

## A new species of the sharpshooter genus *Balacha* from an alpine field in southeastern Brazil (Insecta: Hemiptera: Cicadellidae: Cicadellini)

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### ABSTRACT

The sharpshooter genus *Balacha* Melichar, 1926 includes nine species and is distributed in southeastern and southern Brazil, Uruguay, Paraguay, and Argentina. All species of *Balacha* use only members of the genus *Eryngium* (Apiaceae) as host plants, except for a recently described species that is associated with *Actinocephalus polyanthus* (Eriocaulaceae). Here we describe and illustrate an additional species, *B. caledonia* sp. nov., from an alpine field in Nova Friburgo, state of Rio de Janeiro, southeastern Brazil, which is also associated with *Eryngium*. Among the known species of the genus, the new taxon is morphologically most similar to *B. caparao* Takiya & Mejdalani, 2004, but can be easily distinguished by the shaft of the aedeagus, which has a dorsal lobe on the basal half and no ventroapical lobe, and the female sternite VII with the borders of the posterior emargination sinuous. Our studies indicate that the type locality of the new species and its surrounding Atlantic Forest area in Nova Friburgo harbor an interesting and diverse but still poorly known sharpshooter fauna, including the recently discovered *Paratubana auromarginata* Côrte et al., 2021 (also from *Eryngium*) and *Cavichiana caelivittata* Mejdalani et al., 2023 (from bromeliads).

### Introduction

The sharpshooter genus *Balacha* Melichar, 1926 includes nine species and is distributed in southeastern and southern Brazil, Uruguay, Paraguay, and Argentina, with records from the Atlantic Forest, Cerrado, Pampas, and Chaco biomes. Recent phylogenetic and biogeographic analyses conducted by Quintas et al. (2020) indicated that the exclusive ancestor of all known species of this genus was possibly distributed in the Atlantic Forest, being the presence in other biomes a result of secondary dispersals. *Balacha* is biologically interesting and peculiar because all its known species use only members of the genus *Eryngium* (Apiaceae) as host plants, except for the recently described *B. ancora* Quintas et al., 2020, which is associated with *Actinocephalus polyanthus* (Eriocaulaceae). The body of *Balacha* species is moderately flattened dorsoventrally, a condition perhaps associated with the specialized mesohabitat in the rosettes of *Eryngium* hosts (Takiya and Mejdalani, 2004; Quintas et al., 2020). Apparently, the shift to an *Eryngium* host occurred in the ancestor of all recent *Balacha* species (Takiya and

Mejdalani, 2004), with a new shift recorded only in the *B. ancora* lineage (Quintas et al., 2020). In correlation with the distribution of their hosts, *Balacha* species occur in grasslands in temperate South America and, at lower latitudes in Brazil, are isolated in high altitudinal fields of the southeastern mountain ranges (Takiya and Mejdalani, 2004; Quintas et al., 2020), as in the case of the new taxon described here, which is so far known from a single, apparently small population.

The known species currently recognized in *Balacha* are listed below, including their distribution, and the genus is diagnosed. According to Takiya and Mejdalani (2004), *Balacha* is clearly monophyletic and can be recognized by the following synapomorphies: (1) crown-face transition approximately acute; (2) crown produced anteriorly and with anterior margin subangulate; (3) flattened pronotum continuing, in lateral view, contour of head and mesonotum; and (4) teeth of second valvulae of ovipositor with anterior dorsal projection. The use of *Eryngium* as host plants could perhaps also be considered a putative synapomorphy of *Balacha*. In their morphological phylogenetic analysis, Takiya and Mejdalani (2004) recognized two main groups within the genus, which they called the red clade and the black clade. The former group includes

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currently three species and the latter, six (Quintas et al., 2020). Here we describe and illustrate an additional species assigned to the black clade, *B. caledonia* sp. nov., from an alpine field in the municipality of Nova Friburgo, state of Rio de Janeiro, southeastern Brazil, which is also associated with *Eryngium*. Historically, many collecting expeditions focused on insects have been conducted in Nova Friburgo, both in the previous century and in the current one, most certainly due to the presence of well-preserved areas of Atlantic Forest located relatively close to the city of Rio de Janeiro. Nevertheless, our recent studies in this municipality indicate that a considerable portion of its sharpshooter fauna remains poorly known or even undescribed.

