

Research article

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A new genus and species of Cicadellini (Insecta: Hemiptera: Cicadellidae: Cicadellinae) from the Brazilian Atlantic Forest

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Abstract. The remarkable sharpshooter *Prodiigiella silvano* gen. et sp. nov. is described and illustrated (including the external form, color, male and female terminalia) from the Atlantic Forest of southern and southeastern Brazil (states of Paraná and Rio de Janeiro). The new genus can be distinguished from other Neotropical genera of the Cicadellini by a combination of various morphological features, including an asymmetrical aedeagus with a bifid shaft and peculiar basal and apical processes and ovipositor valvula II distinctly expanded beyond basal curvature, its dorsal margin with 35–40 teeth, and ventral margin without preapical prominence. A discussion comparing *Prodiigiella* with superficially similar taxa of the genera *Macugonalia* Young, 1977, *Ruppeliana* Young, 1977, and *Versigonalia* Young, 1977 is provided. The discovery of this peculiar new genus indicates that much collecting work in the remaining parts of the Atlantic Forest is clearly and urgently needed.

Keywords. Auchenorrhyncha, Membracoidea, morphology, Neotropical region.

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Introduction

The subfamily Cicadellinae Latreille, 1825 (popularly known as sharpshooters) is very large and diverse, being the third largest within the family Cicadellidae (Yang *et al.* 2005). It comprises about 2400 species and 320 genera, distributed in all major zoogeographical regions of the world, being especially rich in the Neotropical Region (Young 1968, 1977, 1986; Mejdalani 1998; Nielson & Knight 2000; Wilson & Turner 2007). Members of this subfamily vary in length from very large leafhoppers (ca 22 mm) to individuals of only 3.4–4.5 mm; many of them are quite colorful (Mejdalani 1998). According to Young (1968), the Cicadellinae can be differentiated from other leafhoppers by the following combination of characters: (1) ocelli located on crown, nearly always closer to the posterior margin than to apex or to anterolateral margin; (2) body usually not flattened dorsoventrally; (3) forewing with outer margin of inner (first) apical cell parallel to long axis of wing; (4) posterior tibiae with macrosetae in four regular rows; (5) proepisternum exposed; (6) lateral clypeal [= frontogenal] sutures extending onto crown and almost always extending to or near ocelli. Members of this subfamily are usually considered generalists, feeding on the xylem of a wide range of plants and laying eggs on herbaceous hosts; some are exclusively grass and sedge feeders, whereas others are specialists on shrubs and trees (Nielson & Knight 2000).

Several tribes have been included in the Cicadellinae over the years (e.g., Evans 1947; Hamilton 1983; Godoy & Webb 1994). However, the classification proposed by Young (1968, 1977, 1986), who published the most detailed monographs on the subfamily, recognized only two tribes, Cicadellini and Proconiini. The Cicadellini, which includes the new genus described here, can be distinguished from the Proconiini by the following combination of characters (Young 1968, 1977): (1) “knees” of hind legs (femur-tibia joints), when at rest position, almost always reaching the proepimeron [= lateral lobe of the pronotum]; (2) male subgenital plates and pygofer almost always with macrosetae; (3) antennal ledges seldom protuberant in dorsal view; (4) posterior femora much more flattened than in the Proconiini; and (5) face usually not pubescent. The Cicadellini is a cosmopolitan and diverse tribe, comprising about 2000 species and 260 genera. These leafhoppers can usually be collected using sweeping nets, aspirators, light traps, Malaise traps, and yellow plates. The use of sticky traps should be avoided because they cause much damage to the specimens, rendering taxonomic and morphological studies difficult.

After the publication of Young’s (1977) monograph on the New World Cicadellini, new Neotropical genera of this tribe have been proposed by several authors (Mejdalani 1994; Nielson & Godoy 1995; Cavichioli 1996, 1998, 2000a, 2000b, 2003, 2010; Takiya *et al.* 2001, 2003; Takiya & Cavichioli 2005; Freytag 2007; Cavichioli & Takiya 2012a; Mejdalani & Cavichioli 2013; Mejdalani *et al.* 2014). Here we propose an additional new genus of Cicadellini, which is so far recorded from the Atlantic Forest of southern and southeastern Brazil (Paraná and Rio de Janeiro states).

