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RESEARCH ARTICLE

A new species of the sharpshooter genus *Hanshumba* (Insecta: Hemiptera: Cicadellidae: Cicadellini) from the Mantiqueira mountain range, southeastern Brazil, associated with olive orchards

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ABSTRACT. A new species of *Hanshumba* Young, 1977 is described and illustrated from the Mantiqueira mountain range (southeastern Brazil), municipalities of Wenceslau Braz (state of Minas Gerais) and São Bento do Sapucaí (state of São Paulo). The new taxon is associated with olive orchards and is considered a potential vector of the bacterium *Xylella fastidiosa*. This bacterium causes a serious disease known in Brazil as olive leaf desiccation syndrome. *Hanshumba mariae* **sp. nov.** can be distinguished from the other five known species of the genus by the following combination of features: (1) apical third of ventral margin of male pygofer with small inner process bearing setae; (2) male abdominal segment X (anal tube) without processes; (3) style with apex narrow, obtuse, not foot-shaped; (4) aedeagus with distinct dorsal lobe along basal two-thirds and with apical portion expanded, bearing dorsal projection; (5) paraphyses with distal pair of rami forceps-like, their basal halves divergent from each other, distal halves approximately parallel, apices acute; (6) female sternite VII with posterior margin shallowly emarginate, bearing slight median lobe; and (7) valvula II of ovipositor with approximately 15 low teeth. Both males and females of the new species are described in detail. A key to the six known species of the genus is provided.

KEY WORDS. Cicadellinae, leafhopper, Membracoidea, morphology, taxonomy.

INTRODUCTION

The Neotropical sharpshooter genus *Hanshumba* Young, 1977 includes five species (Young 1977, McKamey 2007, Mauro-Barr and Carvalho 2008, Froza et al. 2018), viz., *H. brasura* Young, 1977 (type species), *H. similis* Mauro-Barr & Carvalho, 2008, *H. cavichiolii* Mauro-Barr & Carvalho, 2008, *H. setifera* Froza, Cavichioli, Costa & Mejdalani, 2018, and *H. teresa* Froza, Cavichioli, Costa & Mejdalani, 2018. *Hanshumba* is apparently restricted to the Atlantic Forest of southeastern and southern Brazil (states of Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina). This genus can be distinguished from other Neotropical Cicadellini by the following combination of features (Froza et al. 2018): (1) dorsum yellow to green mottled with many irregular dark brown vermiculations and spots; (2) head produced anteriorly but without apical thornlike projection; (3) male pygofer well or strongly produced posteriorly, without processes or with peculiar inner process bearing setae, without area of flexion in the middle portion; (4) subgenital plates not extending as far posteriorly as pygofer apex; (5) aedeagus expanded apically; (6) paraphyses with one or two pairs of rami.

In this paper, a new species of *Hanshumba* from the Mantiqueira mountain range, southeastern Brazil, is described and illustrated (states of Minas Gerais and São Paulo). The new taxon is associated with olive orchards and, therefore, is considered a potential vector of the bacterium *Xylella fastidiosa* Wells et al., 1987. In olive groves, this bacterium causes a serious disease known in Brazil as olive leaf desiccation syndrome (Coletta-Filho et al. 2016, Carvalho et al. 2022). A key to males of the six known species of the genus is provided.

MATERIAL AND METHODS

The specimens studied here were collected in an olive orchard located in the municipality of Wenceslau Braz

(22°36'57.686"S, 45°24'28.208"W; 1780 m a.s.l.), state of Minas Gerais. Additionally, we have studied a male from the municipality of São Bento do Sapucaí (22°38'44.13"S, 45°40'40.653"W; 1512 m a.s.l.), state of São Paulo. These municipalities are located close to each other in the Mantiqueira mountain range. As part of the faunistic studies conducted by Froza (2017), nine yellow sticky traps (Isca®, hot melt model) with dimensions of 30 x 10 cm, one per tree, were employed for capturing leafhopper specimens; these traps were positioned on the north face of the orchard periphery, at 0.8 m above soil level, and were replaced fortnightly. All collected specimens were stored in small tubes containing 70% alcohol until the moment of study.

