

RESEARCH ARTICLE

A new species of *Cavichiana* from southeastern Brazil, with a key to the species of the genus and notes on the distribution of *C. bromelicola* (Insecta: Hemiptera: Cicadellidae)

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ABSTRACT. The sharpshooter genus *Cavichiana* Mejdalani et al., 2014 included so far only two species of about 6–8 mm in length: *C. bromelicola* Mejdalani et al., 2014 (type species) and *C. alpina* Quintas et al., 2020. Both are bromeliad specialists from southeastern and southern Brazil. Here a third species, *C. caelivittata* sp. nov., is described and illustrated based on males and females from the Serra dos Órgãos massif in state of Rio de Janeiro, southeastern Brazil. The new bromeliad specialist can be readily distinguished from the previously known species by the dorsum with a pair of broad whitish-blue stripes, each one extending from antennal ledge over lateroposterior area of crown, lateral portion of pronotum, basal portion of clavus, and forming an elongate arc on corium up to outer margin of first apical cell; the aedeagus bears a dorsoapical digitiform lobe directed posterad. A key to the three species, based on the coloration and morphology of the aedeagus, is provided. In addition, the distribution of *C. bromelicola* is discussed; it is suggested that the trade of bromeliads as ornamental plants is causing the spread of this species to various urban and suburban areas of southeastern Brazil.

KEY WORDS. Atlantic Forest, Bromeliaceae, Cicadellinae, leafhopper, morphology, taxonomy.

INTRODUCTION

The sharpshooter genus *Cavichiana* Mejdalani et al., 2014 includes two beautifully colored species of about 6–8 mm in length: *C. bromelicola* Mejdalani et al., 2014 (type species) and *C. alpina* Quintas et al., 2020. Specimens of these species have so far been collected exclusively on bromeliads from southeastern and southern Brazil, where adults and nymphs usually hide deeply in the rosettes, getting protection, food (xylem sap), and moisture. This record is relevant because previously no other leafhopper species had been observed in its native habitat using bromeliads as a host plant (Mejdalani et al. 2014). However, Felix et al. (2020) recently reported bromeliads as the host plants of *Portanus restingalis* Felix & Mejdalani, 2016 (Aphrodinae, Portanini).

Cavichiana, which is morphologically similar to *Aurigoniella* Takiya et al., 2001, *Juliaca* Melichar, 1926, *Microgoniella* Melichar, 1926, and *Platygonia* Melichar, 1925 (Mejdalani et al. 2014), can be recognized by the following features based on Quintas et al. (2020) and Quintas and Mejdalani (2021): (1) head deltoid and strongly produced anteriorly; (2) ocelli located distinctly anterad of anterior angles of compound eyes; (3) aedeagus tubular and elongate; and (4) paraphyses with both stalk and rami elongate; rami slender, each one with a basidorsal projection. The distinct red color of the compound eyes is perhaps another diagnostic feature of *Cavichiana*. The use of bromeliads as host plants is apparently an exclusive association of this genus within the Cicadellinae. In addition to morphological information on the two previously known species (Mejdalani et al. 2014,

Quintas et al. 2020), a study has been recently conducted on the morphology (scanning electron microscopy) and biology of nymphs of *C. bromelicola* (Quintas and Mejdalani 2021).

In this paper, a new *Cavichiana* species is described and illustrated based on males and females from the Serra dos Órgãos massif, state of Rio de Janeiro, southeastern Brazil. A key to species based on the coloration and aedeagus morphology is provided. We also discuss the distribution of *C. bromelicola*; our field studies and communications from colleagues indicate that the common use of bromeliads as ornamentals in public and private gardens is apparently related with the spread of this species to various localities in southeastern Brazil.

MATERIAL AND METHODS

Structural terminology followed mainly Young (1968, 1977, 1986), 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 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). The examined specimens (three males and seven females) of the new species are deposited in the following institutions: DZRJ – Coleção Entomológica Prof. José Alfredo Pinheiro Dutra, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro; 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.

TAXONOMY

Cavichiana caelivittata sp. nov.