Material and methods

The specimens studied here belong to the following Brazilian institutions: Coleção Entomológica Pe. Jesus Santiago Moure, Departamento de Zoologia, Setor de Ciências Biológicas, Universidade Federal do Paraná, Curitiba (DZUP), Departamento de Entomologia, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro (MNRJ), and Coleção Entomológica Prof. José Alfredo P. Dutra, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro (DZRJ). In the transcriptions of label data, explanatory notes are provided inside square brackets ([]).

Photographs of the body, in dorsal and lateral views, of the apical portion of the female abdomen, and of parts of the male terminalia were taken with a Leica MZ12.5 stereo microscope with an attached digital SCMOS 05000KPB camera. Additional photographs of the male and female terminalia were taken with a Nikon optical microscope also with an attached SCMOS 05000KPB camera. All images were stacked using CombineZ5 software.

Techniques for preparation of terminalia structures follow Oman (1949) for males, with modifications proposed by Cavichioli & Takiya (2012b), and Mejdalani (1998) for females. Terminology follows Young (1968, 1977), except for the facial areas of the head (Hamilton 1981; Mejdalani 1993, 1998) and the female terminalia (Nielson 1965; Hill 1970). Use of the term gonoplac follows Mejdalani (1998). Dissected parts are stored in small vials with glycerin, as suggested by Young & Beirne (1958). The total length of specimens is measured from the apex of the crown to the tips of the forewings at rest position (Young 1977).

Results

Class Insecta Linnaeus, 1758
Order Hemiptera Linnaeus, 1758
Suborder Auchenorrhyncha Duméril, 1806
Family Cicadellidae Latreille, 1825
Subfamily Cicadellinae Latreille, 1825
Tribe Cicadellini Latreille, 1825

Prodiigiella gen. nov.

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Figs 1–17

Type species

Prodiigiella silvano sp. nov.

Diagnosis

Relatively small (6.3–7.7 mm) sharpshooters (Figs 1–2, 17) with crown, pronotum, and mesonotum greenish-yellow mottled with dark brown lines and spots; posterior $\frac{2}{3}$ of pronotal disc with large green area. Frons (Figs 2–3), in lateral view, with inferior third distinctly angulate. Forewing with corium and clavus mostly green; distal half with irregular transverse dark brown markings; apical portion with large, arcuate red area located before translucent membrane. Males with aedeagus (Figs 6–8) asymmetrical; shaft curved ventrally, with two basal processes, one directed ventrally, another directed dorsally; apical portion of shaft bifid, right side with one retrorse process, left side bearing two or three associated processes. Females with sternite VII (Figs 9–10) subquadrangular, with posterior margin slightly rounded; ovipositor valvula II (Figs 13–15) distinctly expanded beyond basal curvature, its dorsal margin with 35–40 teeth, most of them triangular and bearing denticles, and ventral margin without preapical prominence.

Etymology

From the Latin ‘*prodigialis*’, meaning ‘eccentric’, in reference to the peculiar form of the aedeagus (Figs 6–8), plus the feminine suffix *ella*.