## Material and methods

The studied specimens (one male and five females) of the new species are deposited in the following institutions:

DZUP – Coleção Entomológica Pe. Jesus Santiago Moure, Departamento de Zoologia, Setor de Ciências Biológicas, Universidade Federal do Paraná, Curitiba.

MELQ – Museu de Entomologia “Luiz de Queiroz”, Escola Superior de Agricultura “Luiz de Queiroz”, Universidade de São Paulo, Piracicaba.

MNRJ – Departamento de Entomologia, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro.

The morphological terminology employed here followed mainly Young (1968, 1977, 1986), except for the facial areas of the head (Hamilton, 1981; Mejdalani, 1993, 1998), leg chaetotaxy (Rakitov, 1997), and female terminalia (Nielson, 1965; Hill, 1970). Use of the term gonoploc followed Mejdalani (1998). Techniques for preparation of male and female terminalia followed Oman (1949) and Mejdalani (1998), respectively. Dissected parts were stored in small vials with glycerin and attached below the specimens, as recommended by Young and Beirne (1958).

## Results

Genus *Balacha* Melichar, 1926

Type species: *Tettigonia melanocephala* Signoret, 1854, by subsequent designation of China (1938).

Diagnosis (based on Takiya and Mejdalani, 2004)

Medium-sized sharpshooters (Figs. 1a, b) with body moderately flattened dorsoventrally; crown-face transition (Fig. 1b), in lateral view, approximately acute; crown (Fig. 1a), in dorsal view, moderately to strongly produced anteriorly and with anterior margin subangulate; transocular width larger than maximum pronotal width; pronotum (Fig. 1b) flattened, continuing, in lateral view, contour of head and mesonotum; forewing with three closed anteapical cells; males with aedeagal shaft (Fig. 1g) slender, cylindrical, and elongate; females with teeth of second valvulae of ovipositor (Fig. 2h) with anterior dorsal projection.

Species included in *Balacha*

(Distributional records of previously known species provided by Young, 1977; Zanol and Menezes, 1982; Cavichioli and Sakakibara, 1988; Takiya and Mejdalani, 2004; Mejdalani et al., 2009; and Quintas et al., 2020).

*B. ancora* Quintas, Takiya, Cavichioli & Mejdalani, 2020. **Brazil** (state of Minas Gerais).

*B. caledonia* sp. nov. **Brazil** (state of Rio de Janeiro).

*B. caparao* Takiya & Mejdalani, 2004. **Brazil** (state of Minas Gerais).

*B. decorata* Cavichioli & Sakakibara, 1988. **Brazil** (states of Minas Gerais, Paraná, and Santa Catarina); **Paraguay** (departments of Alto Paraná and Concepción).

*B. distincta* (Signoret, 1854). **Brazil** (state of São Paulo). Previous records from Colombia are considered erroneous (see Takiya and Mejdalani, 2004).

*B. lepida* Cavichioli & Sakakibara, 1988. **Brazil** (state of Paraná).

*B. melanocephala* (Signoret, 1854). **Brazil** (states of Paraná, Santa Catarina, and Rio Grande do Sul); **Uruguay** (departments of Montevideo and Tacuarembó); **Paraguay** (department of Presidente Hayes); **Argentina** (Distrito Federal, provinces of Buenos Aires, Chaco, and Formosa). Previous records from Colombia are considered erroneous (see Takiya and Mejdalani, 2004).

*B. nigroflava* Quintas, Takiya, Cavichioli & Mejdalani, 2020. **Brazil** (states of Paraná and Rio Grande do Sul).

*B. rubripennis* Cavichioli & Sakakibara, 1988. **Brazil** (state of Paraná); **Argentina** (province of Buenos Aires).

*B. similis* Cavichioli & Sakakibara, 1988. **Brazil** (states of Minas Gerais, Rio de Janeiro, Paraná, and Rio Grande do Sul); **Argentina** (province of Buenos Aires).