Figs 1–16

<http://zoobank.org/D32E4C94-2F55-404D-9598-D7FEE4F86E49>

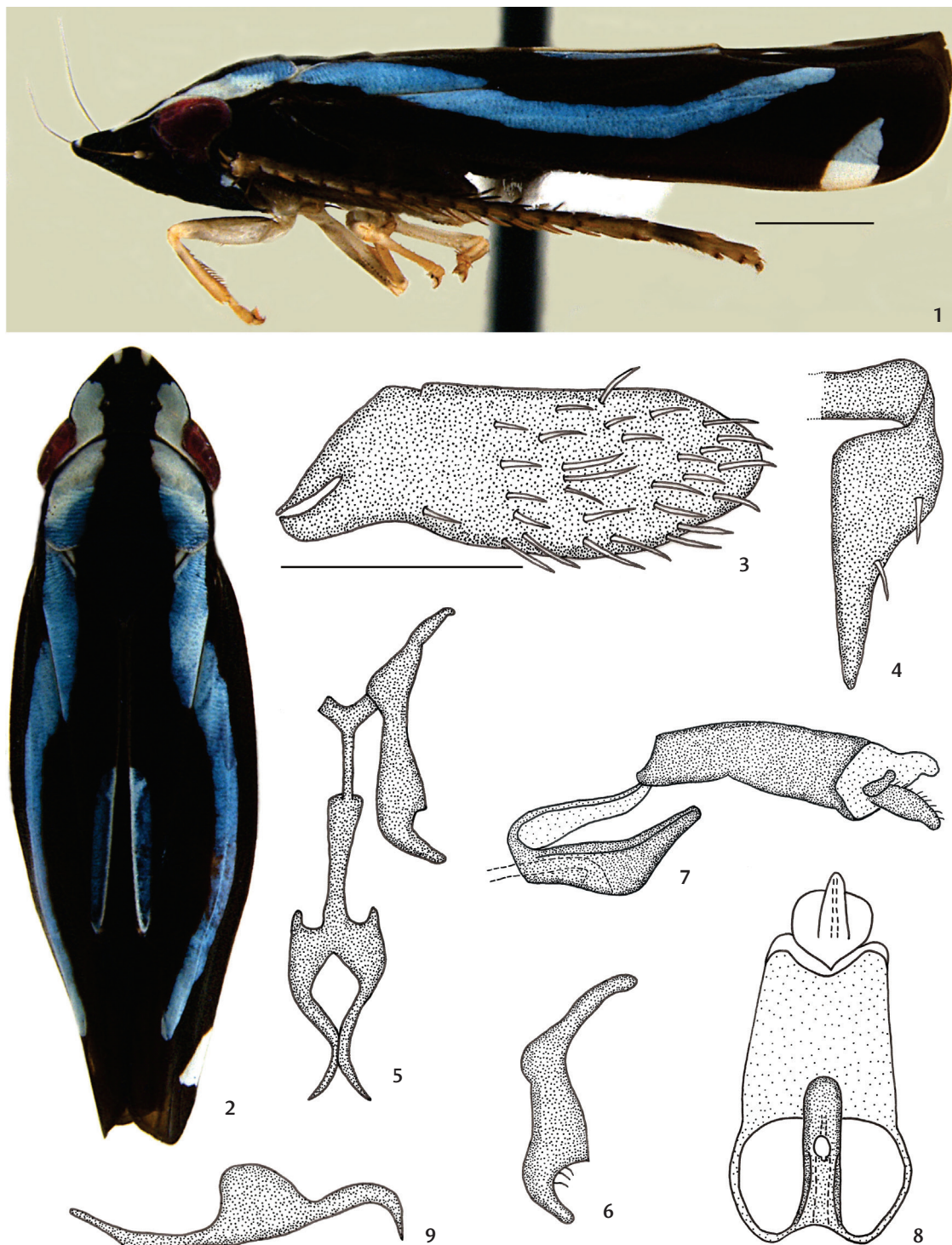
Description. Total length: male holotype 7.7 mm, male paratypes 7.3–7.4 mm (n = 2), female paratypes 7.5–7.8 mm (n = 2).