Description

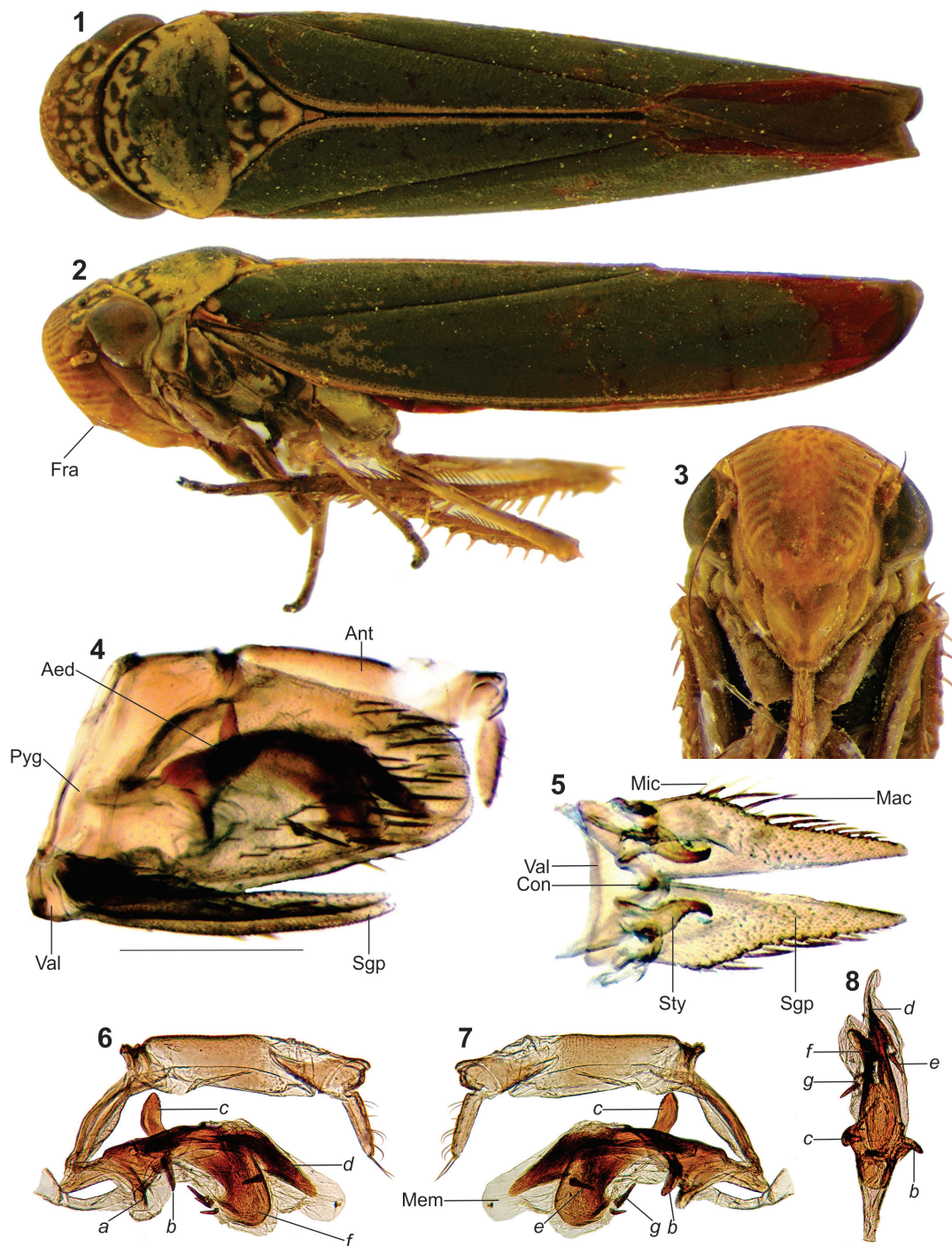
HEAD (Figs 1–3). In dorsal view, well produced anteriorly; median length of crown approximately $\frac{1}{2}$ of interocular width and $\frac{3}{10}$ of transocular width; anterior margin broadly rounded; without carina

at transition from crown to face; ocelli located on imaginary line between anterior eye angles, each ocellus slightly closer to adjacent anterior eye angle than to median line of crown; coronal suture distinct; crown without transverse concavity before ocelli and without median fovea; surface smooth and glabrous; frontogenal suture extending onto crown and attaining ocellus. Antennal ledge, in dorsal view, not protuberant; in lateral view, with anterior margin oblique and convex. Frons convex and robust; surface of median area slightly granular; muscle impressions distinct; in lateral view, inferior third distinctly angulate; epistomal suture incomplete medially. Clypeus, in lateral view, with superior portion continuing contour of frons and inferior portion more nearly horizontal; in ventral view, apex rounded.

THORAX (Figs 1–2). In dorsal view, with pronotal width approximately equal to transocular width of head; lateral pronotal margins slightly convergent anteriorly; posterior margin slightly emarginate; disk mostly smooth; dorsolateral carina complete, rectilinear, declivous anteriorly. Mesonotum with scutellum not transversely striate. Forewing with texture mostly coriaceous, apical membrane restricted to portions of first, second, and third apical cells; apical margin convex; veins distinct; with four apical cells, base of fourth slightly more proximal than base of third; with three closed anteapical cells, their bases slightly proximal in relation to claval apex; without anteapical plexus of veins. Hind wing with vein R2+3 incomplete. Hind legs with femoral setal formula 2:1:1; length of first tarsomere slightly greater than combined length of two more distal tarsomeres; first tarsomere with pair of conspicuous, elongate dorsoapical setae, plantar surface with two parallel rows of very small setae.