At the time of preparing the specimens for examination, description, and illustration, they were dried on filter paper and mounted on insect pins (double mounting). The male and female terminalia were prepared, using 10% KOH, according to the techniques described by Azevedo-Filho and Carvalho (2006) for males and Mejdalani (1998) for females. Genital structures were stored in microvials with glycerin and attached to the pins below the specimens (Young and Beirne 1958).

The structural terminology follows mainly Young (1968, 1977, 1986), except for that of the facial areas of the head, which follows Hamilton (1981) and Mejdalani (1993, 1998). Terms for the structures of the female terminalia are mainly those of Nielson (1965), Hill (1970), and Davis (1975), except use of the term gonoplac (= third ovipositor valvula), which follows Mejdalani (1998). Photographs of the analyzed specimens were produced with digital cameras attached to stereomicroscopes Zeiss Stemi 2000-C, Motic SMZ-171, and Leica M205 C, and light microscope Nikon Eclipse E200. Studied specimens belong to the Museu de Entomologia "Luiz de Queiroz", Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba (MELQ), and the Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro (MNRJ). Label data are quoted exactly with a reversed virgule (\) separating lines on labels. Using the online tool SimpleMappr (Shorthouse 2010), we prepared a map of southeastern Brazil to show the known distribution of the new species.

TAXONOMY

Hanshumba mariae sp. nov.

Figs 1–15

https://zoobank.org/B07F2C83-A7DA-42D1-B77D-FFB79454441D

Diagnosis. This new species can be distinguished by the following combination of features: (1) apical third of ventral margin of male pygofer with inner setose process very small (Fig. 2); (2) male abdominal segment X (anal tube) without processes (Fig. 5); (3) style with apex narrow, obtuse, not foot-shaped (Fig. 3); (4) aedeagus with distinct dorsal lobe along basal two-thirds and with apical portion expanded, bearing dorsal projection (Fig. 5); (5) paraphyses with distal pair of rami forceps-like, their basal halves divergent from each other, distal halves approximately parallel, apices acute (Fig. 4); (6) female sternite VII with posterior margin shallowly emarginate, bearing slight median lobe (Fig. 7); and (7) valvula II of ovipositor with approximately 15 low teeth (Figs 12–14).

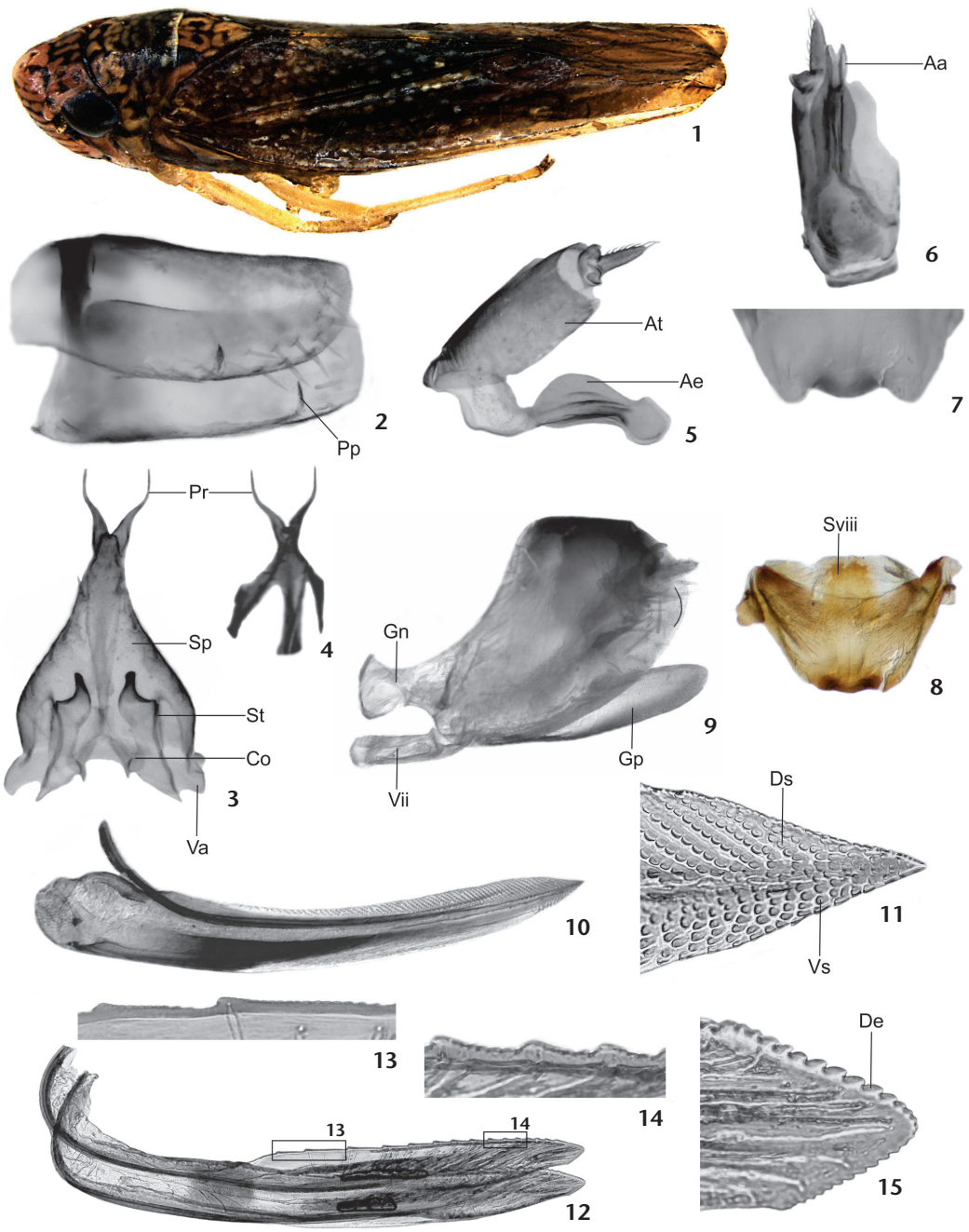
Description. Length of male holotype 6.1 mm, male paratype 6.1 mm, female paratypes 5.9–6.5 mm (n = 3).

