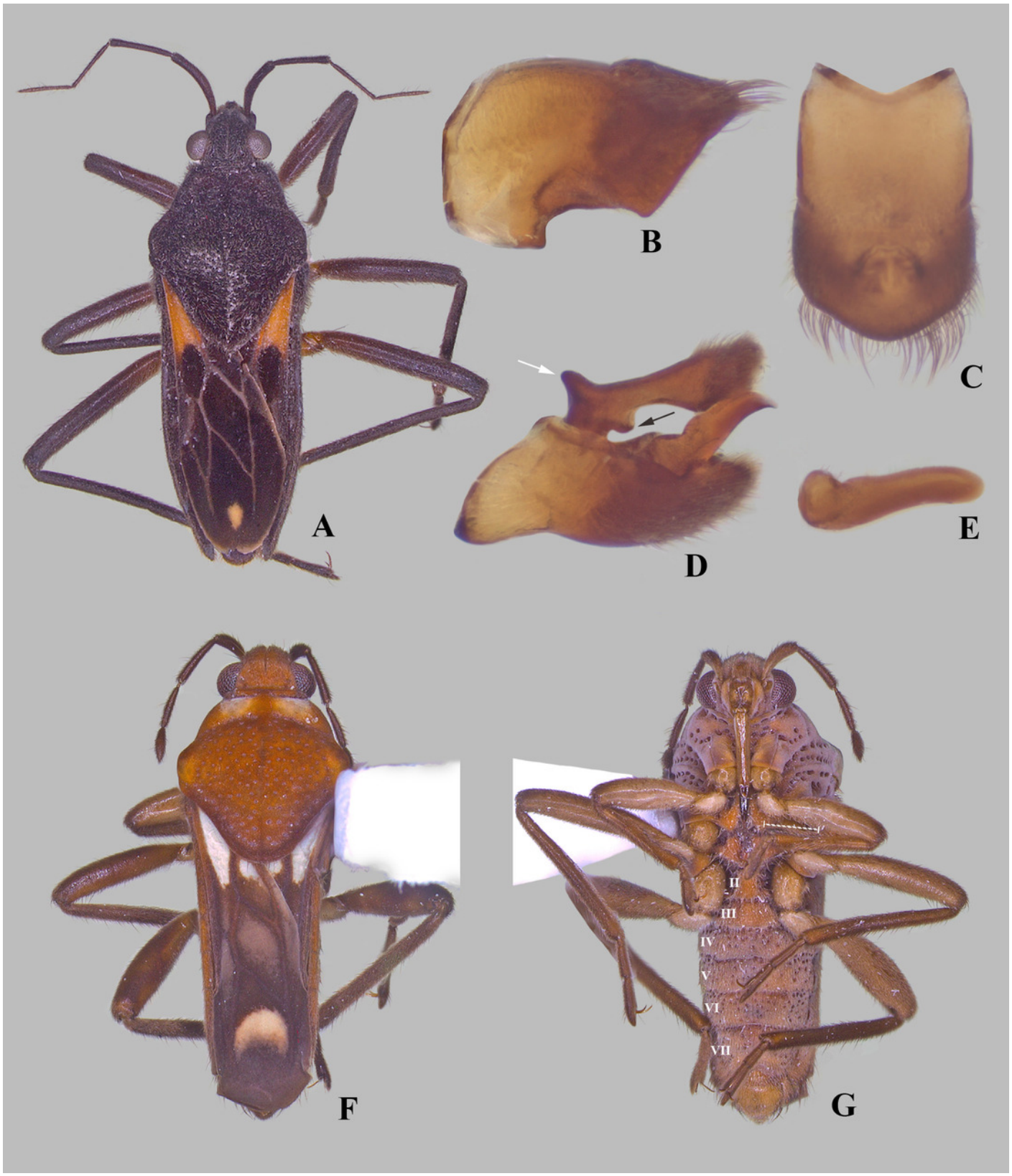
A
B
C
D
E
F
G
II
III
IV
V
VI
VII

Figure 8

Geographic distribution records of *Foveavelia* species.