MALE TERMINALIA. Pygofer (Fig. 4), in lateral view, well produced posteriorly; posterior margin truncate; without processes; macrosetae distributed mostly on apical third and more anteriorly near ventral margin. Valve (Figs 4–5), in ventral view, short and subtriangular. Subgenital plate (Figs 4–5), in ventral view, subtriangular; broad at basal third, with outer margins approximately parallel, then narrowing gradually to apex; with uniseriate macrosetae laterally, microsetae also present; plates separated throughout their length; in lateral view, not extending as far posteriorly as pygofer apex. Style (Fig. 5), in dorsal view, extending posteriorly beyond apex of connective; without preapical lobe; apical portion curved outwards; outer preapical border with setae; apex subacute. Connective (Fig. 5), in dorsal view, Y-shaped, small, arms short and robust; stalk short, narrow, with distinct median keel. Aedeagus (Figs 6–8) asymmetrical; shaft long and curved ventrally, with two basal processes, right one (Figs 6b, 7b, 8b) slender and directed ventrally, left one (Figs 6c, 7c, 8c) robust and directed dorsally; apical portion of shaft distinctly bifid and with membranous projections, right side (Fig. 6d) with obtuse apex and bearing one retrorse preapical process with membranous base (Fig. 7e), left side (Fig. 6f) with truncate apex and bearing two or three associated processes with membranous bases (Fig. 7g); aedeagal atrium with single ventral process (Fig. 6a) and pair of long, narrow dorsal apodemes connected to anal tube. Paraphyses absent.

FEMALE TERMINALIA. Sternite VII (Figs 9–10), in ventral view, simple, subquadrangular, with posterior margin slightly rounded. “Internal” sternite VIII forming large but poorly defined bilobate structure [of gray tonality in macerated specimens] located at ovipositor base. Pygofer (Figs 9–10), in lateral view, well produced posteriorly; apical portion triangular, apex subacute; macrosetae located mostly on apical portion and extending anteriorly along ventral margin. Valvifer I (Fig. 11), in lateral view, guttiform, distinctly expanded on median portion. Valvula I (Figs 11–12), in lateral view, with blade more distinctly narrowed along apical fourth; apex acute; base forming distinct rounded lobe projected anteriorly; dorsal sculptured area extending from basal portion to apex, formed mostly by linear processes arranged in oblique lines, basal processes positioned more horizontally; ventral sculptured area restricted to apical portion, formed mostly by linear processes; ventral interlocking device elongate, located on basal half of valvula. Valvula II (Figs 13–15), in lateral view, distinctly expanded beyond basal curvature, narrowing gradually toward apical portion; without preapical prominence; apex subacute; dorsal margin



Figs 1–8. *Prodigiella silvanoii* gen. et sp. nov., ♂, paratype. **1.** Body, dorsal view (total length = 6.9 mm). **2.** Body, lateral view. **3.** Face, anteroventral view. **4.** Genital capsule, lateral view, showing position of aedeagus. **5.** Valve, subgenital plates, connective, and styles, dorsal view. **6.** Aedeagus and anal tube, lateral view (left side). **7.** Aedeagus and anal tube, lateral view (right side). **8.** Aedeagus, ventral view. Abbreviations: Aed = aedeagus; Ant = anal tube; Con = connective; Fra = angle of frons; Mac = macroseta; Mem = membranous area; Mic = microseta; Pyg = pygofer; Sgp = subgenital plate; Sty = style; Val = valve. See description of male terminalia for letters associated with Figs 6–8. Scale bar = 0.5 mm.

with 35–40 continuous teeth, most teeth triangular and bearing denticles, basalmost teeth (located on ascending portion of blade) small and irregular, followed by elongate teeth that become progressively smaller toward apex; blade with distinct ducts extending toward teeth and apex. Gonoplac (Fig. 16), in lateral view, with basal half narrow and apical half distinctly expanded; apex obtuse; surface with tiny tegumentary processes (denticuli) on apex and extending anteriorly along ventral margin; few setae also present.

Distribution

Atlantic Forest biome of southern and southeastern Brazil (Paraná and Rio de Janeiro states). See discussion below for notes on the record from Rio de Janeiro.

Prodiella silvano gen. et sp. nov.

