

RESEARCH PAPER

# *Gibbocicada brasiliانا*, new genus and new species from Brazil and a key for the genera of Tibicinini (Hemiptera: Auchenorrhyncha: Cicadidae)

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**Abstract.** Four examined specimens from Brazil, Ceará, with morphological characteristics belonging to Tibicinini (Hemiptera: Cicadidae) revealed an undescribed genus and species. *Gibbocicada brasiliانا* gen. et sp. nov., representing the first record of Tibicinini in Brazil, is recognized mainly for the head three times shorter than pronotum in dorsal view, the lateral ocelli almost reaching the anterior margin of pronotum, the pronotum and mesonotum pronounced dorsally in lateral view, and the fore wings with the median and cubitus anterior veins rising from the same point in the basal cell. A key to the genera of Tibicinini is presented.

**Keywords.** Hemiptera, Cicadomorpha, Tettigadinae, cicada, systematics, taxonomy, Neotropical Region

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## Introduction

Tibicininae Distant, 1905 is one of the four subfamilies of Cicadidae, with distribution in the Neotropical, Nearctic, and Palearctic Regions (MARSHALL et al. 2018). MOULDS (2005) in a cladistic analysis of Cicadidae recovered *Tibicina haematodes* Scopoli, 1763 (Tibicinini), *Tettigades ulnaria* Distant, 1906 (Tettigadini Distant, 1905) and *Platypedia putnami* (Uhler, 1877) (Platypediini Kato, 1932) in the same clade, and proposed to abandon the use of the name Tibicininae in favor of Tettigadinae (MOULDS 2005). However, such a nomenclatural change would require suppression of Tibicininae by the International Commission on Zoological Nomenclature. No petition has ever been submitted to the Commission, so Tibicininae is the valid name under the International Code of Zoological Nomenclature, followed by subsequent authors (SANBORN 2013, MARSHALL et al. 2018). Recently two new tribes and an updated diagnosis were proposed for Tibicininae, raising the number of tribes in the subfamily to five (SANBORN 2014, MARSHALL et al. 2018), that was also recovered as monophyletic (MARSHALL et al. 2018).

Tibicinini is the second most diverse tribe in Tibicininae comprising eight genera and 97 species, all occurring in the Holarctic and Oriental Regions (SANBORN 2013, WANG et al. 2017, MARSHALL et al. 2018). The monophyly of Tibicinini was recovered by MARSHALL et al. (2018). However, studies addressing the taxonomy of the tribe have been scarce. The only diagnosis for Tibicinini was proposed by DISTANT (1905), and a new one is in need so that genital and other characteristics that differentiate the tribe within the subfamily can be included.

When studying the Cicadidae housed in the Museu de Zoologia da Universidade de São Paulo, Brazil (MZSP) I found four specimens collected in Ceará (Brazil) matching the characteristics proposed for Tibicininae (MARSHALL et al. 2018), and Tibicinini (DISTANT 1905). Since characters of these four specimens don't match any other genera of Tibicinini, a new genus and species are proposed here, representing the first record for the tribe in Brazil. Also, a key for Tibicinini is presented in order to facilitate the identification of its genera.