Male. Head (Fig. 1), in dorsal view, well produced anteriorly, rounded apically; median length of crown approximately seven-tenths of interocular width and four-tenths of transocular width. Ocelli located slightly before imaginary line between anterior eye angles, each slightly closer to adjacent anterior eye angle than to median line of crown. Antennal ledge, in dorsal view, slightly protuberant; in lateral view, with anterior margin slightly oblique and convex. Frons with median portion slightly convex; epistomal suture obscure medially; clypeus not protuberant.

Thorax (Fig. 1), in dorsal view, with pronotal width approximately equal to transocular width of head; pronotum with lateral margins slightly convergent anteriorly; posterior margin concave; dorsolateral carena declivous anterad, indistinct at area adjacent to eye. Mesonotum with scutellum slightly transversely striate. Forewing (Fig. 1) with membrane not sharply delimited, including at least apical cells, much of anteapical cells, and costal apical cell; with three closed anteapical cells, their bases proximal to claval apex. Hind wing with vein R_{2+3} incomplete. Hind leg with length of first tarsomere approximately equal to combined length of two more distal tarsomeres, with two parallel rows of small setae on plantar surface.

Color (Fig. 1). Ground color of dorsum pale yellow to green mottled with many irregular brown vermiculations and spots. Anterior margin of crown and mesonotum with larger spots. Membrane of forewing translucent, with green spots on anteapical cells. Face, lateral and ventral portions of thorax, and legs mostly yellow; superior portions of antennal ledge and lateral lobe of pronotum with brown spot.

Terminalia. Pygofer (Fig. 2), in lateral view, strongly produced posteriorly; distal half slightly narrower than basal half; posterior margin broadly rounded; apical third of ventral margin with small inner process bearing setae, additional processes absent; macrosetae distributed mostly on posterior portion and extending anteriorly along ventral margin. Subgenital plate (Fig. 3), in ventral view, subtriangular, with basal one-fourth distinctly expanded and then narrowing gradually toward apex; surface with mostly small macrosetae along outer margin, microsetae also present; plates not fused to each other at base; in lateral view, not extending as far posteriorly as pygofer apex. Connective (Fig. 3), in dorsal view, Y-shaped; stalk with slight median keel. Style (Fig. 3), in dorsal view, extending posteriorly beyond apex of connective; with distinct outer preapical lobe; outer preapical area bearing setae; apex narrow, obtuse, not foot-shaped. Aedeagus (Figs 5, 6) symmetrical; shaft, in lateral view, elongate; basal two-thirds with distinct dorsal lobe; apical portion expanded, with slight dorsal projection, dorsal margin