Male holotype. Body (Figs 1, 2), in lateral view, distinctly flattened dorsoventrally in comparison with most sharp-

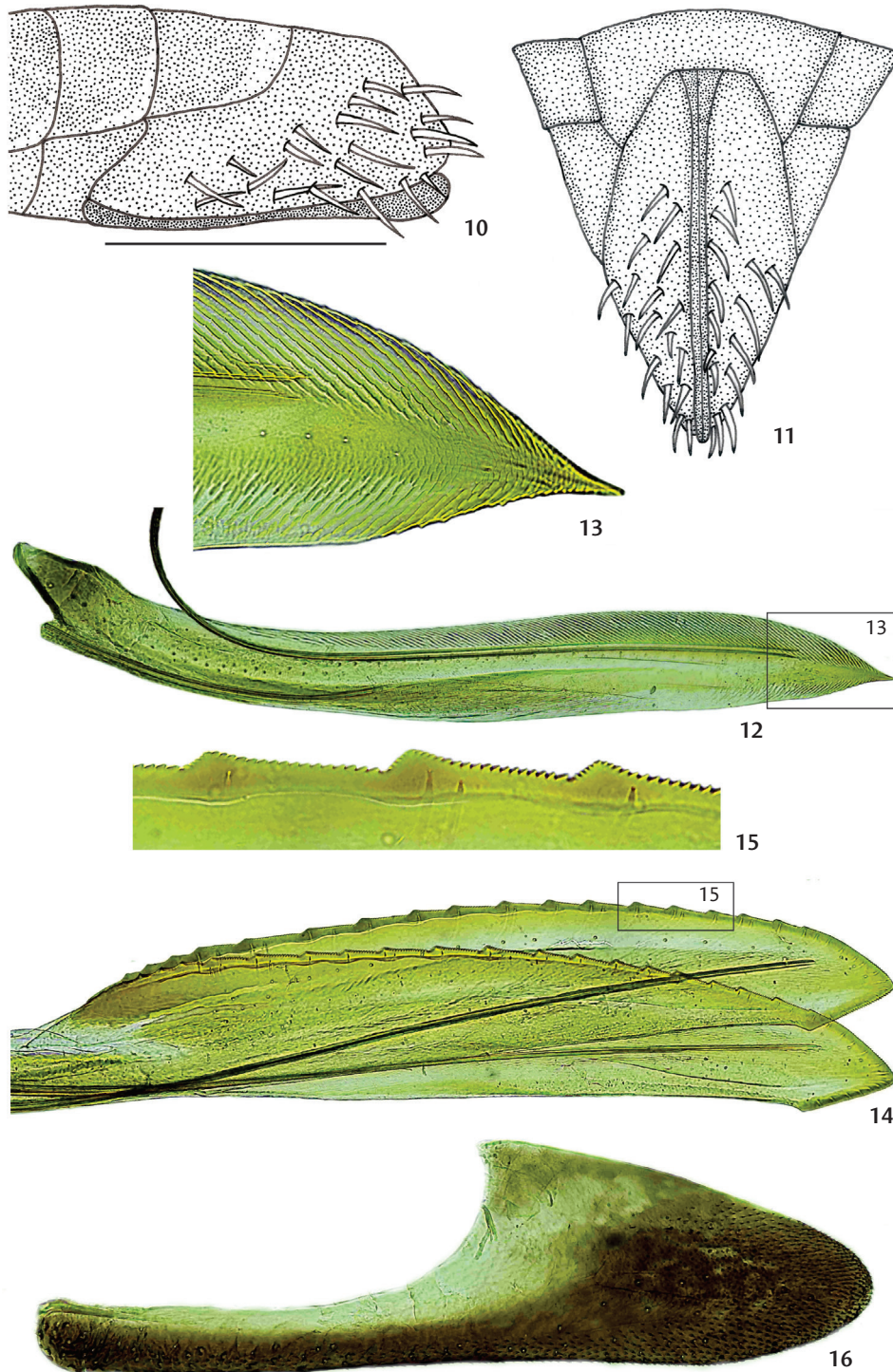
shooters. Head (Fig. 2), in dorsal view, strongly produced anteriorly; median length of crown approximately equal to interocular width and 6/10 of transocular width; anterior margin narrowly rounded; with distinct and elevated carina at transition from crown to face; ocelli located distinctly before line between anterior eye angles, each closer to median line of crown than to adjacent eye angle; surface of crown distinctly depressed; eyes, in dorsal view, oblong; frontogenal suture extending onto crown and attaining ocellus. Antennal ledge, in dorsal view, not protuberant, its outer margin slightly rounded and carinate; in lateral view, with anterior margin approximately rectilinear and oblique. Face without pubescence; frons flattened medially, muscle impressions distinct; epistomal suture obsolete medially; clypeus flattened, its contour continuing profile of frons, apex convex.