### *Balacha caledonia* sp. nov. (Figs. 1-3)

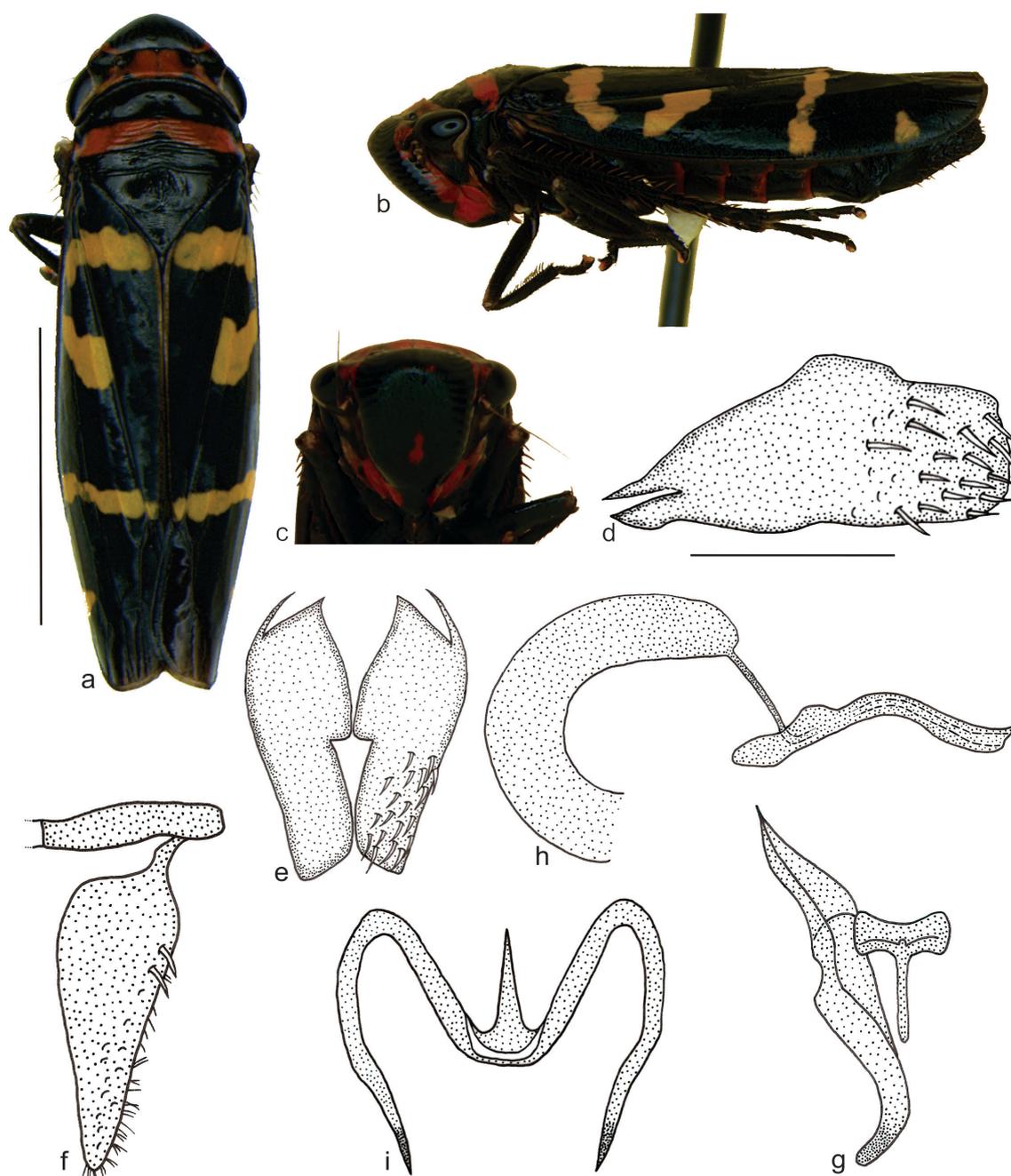
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Total length. Male holotype 8.2 mm; female paratypes 8.5–8.8 mm (n = 3).