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Figs 1–17

Diagnosis

Crown, pronotum, and mesonotum (Figs 1–2, 17) greenish-yellow mottled with irregular dark brown lines and spots; posterior $\frac{2}{3}$ of pronotal disc with large dark green area. Forewing (Figs 1–2, 17) with corium and clavus mostly green; distal half with irregular transverse dark brown markings; apical portion with large, arcuate dark red to brown area located before well-defined translucent membrane. Frons (Figs 2–3, 17) laterally with transverse brown stripes associated with muscle impressions.

Etymology

The new species is described in honor of Silvano Rodrigues Pecky (1964–2022), father of the first author.

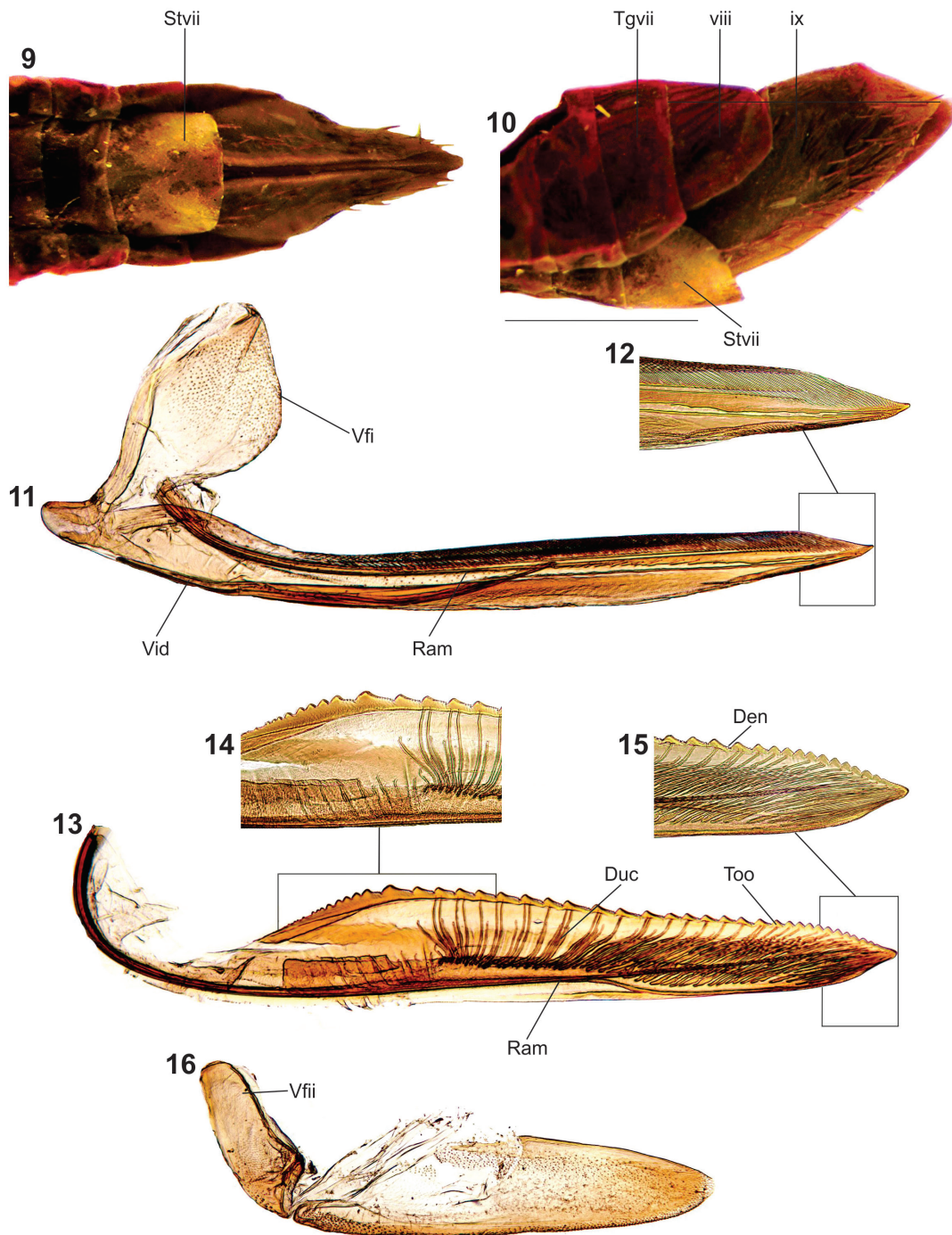
Material examined

Holotype

BRAZIL • ♂; State of Paraná, PR [Paraná], Antonina, RPPN [Reserva Particular do Patrimônio Natural] – Guaricica; 50 m a.s.l.; 25.316°S, 48.696°W; 23–27 Oct. 2017; sweep; A.C. Domahovski leg.; DZUP.