Thorax (Fig. 2) with pronotal width approximately equal to transocular width of head; lateral pronotal margins slightly convergent anteriorly; posterior margin concave, sinuous; central portion of disk of pronotum with transverse rugae, except anteriorly; dorsolateral carina complete, rectilinear, declivous anterad. Mesonotum with scutellum not distinctly striate. Forewing without distinct apical membrane; veins indistinct, not elevated; with four apical cells, base of fourth more proximal than base of third; three anteapical cells, their bases obscure. Hind wing with vein R2+3 incomplete. Hind leg with femoral setal formula 2.1.1; length of first tarsomere greater than combined length of second and third, with two parallel rows of distinct setae on plantar surface.

Male terminalia with pygofer (Fig. 3), in lateral view, well produced posteriorly; lacking processes; posterior margin broadly rounded; ventral margin with basal emargination; macrosetae distributed mostly on posterior half of disk. Valve (Fig. 4), in ventral view, subrectangular; anterior margin distinctly emarginate. Subgenital plate (Fig. 4), in ventral view, subtriangular, distinctly narrowed on basal half, outer margin rounded at base; few uniseriate macrosetae distributed mostly on basal half; plates separated medially from each other throughout their length; in lateral view, not extending as far posteriorly as pygofer. Connective (Fig. 5) poorly sclerotized; in dorsal view, Y-shaped; stalk slender. Style (Figs 5, 6), in dorsal view, elongate, with distinct outer preapical projection; outer preapical area with few setae; apical portion digitiform, oblique, directed outwards. Aedeagus (Figs 7, 8) symmetrical; shaft, in lateral view, expanded apically, with dorsoapical digitiform lobe directed posterad, without apical crown of spines; gonod-



Figures 1–9. *Cavichiana caelivittata* sp. nov., male: (1) habitus, lateral view; (2) habitus, dorsal view (antennae and legs not depicted); (3) pygofer, lateral view; (4) valve and subgenital plate, ventral view; (5) connective, style, and paraphyses, dorsal view; (6) style, variation, dorsal view; (7) aedeagus and anal tube, lateral view; (8) aedeagus and anal tube, ventral view; (9) paraphyses, lateral view. Scale bars: 1 = 1 mm, 3 = 0.5 mm.



Figures 10–16. *Cavichiana caelivittata* sp. nov., female: (10) apical portion of abdomen, lateral view; (11) terminalia, ventral view; (12) valvula I, lateral view (base of ramus incomplete); (13) apex of valvula I at higher magnification, lateral view, showing dorsal and ventral sculptured areas; (14) valvulae II, lateral view (bases not depicted); (15) teeth of valvula II at higher magnification, lateral view, showing denticles; (16) gonoplac, lateral view. Scale bar: 10 = 1 mm.

uct distinct, curved ventrally at apical portion; gonopore located preapically. Paraphyses (Figs 5, 9) symmetrical; stalk elongate, connected to stalk of connective; each ramus, in lateral view, strongly expanded dorsally at base and forming poorly sclerotized, slender elongate posterior process with curved distal portion.