Head (Figs. 1a-c). Crown, in dorsal view, well produced anteriorly, its median length approximately 6/10 of interocular width and 4/10 of transocular width; surface smooth, glabrous, with transverse concavity at interocellar area; anterior margin rounded; without carina at transition from crown to face. Ocelli located on imaginary transverse line between anterior angles of compound eyes, each ocellus equidistant from median line of crown and adjacent anterior eye angle. Coronal suture distinct. Frontogena suture distinct, extending onto crown to near ocellus. Temporal suture indistinct. Antennal ledge, in dorsal view, slightly protuberant; in lateral view, not carinate dorsally and with anterior margin oblique and convex. Face with frons flattened medially; texture of disc finely granular; muscle impressions distinct. Epistomal suture obsolete. Clypeus robust, contour of its inferior portion, in lateral view, forming distinct angle with superior portion; apex convex.

Thorax (Figs. 1a, b). Pronotum, in dorsal view, with width slightly smaller than transocular width of head; lateral margins parallel; posterior margin distinctly concave medially; dorsolateral carina complete, rectilinear, slightly declivous anterad; disc glabrous, its posterior half distinctly rugose medially. Mesonotum, in dorsal view, with scutellum finely transversely striated. Forewing without well-defined apical membrane; texture coriaceous and smooth; venation elevated and mostly distinct; without anteapical plexus of veins; with three closed anteapical cells, their bases located more proximally than claval apex; with four apical cells, base of fourth more proximal than base of third. Hind wing with vein R2+3 incomplete. Hind leg with femoral apical setal formula 2:1:1; first tarsomere longer than combined length of two more distal tarsomeres, its plantar surface with two parallel rows of small setae.

Coloration (Figs. 1a-c, 3a, b). Ground color of anterior dorsum dark brown to black. Crown with four orange maculae along posterior margin; antennal ledge tinged with orange. Pronotum with distinct, medially constricted orange transverse stripe. Forewing dark brown to black; with four contrasting yellow markings: (1) basalmost one forming slightly curved stripe over base of corium and clavus, (2) second one from claval sulcus to outer margin of first discal cell, oblique, directed anteriorly, (3) third one forming transcommisural stripe originating at apex of clavus and almost reaching costal margin, (4) fourth one a spot located close to base of fourth apical cell, distinctly smaller than the others. Ground color of face and lateral and ventral areas of thorax dark brown to black; frons with orange stripe along frontogena suture; clypeus with pair of large lateral orange areas connected to frontal stripe;



**Figure 1** *Balacha caledonia* sp. nov. (a) Female, dorsal habitus (scale bar = 4mm); (b) female, lateral habitus; (c) female, face. (d-i) Male terminalia: (d) pygofer, lateral view (scale bar = 1mm); (e) pygofer, ventral view; (f) valve and subgenital plate, ventral view; (g) connective and style, dorsal view; (h) ejaculatory bulb and aedeagus, lateral view; (i) paraphyses, dorsal view.

lorum orange; gena with few small orange or brown markings; labium dark brown to black; additional small irregular orange spots may also be present on face. Legs dark brown to black; setal rows of hind tibia (AD, PD, AV, PV) contrasting brown. Abdomen dark brown to black; posterior portions of sternites and laterotergites orange.