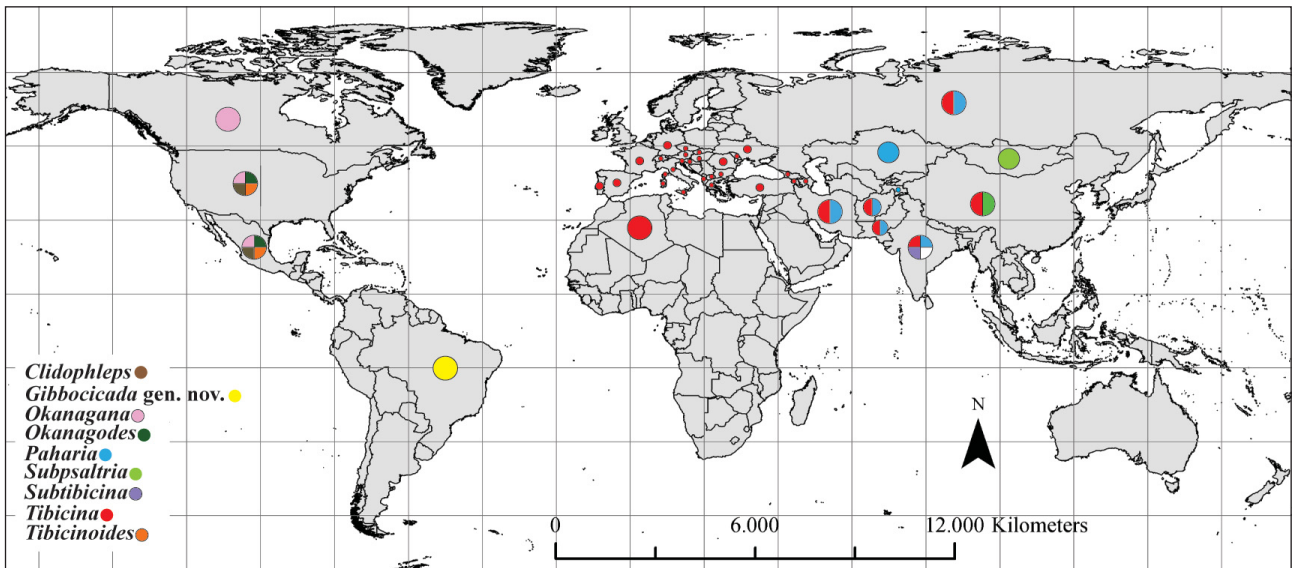


Fig 1. Distribution of genera of Tibicini in the Holarctic, Oriental and Neotropical Regions based on METCALF (1963), DUFFELS & VAN DER LAAN (1985), SANBORN (2013) and this paper.

## Material and methods

The type material is deposited at MZSP. The male genitalia were extracted from one specimen (here designated as paratype) with forceps, heated in a potassium hydroxide aqueous solution (10% KOH), washed in water and stored in microvials filled with glycerine and attached to the same pin as the specimen. The morphological characters were observed, scored, measured, and illustrated using a stereoscopic microscope. Photographs were obtained with Nikon AZ100M and stacked with the Nikon NIS-Elements AR Microscope Imaging Software. Full body images (dorsal view) were made with a digital camera. Vector drawings were traced on the photographs.

The terminology of MOULDS (2005, 2012) and MARSHALL et al. (2018) is adopted for the morphological descriptions. Measurements are given in millimeters for the following morphometric characters:

lb	length of body;
lfw	length of fore wing;
lh	length of head;
lhw	length of hind wing;
lm	length of mesonotum;
lp	length of pronotum including pronotal collar;
wfw	width of fore wing;
wh	width of head including eyes;
whw	width of hind wing;
wm	width of mesonotum;
wp	width of pronotum including pronotal collar.

For males, the length of body was measured from the head to the sternite VIII, and for females from the head to the dorsal beak.

The key to the genera was elaborated from photographs of types and other specimens deposited at the American Museum of Natural History, New York, USA (AMNH) and from descriptions available in the literature (DAVIS 1916, 1919, 1936; CHEN 1943; QUARTAU et al. 2001; HEATH & SANBORN 2007; SANBORN 2009; LEE 2012; AHMED et al. 2015; WANG et al. 2017).