Color (Figs 1, 2). Dorsum dark brown to black with pair of broad conspicuous stripes, each one extending from antennal ledge over lateroposterior area of crown, lateral portion of pronotum, basal portion of clavus, and forming elongate arc on corium up to outer margin of first apical cell; this pair of stripes mostly whitish-blue except on crown and anterior portion of pronotum where dirty white hue predominates; inner margin of stripe with small emargination adjacent to ocellus. Crown with two pairs of small dirty white spots, one at apex and another at inner ocellar margins; eyes distinctly red. Forewing with transcommissural, elongate whitish-blue marking on clavus extending from median portion to apex; corium with subtriangular whitish-blue spot at apical portion, extending from costal margin to base of third apical cell. Face, lateral lobe of pronotum, and lateral and ventral areas of mesothorax mostly black; superior portion of frons with median dirty white spot; gena with bluish-white spot adjacent to lorum. Labium, labrum, and legs mostly brownish-yellow. Abdomen dark brown ventrally, posterior margin of sternites and laterotergites tinged with brownish-yellow; pygofer and subgenital plates dark brown, macrosetae yellowish-brown; posterior and ventral margins of pygofer lobes brownish-yellow.

Female paratypes. External morphology and color similar to the male holotype. Terminalia with sternite VII (Figs 10, 11), in ventral view, broadly and deeply emarginate posteriorly. "Internal" sternite VIII, in dorsal view, without distinct sclerites. Pygofer (Figs 10, 11), in lateral view, moderately produced posteriorly; posterior margin narrowly rounded; macrosetae distributed mostly on posterior half and extending anteriorly along ventral margin (those located along ventral margin larger than other ones). Valvifer I, in lateral view, subrectangular. Valvula I (Fig. 12), in ventral view, with basal portion slightly expanded and directed outward; in lateral view, blade with apex (Fig. 13) acute, spiniform; dorsal sculptured area extending from basal portion to apex, formed apically mostly by scale-like processes arranged in oblique lines and basally by more linear processes; ventral sculptured area restricted to apical portion, formed mostly by scale-like processes; ventral interlocking device elongate, restricted to basiventral area of blade. Valvula II (Fig. 14), in lateral view, expanded beyond

basal curvature, dorsal margin convex; apex obtuse; ventral preapical prominence distinct; dorsal margin with about 18 continuous teeth, most of them subtriangular, elongate and flat (Fig. 15), basal teeth smaller and irregular; denticles distributed on teeth and on dorsal and ventral apical portions of blade, except on apex (dorsal dentate apical area longer than ventral area); valvula with ducts extending towards teeth and apex. Gonoplac (Fig. 16) extending approximately as far posteriorly as pygofer; 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. Pygofer lobes dark brown with posterior and ventral margins usually brownish-yellow, macrosetae yellowish-brown; gonoplacs dark brown to black.

Type material. Atlantic Forest, southeastern Brazil, state of Rio de Janeiro. Male holotype, three female paratypes: "RJ [state of Rio de Janeiro] Nova Friburgo \ Estrada Pico do \ Caledônia \ 6/XII/2019 \ Mejdalani, Pecly, \ Quintas, Ferreira, Alves" (MNRJ, one female at MELQ - ES-ALQENT001738); one male paratype, two female paratypes: "RJ Nova Friburgo \ Caminho para o Pico \ do Caledônia \ 22/VI/2019 \ Mejdalani, Pecly, \ Quintas, Ferreira" (MNRJ); two female paratypes: "RJ Nova Friburgo \ Arredores Pico Caledônia \ 22/V/2022 \ Mejdalani, Pecly, \ Quintas, Oliveira, Alves" (DZ RJ, DZUP); one male paratype: "BR - RJ - Teresópolis \ PARNASO [Parque Nacional da Serra dos Órgãos] - Trilha \ P. [Pedra] do Sino \ 07-X-2021 \ N. H. Pecly col." (DZ RJ).

Etymology. The specific name (declinable adjective, feminine), *caelivittata*, of Latin derivation, refers to the conspicuous dorsal pair of whitish-blue longitudinal stripes.

Taxonomic notes. *Cavichiana caelivittata* sp. nov. can be readily distinguished from *C. bromelicola* and *C. alpina* by the coloration (Figs 1, 2) and aedeagal morphology (specific diagnostic character states are provided in the key below). The depressed crown surface and the distinct carina located at the transition crown-face (Fig. 2) are also diagnostic features of the new species. The large dorsal expansion at the bases of the paraphyses rami (Fig. 9) of the new species is located in the same area of the dentiform projection of the two previously known species (see Mejdalani et al. 2014, Quintas et al. 2020), suggesting that the former is homologous to the latter; the presence of this structure is a diagnostic feature of *Cavichiana*. Therefore, we conclude that the new taxon has the four diagnostic features of the genus proposed by Quintas et al. (2020) and listed above in the introduction.