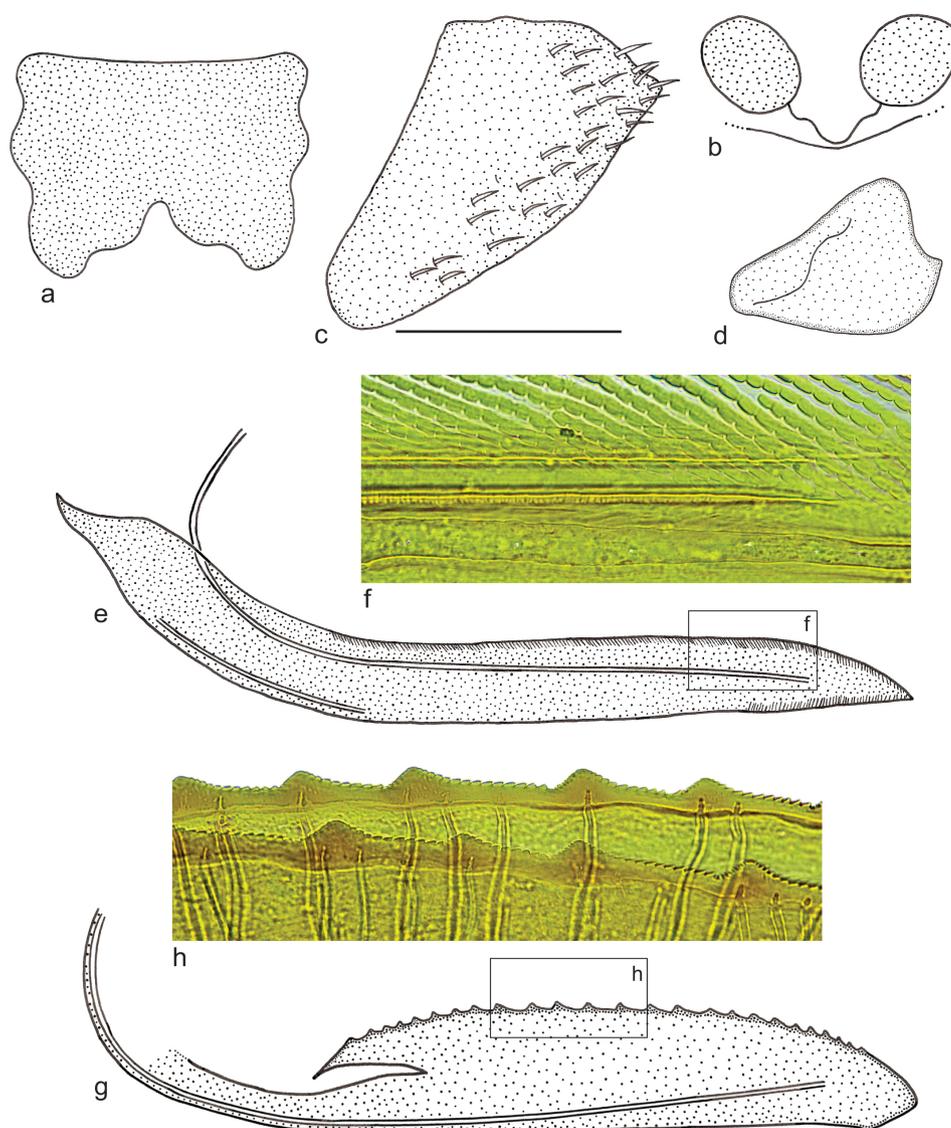
**Male terminalia.** Pygofer (Figs. 1d, e), in lateral view, well produced posteriorly; without processes; posterior margin mostly truncate; surface with macrosetae distributed mainly on posterior half; in ventral view, ventral margin with distinct emargination on median portion. Valve (Fig. 1f), in ventral view, subrectangular, short, slightly constricted medially. Subgenital plate (Fig. 1f), in ventral view, triangular, narrowing gradually toward apex; with few macrosetae located close

to outer margin; microsetae also present; plates linked basally to each other and to valve by large membranous area; in lateral view, plate extending almost as far posteriorly as pygofer apex. Connective (Fig. 1g), in dorsal view, T-shaped; stem narrow and elongate, with median keel. Style (Fig. 1g), in dorsal view, very elongate, extending much farther posteriorly than connective; without preapical lobe; apical portion digitiform, curved outward; apex obtuse. Aedeagus (Fig. 1h) symmetrical; shaft, in lateral view, elongate, tubular, arcuate dorsally, not curved at its base; without processes; basal half with dorsal lobe; apical portion without ventral lobe; gonopore located apically; ejaculatory bulb strongly developed in comparison with size of shaft. Paraphyses (Fig. 1i), in dorsal view, with stalk elongate,

triangular, connected to stem of connective; rami very elongate, slightly convergent apically; each ramus with basal portion directed anteriorly, then with sharp turn posteriorly, apex acute.