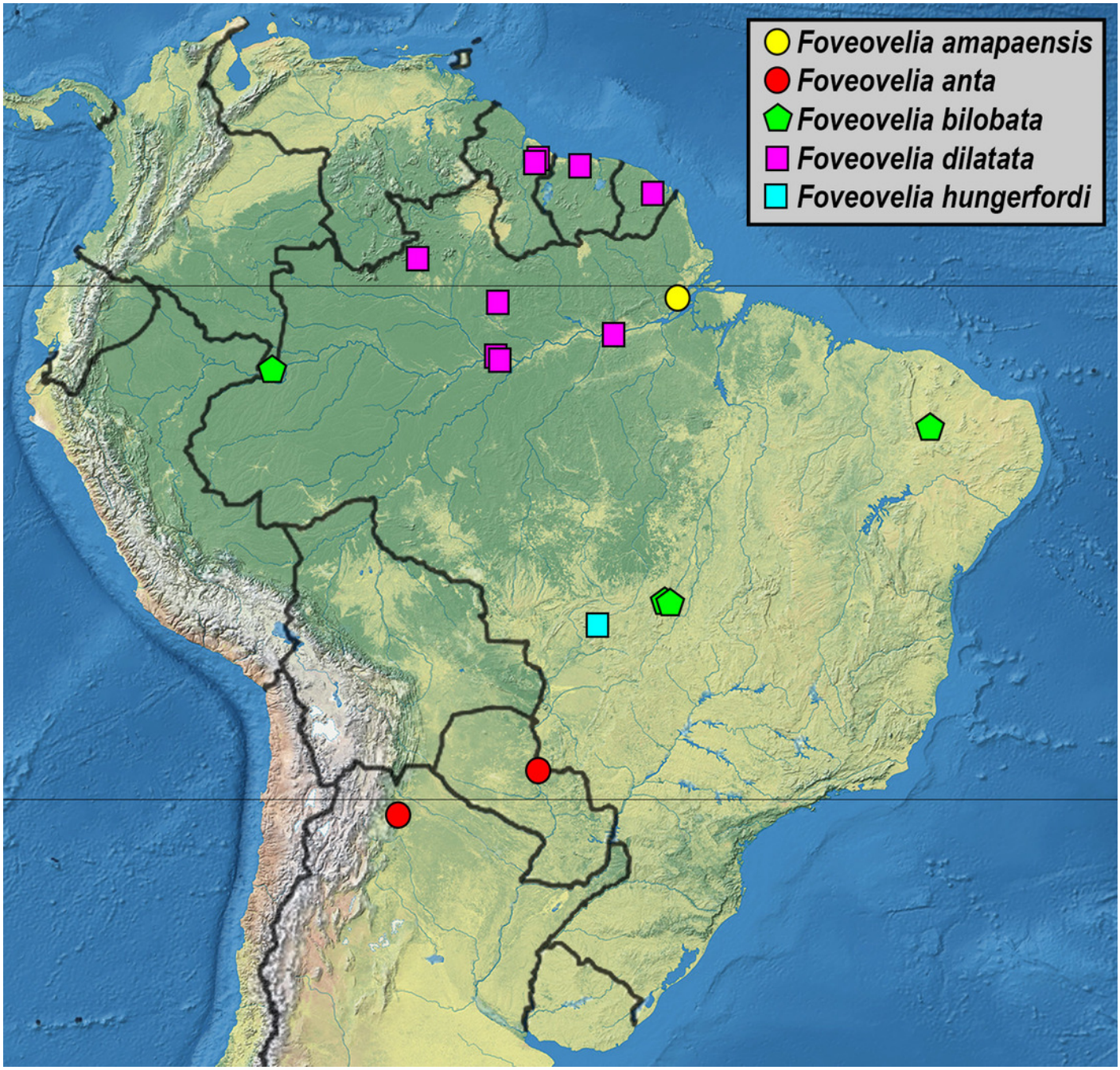

Table 1(on next page)

Checklist of species of *Foveavelia*.

All species are removed from the genus *Paravelia*.

1

Taxon	Distribution
Foveavelia amapaensis (Rodrigues, Moreira, Nieser, Chen & Melo, 2014)	Brazil (Amapá)
Foveavelia anta (Mazzucconi, 2000)	Argentina (Salta), Paraguay (Concepción)
Foveavelia bilobata (Rodrigues, Moreira, Nieser, Chen & Melo, 2014)	Brazil (Ceará, Mato Grosso), Colombia (Amazonas)
Foveavelia dilatata (Polhemus & Polhemus, 1984)	Brazil (Amazonas, Pará), French Guiana (Saint-Georges), Guyana (Upper Demerara-Berbice), Suriname (Para)
Foveavelia hungerfordi (Drake & Harris, 1933)	Brazil (Mato Grosso)

2