Paratypes

BRAZIL – State of Paraná • 1 ♂, 3 ♀♀; Antonina; Res. [Reserva], Rio Cachoeira; 50 m a.s.l.; 25.316° S, 48.696° W; 23–27 Jan. 2017 Malaise; Entomologia UFPR; MNRJ • 3 ♂♂; same collection data as for preceding; DZUP • 1 ♂, 4 ♀♀; same collection data as for preceding; sweep; A.C. Domahovski leg.; DZUP • 1 ♂, 1 ♀; same collection data as for preceding; DZRJ • 1 ♀; same collection data as for preceding; 25–26 Mar. 2017; DZUP • 1 ♀; Morretes, P. [Parque] E. [Estadual] do Marumbi, caminho para Estação Eng. [Engenheiro] Lang; 330 m; 25°25'41" S, 48°54'55" W; 27 Sep. 2016; sweep; A.C. Domahovski leg.; DZUP • 1 ♂; Antonina, Reserva Sapitanduva; 29 Dec. 1986; Lev. [Levantamento] Ent. [Entomológico] PROFAUPAR; Malaise; DZUP • 1 ♂; same data as for preceding, 18 Aug. 1986; MNRJ • 1 ♂; Morretes; (IAPAR); 18–25 Mar. 1985; CIIF [Centro de Identificação de Insetos Fitófagos]; Malaise; DZUP • 1 ♂, 2 ♀♀; same data as for preceding; 4–11 Mar. 1985; DZUP • 1 ♀; Morretes; 23 Feb. 2018; sweep; A.C. Domahovski leg.; DZUP • 2 ♂♂, 3 ♀♀; Antonina; RPPN [Reserva Particular do Patrimônio Natural] Guaricica; 25.316° S, 48.696° W; 31 Jan.–4 Feb. 2022; by light; Entomologia – UFPR; DZUP • 1 ♂; same data as for preceding; 25–29 Nov. 2019; MNRJ • 2 ♀♀; same data as for preceding; sweep; MNRJ • 1 ♀; same data as for preceding; 15–19 Apr. 2019; DZUP • 1 ♀; Morretes; 18 Feb. 1985; CIIF; by light; DZUP • 1 ♀; same data as for preceding; 5–6 Nov. 1985; DZUP • 2 ♀♀; same data as for preceding; 27 Dec. 1984–6 Jan. 1985; CIIF - Malaise; DZUP • 1 ♀; same data as for



Figs 9–16. *Prodigiella silvanoI* gen. et sp. nov., ♀, paratype. **9.** Apical portion of abdomen, ventral view. **10.** Apical portion of abdomen, lateral view. **11.** Valvifer I and valvula I, lateral view. **12.** Apical portion of valvula I at higher magnification. **13.** Valvula II, lateral view. **14.** Basal portion of valvula II at higher magnification. **15.** Apical portion of valvula II at higher magnification. **16.** Valvifer II and gonoplac, lateral view. Abbreviations: Den = denticle; Duc = duct; Ram = ramus; Stvii = sternite vii; Tgvii-ix = tergites; Too = tooth; Vfi = valvifer I; Vfii = valvifer II; Vid = ventral interlocking device. Scale bar = 1.0 mm.

preceding; 12–19 Nov. 1984; CIIF; Malaise; DZUP • 1 ♀; same data as for preceding; 17–27 Dec. 1984; CIIF; Malaise; DZUP. – **State of Rio de Janeiro** • 1 ♀; Tijuca; Jan. 1935; Charles Hathamay; gen. sp. unknown; det. D.A. Young; DZUP.

Description

MEASUREMENTS (mm). Holotype (♂): total length 7.0. Paratypes (♂): 6.3–7.0 mm (n = 5); (♀): 7.2–7.7 (n = 5).