Female terminalia. Sternite VII (Fig. 2a), in ventral view, with posterior margin sinuous, including deep median emargination. "Internal" sternite VIII (Fig. 2b), in dorsal view, with pair of distinct ovoid sclerites connected to each other by transverse bar. Pygofer (Fig. 2c), in lateral view, moderately produced posteriorly; posterior margin triangularly produced; apex obtuse; macrosetae distributed mostly on posterior half and extending anteriorly along ventral margin. Valvifer I (Fig. 2d), in lateral view, expanded posteriorly; posterior margin with small dentiform projection. Valvula I (Figs. 2e, f), in ventral view, with basal portion broadened; blade, in lateral view, approximately rectilinear beyond basal curvature; apical portion with ventral and dorsal margins serrated; apex acute; ventral interlocking device located on basiventral half of blade; dorsal sculptured area extending from basal portion to apex of blade, formed mostly by scale-like processes arranged in oblique lines; ventral sculptured area

restricted to apical portion, formed by scale-like processes; basal portion of valvula with scattered setae/pores also extending posteriorly along area below ramus. Valvula II (Figs. 2g, h), in lateral view, expanded beyond basal curvature; dorsal margin regularly convex; blade with about 25 continuous, sclerotized subtriangular teeth, those at ascending basal portion small, followed by about eight elongate ones (with flat, low posterior area) and then becoming smaller, at descending portion, toward apex; denticles distributed on teeth and on dorsal and ventral apical portions of valvula, except on apex (dorsal and ventral dentate apical areas with similar sizes); ventral margin of blade approximately rectilinear; basidorsal hyaline area distinct; preapical prominence small but distinct; apex obtuse; blade with ducts extending toward teeth and apex. Gonoplac extending slightly beyond pygofer apex; in lateral view, with basal half narrow and apical half distinctly expanded; apex obtuse; surface with denticuli and few setae distributed on apical portion and extending anteriorly along ventral margin (apical setae distinctly larger than more basal ones).



**Figure 2** *Balacha caledonia* sp. nov. Female terminalia: (a) sternite VII, ventral view; (b) "internal" sternite VIII, dorsal view; (c) pygofer, lateral view (scale bar = 1 mm); (d) valvifer I, lateral view; (e) valvula I, lateral view; (f) apical portion of ramus and dorsal sculptured area of valvula I, lateral view; (g) valvula II, lateral view; (h) teeth, denticles, and ducts of valvulae II, lateral view (sections of two blades shown in photograph).

**Etymology.** The specific epithet, *caledonia*, refers to the type locality of the new taxon (Pico do Caledônia, municipality of Nova Friburgo, state of Rio de Janeiro, southeastern Brazil). It is a noun in apposition.

**Known host plant:** *Eryngium* sp. (Apiaceae).

**Type material.** Southeastern Brazil, state of Rio de Janeiro. Male holotype: "RJ [state of Rio de Janeiro] Nova Friburgo \ Arredores [do] Pico [do] Caledônia [2,257m a.s.l.] \ 22/V/2022 \ Mejdalani, Pecly, \ Quintas, Oliveira, Alves" (MNRJ-ENT3-2394). Paratypes: four females, same data as the holotype (DZUP, MELQ-ESALQENT001775, MNRJ-ENT3-2393, 2396); one female: "RJ Nova Friburgo \ Pico do Caledônia \ 22/VI/2019 \ Mejdalani, Pecly, Quintas, Ferreira (MNRJ-ENT3-1860).