Figures 1–15. *Hanshumba mariae* sp. nov. (1) female, habitus, laterodorsal view (length 5.9 mm); (2–6) male terminalia: (2) pygofer, latero-ventral view; (3) valve, subgenital plates, connective, styles, and distal rami of paraphyses, dorsal view (the stalk and proximal rami of the paraphyses are not visible); (4) paraphyses, dorsal view; (5) aedeagus and anal tube, lateral view; (6) aedeagus and anal tube, ventral view; (7–15) female terminalia: (7) distal portion of sternite VII, ventral view; (8) sternite VII and "internal" sternite VIII, anteroventral view; (9) pygofer (contour of posterior margin highlighted), also showing the gonangulum, valvifer II, gonoplac, and part of the anal tube, lateral view; (10) valvula I of ovipositor, lateral view; (11) apex of valvula I, lateral view; (12) valvulae II of ovipositor, lateral view; (13) teeth at basal portion, lateral view; (14) teeth at apical portion, lateral view; (15) apex of valvula II, lateral view. (Aa) aedeagal apex, (Ae) aedeagus, (At) anal tube, (Co) connective, (De) denticle, (Ds) dorsal sculptured area, (Gn) gonangulum, (Gp) gonoplac, (Pp) pygofer process, (Pr) paraphyses ramus, (Sp) subgenital plate, (St) style, (Sviii) "internal" sternite VIII, (Va) valve, (Vii) valvifer II, (Vs) ventral sculptured area.

straight from projection to apex; gonoduct distinct, gonopore located ventroapically. Paraphyses (Fig. 4), in dorsal view, with stalk elongate, slightly constricted medially, articulated with apex of connective; with two pairs of rami: proximal pair directed anterad, slightly asymmetrical; distal pair directed posterad, forceps-like, basal halves of rami divergent from each other, distal halves approximately parallel, their apices acute. Anal tube (Fig. 5), in lateral view, with segment X lacking inner process.

Female. External form and color as described above for the male. Terminalia. Sternite VII (Fig. 7), in ventral view, slightly narrowed posteriorly; posterior margin shallowly emarginate, bearing slight median lobe. "Internal" sternite VIII (Fig. 8), in dorsal view, with irregular, median sclerotized area associated with ovipositor base. Pygofer (Fig. 9), in lateral view, slightly produced posteriorly; posterior margin broadly rounded; few macrosetae on posterior portion and near posteroventral margin. Valvifer I, in lateral view, subquadrate. Valvula I (Figs 10, 11), in ventral view, with basal portion triangularly expanded; blade, in lateral view, slightly curved dorsally; apex acute; ventral interlocking device elongate, extending along basal half of valvula; blade surface, especially basal half, with few small setae [trichoid sensilla] and many pores located below or adjacent to ramus, base with distinct group of denticuli; dorsal sculptured area extending from basal portion to apex of blade, formed by distinct scale-like processes arranged mostly in oblique lines; ventral sculptured area restricted to apical portion, formed by scale-like processes. Valvula II (Figs 12–15), in lateral view, only slightly expanded beyond basal curvature; ventral preapical prominence inconspicuous; apex obtuse; dorsal margin with approximately 15 low, poorly defined teeth that become progressively smaller toward apex, basalmost three teeth very elongate; denticles distributed on teeth and on apical portion of blade (dorsal dentate apical portion longer than ventral portion); valvula with ducts extending to teeth (or terminating below them) and to apex; membrane associated with basal portion of valvula with distinct pores. Gonoplac (Fig. 9) of the usual Cicadellinae type: in lateral view, distinctly expanded at apical half; apex obtuse; denticuli distributed at basal half, narrow area along ventral margin of apical half, and apex; these areas also bearing few setae.