COLORATION (Figs 1–3, 17). Anterior dorsum (crown, pronotum, and mesonotum) greenish-yellow mottled with irregular dark brown lines and spots; posterior $\frac{2}{3}$ of pronotal disc with large dark green area. Forewing with corium and clavus mostly green with veins partially dark brown; distal half with irregular transverse dark brown markings (other irregular small dark brown markings may also be present); apical portion with large, arcuate dark red to brown area located before well-defined translucent membrane; irregular greenish-yellow markings and areas may be present along costal margin and on veins. Ground color of face mostly yellow; frons laterally with transverse brown stripes associated with muscle impressions and centrally with small irregular brown markings. Legs yellowish-brown to brown. Abdomen with tergites and outer portion of laterotergites red; inner portion of laterotergites and sternites brownish-yellow with irregular dark brown markings; male genital capsule red to brown laterally and dorsally (pygofer) and brown ventrally (valve and subgenital plates); female with sternite VII brownish-yellow, pygofer red dorsally and brownish-yellow ventrally, gonoplac brown.



Fig. 17. *Prodigiella silvanoii* gen. et sp. nov., ♀, photographed at Parque Estadual da Pedra Branca, Municipality of Rio de Janeiro, southeastern Brazil. See discussion for notes on the records of the new species from State of Rio de Janeiro.

Discussion

The color pattern and external morphology of specimens of *Prodiigiella silvanoii* gen. et sp. nov. are superficially similar to those of species of *Macugonalia* Young, 1977, *Ruppeliana* Young, 1977, and *Versigonalia* Young, 1977; indeed, using Young's key to the New World genera of the Cicadellini, specimens of the new species run, tentatively, to *Ruppeliana* (couplet 110). As in the case of *Prodiigiella* gen. nov., these three genera also have species distributed in the Atlantic Forest of southern and southeastern Brazil (Young 1977; Mejdalani 1998; Mejdalani *et al.* 2009; Cavichioli *et al.* 2017). The peculiar asymmetrical aedeagus of *Prodiigiella*, including its bifid apical portion and basal and apical unpaired processes (Figs 6–8), will readily distinguish the new taxon from *Macugonalia*, *Ruppeliana*, *Versigonalia* and other South American Cicadellini genera. The aedeagus is symmetrical in *Macugonalia*, *Ruppeliana*, and *Versigonalia*; in the first two genera, it usually bears paired basal processes (Young 1977; Cavichioli 2004; Carvalho *et al.* 2014; Cavichioli *et al.* 2017), whereas in the third genus an unpaired basal sclerite, which appears as a distinct ventral aedeagal process or as a paraphysis, is present (Young 1977, but see Camisão *et al.* 2014 for notes on the possible incomplete preservation of the male terminalia of the single specimen (syntype) of *Versigonalia vermiculata* (Signoret, 1855) that has been dissected). Genera of Cicadellini that include species with an asymmetrical aedeagal shaft are quite distinct and apparently not related to *Prodiigiella* gen. nov. (e.g., *Allogonia* Melichar, 1926, *Apulia* Distant, 1908, *Fingeriana* Cavichioli, 2003, *Lebaziella* Cavichioli, 2010, *Macunolla* Young, 1977, *Nielsonia* Young, 1977, and *Ramosulus* Young, 1977).

It should be noted that the single specimen of the new species that we examined from the State of Rio de Janeiro is a female, which was labeled as “gen. sp. unknown” by the late David A. Young. Although we treated this female as a paratype, further collecting work and taxonomic studies are necessary to confirm the identity of specimens from this part of Brazil; externally, the female is very similar to the specimens from the State of Paraná, where the type locality is located; furthermore, we obtained a fine photograph (Fig. 17) of another female from Rio de Janeiro that is also quite similar to individuals from the type locality.

Although most of the Brazilian leafhopper taxonomists are based in institutions located in the southeastern and southern regions of the country, it is clear that the Atlantic Forest diversity of this important insect group is still poorly known, as shown, for instance, by the peculiar taxon described here. Much collecting work in the remaining parts of the Atlantic Forest, using all techniques suitable for leafhopper sampling, is clearly and urgently needed. Also, leafhoppers should be searched for in backlogs of scientific collections. We believe that many interesting genera and species of Cicadellinae, as well as representatives of other leafhopper subfamilies, are still waiting discovery in the Atlantic Forest and other endangered Brazilian biomes.

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