## Discussion

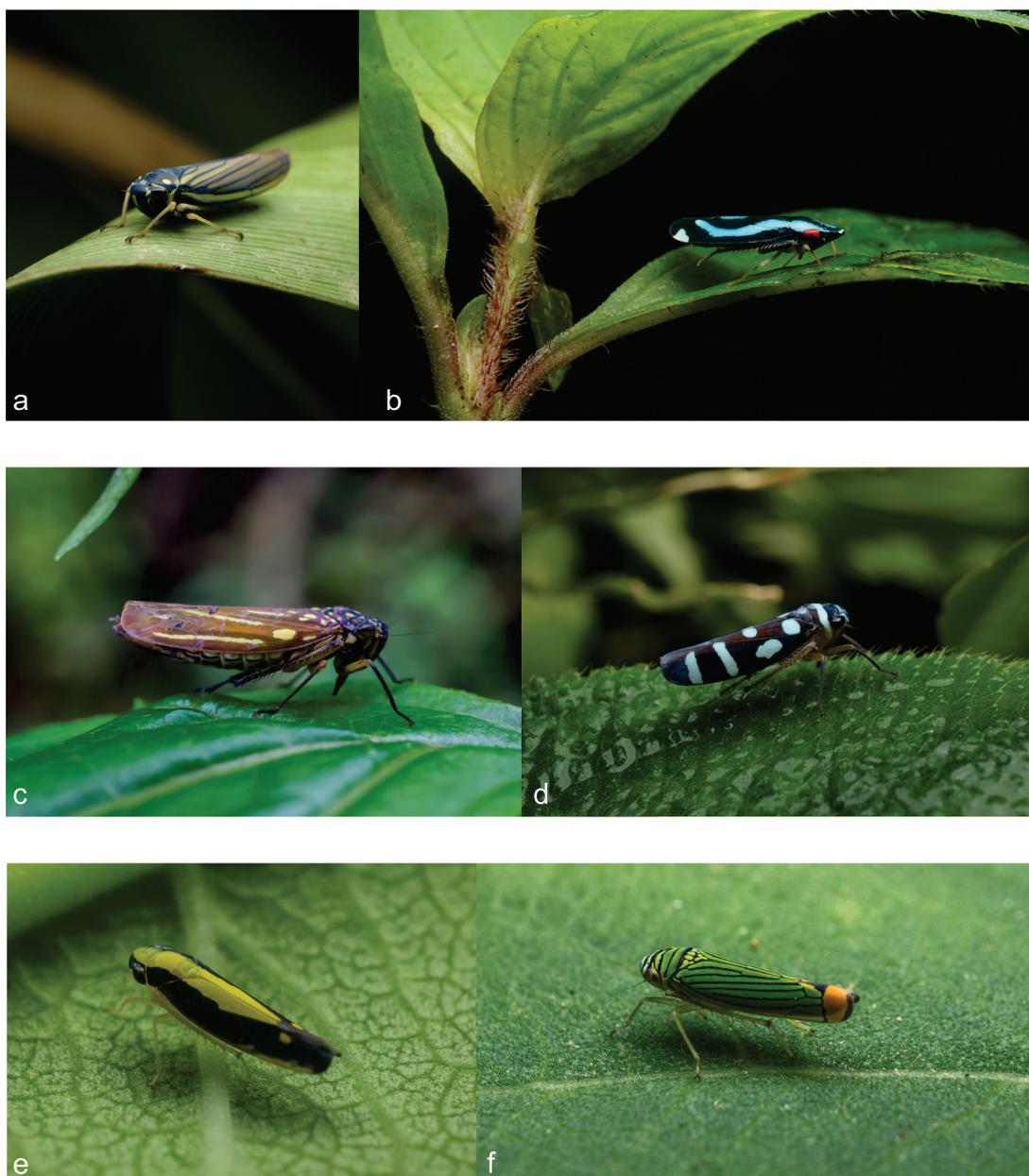
Specimens of the type series of *B. caledonia* sp. nov. have all the same color pattern (Figs. 1a-c). Among the known species of *Balacha*, the new taxon is morphologically most similar to *B. caparao*; both are members of the black *Balacha* clade sensu Takiya and Mejdalani (2004). The positions and form of maculae or stripes on the pronotum and forewings are similar in the two species, but they are ivory to white in *B. caparao* and orange or yellow in *B. caledonia* (Figs. 1a, b, 3a, b). Similarities were also observed in the male (valve and subgenital plates, connective and styles, aedeagus, paraphyses) and female terminalia (sternite VII, "internal" sternite VIII, pygofer, ovipositor valvulae II and their teeth). Indeed, the amount of observed shared features suggests that these two species could be closely related; perhaps, they are

sister taxa. However, in addition to color differences, *B. caledonia* can be easily distinguished from *B. caparao* by the shaft of the aedeagus (Fig. 1h), which has a dorsal lobe on the basal half and no ventroapical lobe (basidorsal lobe absent in *B. caparao* and ventroapical one present), and by the female sternite VII (Fig. 2a) with the borders of the posterior emargination sinuous (rectilinear in *B. caparao*). Furthermore, *B. caledonia* is so far known from a single, apparently small population restricted to the Pico do Caledônia area in Nova Friburgo, state of Rio de Janeiro, whereas *B. caparao* is recorded from the far away located (circa 220km apart in a straight line) Serra do Caparaó in state of Minas Gerais (Takiya and Mejdalani, 2004). Considering, as aforementioned, that at lower latitudes in Brazil *Balacha* species are isolated in high altitudinal fields of the southeastern mountain ranges (Takiya and Mejdalani, 2004; Quintas et al., 2020), it appears clear to us that the populations of these species are completely isolated from each other.