Type material. Southeastern Brazil, Mantiqueira mountain range, states of Minas Gerais and São Paulo. Holotype male: "Wenceslau Braz \ MG [Minas Gerais] 15-31/X/2019 \ J. A. FROZA" (MELQ, ESALQENT001731). Paratypes: two females, "Wenceslau Braz \ MG 01-16/XI/2018 \ J. A. FROZA" (MELQ, ESALQENT001732 and 001733); one male and four females, "Wenceslau Braz \ MG \ 30/IX-15/X/2019 \ J. A. FROZA col." (MNRJ); one male, "São Bento do \ Sapucaí – SP [São Paulo] \ 14-28/IX/2019 \ J. A. FROZA col." (MNRJ); one male, "São Bento do Sapucaí \ SP X-2015 \ J. A. FROZA" (destroyed by the fire at MNRJ).

Etymology. The new species is described in honor of Maria Aparecida Froza, first author's mother, who greatly encouraged her for the scientific career and life.

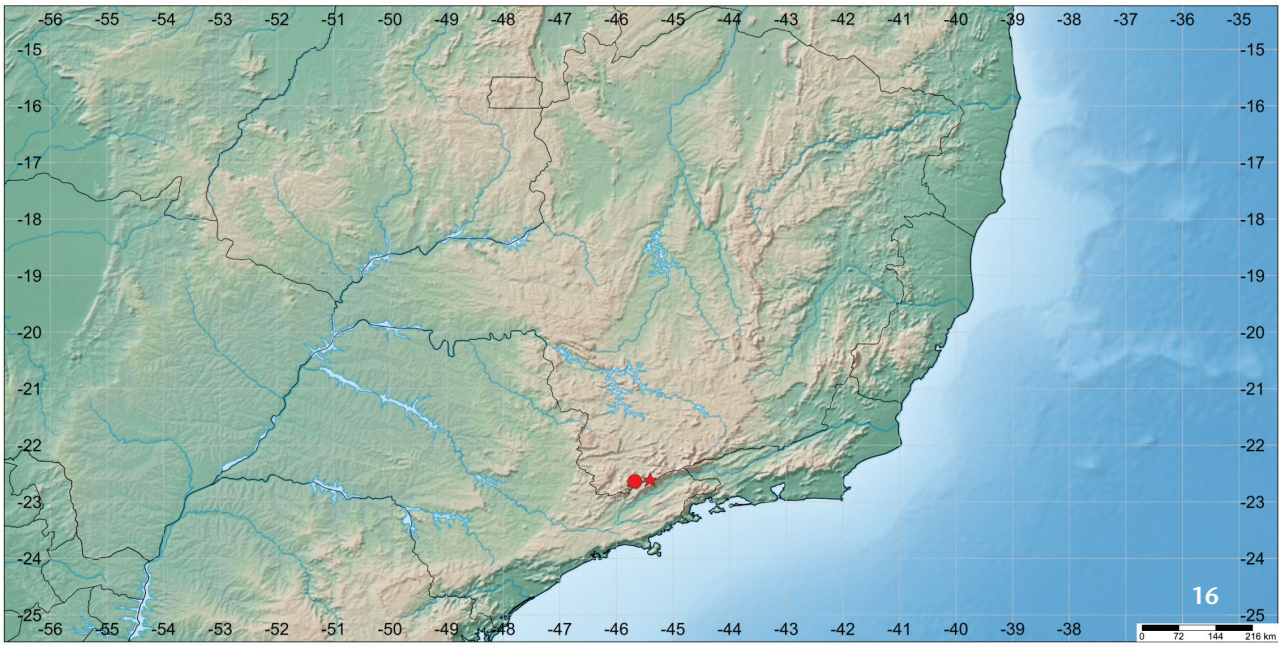
Key to males of *Hanshumba* Young, 1977 (modified from Froza et al. 2018)