Key to species of *Cavichiana*

1. Forewings with large, circular transcommissural yellow spot bordered by irregular blue to white area, anterior portion of this spot (mostly the blue to white border) covering scutellum. Aedeagus with apical crown of spines.....*C. bromelicola*
- 1'. Forewings with elongate blue or orange markings, without large circular yellow spot. Aedeagus with basal or apical dorsal lobe, without apical crown of spines 2
2. Forewings with basal portion of clavus and area along commissural margin orange; remainder of clavus (except dark brown apex) blue; corium with large blue area adjacent to claval sulcus, connected to blue area of clavus. Aedeagus with basidorsal lobe *C. alpina*
- 2'. Forewings and anterior dorsum (Fig. 2) with pair of broad stripes, each one extending from antennal ledge over lateroposterior area of crown, lateral portion of pronotum, basal portion of clavus, and forming elongate arc on corium up to outer margin of first apical cell; this pair of stripes mostly whitish-blue except on crown and anterior portion of pronotum where dirty white hue predominates. Aedeagus (Fig. 7) with dorsoapical digitiform lobe directed posterad
.....*C. caelivittata* sp. nov.

Notes on the distribution of *Cavichiana bromelicola*

The type localities of the three known *Cavichiana* species are in the Atlantic Forest biome in southeastern Brazil. *Cavichiana bromelicola* was originally described from an area of coastal vegetation (Restinga de Maricá), whereas *C. alpina* and *C. caelivittata* sp. nov. are from mountainous regions (Itatiaia massif in Mantiqueira mountain range and Serra dos Órgãos massif in Serra do Mar mountain range, respectively). However, after the publication of the original description of *C. bromelicola* (Mejdalani et al. 2014), we and colleagues have commonly collected or observed specimens of this species from ornamental bromeliads in urban and semiurban areas in southeastern Brazil, including the Bromeliad Collection of the Jardim Botânico do Rio de Janeiro (JBRJ), a small square in Lumiar in the municipality of Nova Friburgo, and several public or private gardens (both lowland and mountainous localities). Quintas and Mejdalani (2021) provided a table that records ten bromeliad species as hosts of *C. bromelicola*, including plants from JBRJ and natural environments. Examination of the color pattern and male terminalia of specimens from anthropic environments indicates that they

can be confidently identified as *C. bromelicola*, although small variations were observed, especially in the crown of apical spines of the aedeagus. Perhaps, such variations have arisen through genetic drift (Futuyma 1992, Ridley 2006), due to sexual reproduction limited to a very small number of closely related sharpshooters contained within a single or a few adjacent bromeliads (i.e., endogamy). In our field studies, we have observed *C. bromelicola* individuals almost exclusively on bromeliads, a fact suggesting that they do not use other kinds of plants as hosts. Apparently, these sharpshooters have very limited dispersal capacity, which means that they most likely do not fly for long distances from one bromeliad to another. The present hypothesis of a single species should be further investigated through molecular approaches and a phylogeographic analysis. As observed by Quintas and Mejdalani (2021), the trade of bromeliads can cause the artificial dispersal of *C. bromelicola*. Considering that sharpshooters are the main vectors of the gram-negative, xylem-limited bacterium *Xylella fastidiosa* Wells et al., 1987 (Wells et al. 1987), which causes serious diseases in various cultivated plants in Brazil and elsewhere (Redak et al. 2004, Carvalho et al. 2022), we recommend that specimens of *C. bromelicola* be tested for the presence of this phytopathogen. The reader is referred to Mejdalani et al. (2014), Quintas et al. (2020), and Quintas and Mejdalani (2021) for details on the distribution and collecting data of specimens of *C. bromelicola* and *C. alpina*.

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Author contributions

GM discovered the new species, assigned it to *Cavichiana*, and devised the study. GM, VQ, NHP, JAF, SRC, and APS prepared the description, drawings, and photographs. The first author wrote most of the manuscript, which was reviewed and approved by the other ones.

Competing Interests

The authors have declared that no competing interests exist.

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