Our preliminary studies indicate that the type locality of the new species (Pico do Caledônia) and its surrounding Atlantic Forest area in the municipality of Nova Friburgo harbor an interesting and diverse but still poorly known Cicadellinae (sharpshooters) fauna (Figs. 3, 4). According to Costa (1992), the Pico do Caledônia area has a characteristic alpine field vegetation from 1,800m to the highest summit at 2,257m. The sites located below 1,800m have mostly secondary forests showing distinct degrees of regeneration. Perhaps the various physiognomies observed therein provide suitable habitats for a high diversity of sharpshooter species. Numerous sharpshooters (G. Mejdalani, unpublished data) can be easily observed on the shrubs and small trees located along the road to the summit [e.g., *Amblyscartidia albofasciata* (Walker, 1851) (Fig. 4d),



**Figure 3** *Balacha caledonia* sp. nov. photographed at the type locality, an alpine field in Nova Friburgo, state of Rio de Janeiro, southeastern Brazil, on its host plant (*Eryngium* sp., Apiaceae). (a) Dorsal view; (b) lateral view. Photos taken by André Almeida Alves.



**Figure 4** Cicadellinae from the municipality of Nova Friburgo, southeastern Brazil. Three species so far known only from the Pico do Caledônia area (a-c) and three species with widespread distribution in the Atlantic Forest (d-f). (a) *Paratubana auromarginata* Côrte, Peclý, Quintas, Ferreira, Cavichioli & Mejdalani, 2021; (b) *Cavichiana caelivittata* Mejdalani, Quintas, Peclý, Froza, Carvalho & Silva, 2023; (c) *Macugonalia semiguttata* (Signoret, 1853); (d) *Amblyscartidia albofasciata* (Walker, 1851); (e) *Neodayoungia xanthonota* (Signoret, 1854); (f) *Laneola rubricauda* (Signoret, 1854). Photos taken by André Almeida Alves.

*Erythrogonia hertha* Medler, 1963, *Laneola rubricauda* (Signoret, 1854) (Fig. 4f), *Macugonalia spinolai* (Signoret, 1853), *Ruppeliana episcopalis* (Signoret, 1853), *R. grossii* Cavichioli et al., 2017, *Subrasaca curvovittata* (Stål, 1862), and *Versigonalia ruficauda* (Walker, 1851); a detailed list of species of the area is currently in preparation]. Two Cicadellini species recently discovered in this region are *Paratubana auromarginata* Côrte et al., 2021 (also associated with *Eryngium* sp. located at the summit; Fig. 4a) and *Cavichiana caelivittata* Mejdalani et al., 2023 (a bromeliad specialist from the surrounding Atlantic Forest area; Fig. 4b) (Côrte et al., 2021; Mejdalani et al., 2023). Also, a previously poorly known species from this tribe, *Macugonalia semiguttata* (Signoret, 1853) (Fig. 4c), was redescribed in detail based on specimens from the border of the forest area (Peclý et al., 2022).

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Our biologist friends André L. D. Ferreira, André A. Alves, and Gabriel A. Oliveira provided great help during the field studies in Nova Friburgo. In addition, AAA took nice photographs of various leafhoppers, including the new species presented here.

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### Conflicts of interest

The authors declare no conflicts of interest.

### Author contribution statement

GM, NHP, and VCQ observed and collected specimens in Nova Friburgo. The first author studied the specimens in the laboratory, assigned them to *Balacha*, and confirmed the existence of a new species. Descriptions and illustrations were prepared by GM, APS, JAF, SRC, and NHP. GM wrote most of the manuscript, which was reviewed and approved by the other authors.

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