1. Paraphyses with two pairs of rami, one directed anterad and another posterad 2
1′. Paraphyses with single pair of rami directed posterad 4
2. Aedeagus, in lateral view, with dorsal lobe along basal two-thirds of shaft [states of Minas Gerais and São Paulo] ..... *H. mariae* sp. nov.
2′. Aedeagus, in lateral view, without such lobe..... 3
3. Aedeagus, in ventral view, with pair of small dentiform processes, without longitudinal flanges [State of Espírito Santo]..... ..... *H. setifera* Froza, Cavichioli, Costa & Mejdalani, 2018
3′. Aedeagus, in ventral view, without small dentiform processes, with three pairs of longitudinal flanges [State of Espírito Santo] .... *H. teresa* Froza, Cavichioli, Costa & Mejdalani, 2018
4. Paraphyses rami, in dorsal view, with conspicuous spiniform process directed posterad [State of Rio de Janeiro] ... . *H. similis* Mauro-Barr & Carvalho, 2008
4′. Paraphyses rami, in dorsal view, without such process... 5
5. Aedeagal shaft, in lateral view, with constriction delimiting lobe at apical third [State of Paraná]..... .....*H. cavichiolii* Mauro-Barr & Carvalho, 2008
5′. Aedeagal shaft, in lateral view, gradually expanded posterad, without distinct constriction [State of Santa Catarina] .... *H. brasura* Young, 1977

DISCUSSION

The new taxon, *H. mariae* sp. nov., has the same color pattern (Fig. 1) found in other species already described within the genus *Hanshumba*, i.e., yellow to green dorsum mottled with many irregular dark brown vermiculations and spots (Young 1977, Mauro-Barr and Carvalho 2008, Wilson et al. 2009, Froza et al. 2018). This shared color pattern makes the association between males and females of a given species somewhat difficult (Froza et al. 2018). However, in the present work, we have confidently associated females with males because almost all of them were collected from the same orchard in the type locality (Wenceslau Braz) and no other *Hanshumba* species has been found there so far. The new species shares the presence of two pairs of paraphyses rami (Fig. 4) with *H. setifera* and *H. teresa* (Froza et al. 2018), whereas the other three known species have just one pair (Young 1977, Mauro-Barr and Carvalho 2008). The characters provided above in the diagnosis will readily distinguish *H. mariae* sp. nov. from the remaining species of the genus. The ovipositor valvulae II bear approximately 15 teeth in *H. mariae* sp. nov. (Fig. 12), whereas in *H. brasura*, *H. cavichiolii*, and *H. similis* more than 20 teeth are present (Mauro-Barr and Carvalho 2008); females of *H. setifera* and *H. teresa* are, unfortunately, unknown (Froza et al. 2018). Therefore, valvulae II vary interspecifically within *Hanshumba* and provide a useful feature for the recognition of the new species.

Preliminary studies carried out by Froza (2017, 2022) indicated that *H. mariae* sp. nov. could be a vector of the bacte-



Figures 16–18. (16) relief map showing the position in the Mantiqueira mountain range (southeastern Brazil) of the type locality – Wenceslau Braz (star) – and the nearby São Bento do Sapucaí (circle), where material of *Hanshumba mariae* sp. nov. has also been collected. (17, 18) two views of the olive orchard at the type locality.

rium *X. fastidiosa* for olive trees. The new taxon is among the predominant Cicadellinae species in the sampled olive orchard from Wenceslau Braz (Figs 16–18). In order to confirm whether it is really a vector of this bacterium, transmission studies will be conducted in the near future. Other predominant sharpshooter species in Mantiqueira olive orchards include *Bucephalogonia xanthophis* (Berg, 1879), *Dilobopterus costalimai* Young, 1977, *Erythrogonia phoenicea* (Signoret, 1853), *E. sinvali* Froza, Quintas & Mejdalani, 2021, *Macugonalia leucomelas* (Walker, 1851), *M. cavifrons* (Stål, 1862), *Scopogonalia paula* Young, 1977, *Scoposcartula tobiasi* Cavichioli & Mejdalani, 1996, *Sibovia sagata* (Signoret, 1854), and *Subrasaca bimaculata* Silva, Cavichioli & Mejdalani, 2013 (Froza 2017, 2022). Almost all of these species are quite common in human-modified areas of southeastern Brazil.

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Author Contributions

JAF and GM contributed equally to the study conception and

design. Preparation of specimens, description, illustrations, and comparison with related forms were performed by both of them. They wrote the first draft of the manuscript and subsequent versions, and both approved the final version. This contribution is part of JAF's Ph.D. Thesis.

Competing Interests

The authors have declared that no competing interests exist.

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