## Taxonomy

### Tibicininae Distant, 1905

**Diagnosis** (modified from MARSHALL et al. 2018). Metanotum entirely concealed at dorsal midline (except in *Platypedia* Uhler, 1888 and *Tibicina* Kolenati, 1857). Fore wing veins CuP and 1A unfused (fused in *Platypedia* and *Neoplatypedia* Davis, 1920, and partially fused in *Gibbocicada* gen. nov.). Hind wing veins RP and M unfused at their bases. Male operculum with distinctive S-shape and deeply concave lateral margins (except in *Gibbocicada* gen. nov.), and with distal margins not reaching distal margins of tympanal cavities. Abdominal timbal cavity lacking timbal covers or with a partial turned-back rim. Pygofer with distal shoulder undeveloped; pygofer upper lobe usually absent (present in Selymbriini Moulds & Marshall, 2018). Uncus exceedingly long and non-retractable within pygofer. Claspers absent. Aedeagus with ventrobasal pocket present; aedeagus restrained by tubular encapsulation below uncus. Apical part of theca with a pair of leaf-like lateral lobes (except in *Gibbocicada* gen. nov.).

### Tibicinini Distant, 1905

**Type genus.** *Tibicina* Kolenati, 1857 (type species *Cicada haematodes* Scopoli, 1763).

**Diagnosis** (modified from DISTANT 1905 and LEE 2012). Head including eyes narrower than the lateral angle of pronotal collar and narrower than mesonotum. Supra-antennal plates not meeting the eyes laterally (except in *Okanagodes* Davis, 1919). Pronotum longer than head, generally more or less distinctly narrowed anteriorly. Mesonotum wider than pronotum (not including the pronotal collar). Mesonotal stridulatory apparatus absent. Male operculum not reaching posterior margins of sternite II. Wings hyaline (tinged in yellowish brown in *Subtibicina* Lee, 2012); base of wings usually reddish or yellowish orange; veins of fore wings fuscous black (only in *Subpsaltria* Chen, 1943). Fore

wings: somewhat talc-like and obscurely wrinkled, their greatest width always more than one third of their length; marginal area present. Hind wing first cubital cell width at distal end about equal to second cubital cell. Abdomen more or less cylindrical and attenuated posteriorly. Timbal organs present. Uncus usually very prolonged and prominent. Pygofer upper lobes absent. Claspers absent. Theca not laterally expanded or distally ornamented.

**Included genera and number of species.** *Clidophleps* Van Duzee, 1915 (8 species); *Gibbocicada* gen. nov. (1); *Okanagana* Distant, 1905 (57); *Okanagodes* Davis, 1919 (3); *Paharia* Distant, 1905 (6); *Subpsaltria* Chen, 1943 (1); *Subtibicina* Lee, 2012 (1); *Tibicina* Kolenati, 1857 (17); *Tibicinoides* Distant, 1914 (3).

**Distribution.** Holarctic, Oriental and Neotropical (Fig. 1).

### *Gibbocicada* gen. nov.

(Figs 2–18)

**Type species.** *Gibbocicada brasiliana* sp. nov., here designated.

**Diagnosis.** The new genus can be distinguished from all other genera in the Tibicinini by the following combination of characters: head short, three times shorter than pronotum in dorsal view (Fig. 6); lateral ocelli almost reaching the anterior margin of pronotum in dorsal view (Fig. 6); anterior margin of lateral lobe of pronotum reaching the eyes (Fig. 6); pronotum and mesonotum pronounced dorsally in lateral view (Fig. 5); dorsal midline of pronotal collar very broad, as wide as the diameter of eye (Fig. 6); lateral angle of pronotal collar laterally pronounced (Fig. 6); meracanthus large, of the same length as operculum (Fig. 9); fore wings with the median and cubitus anterior veins rising from the same point in the basal cell (Fig. 3); tergite 1 fully covered by cruciform elevation; uncus posteriorly developed (Fig. 13); basal lobe long, almost reaching the uncus (Fig. 13). The new genus can be distinguished from *Okanagodes* by the distance between the lateral ocellus and eyes greater than diameter of ocellus, and by the postclypeus short, slightly prominent relative to the anterior margin of head in dorsal view; from *Clidophleps* by the medial cell not much narrower than radial cell; from *Okanagana* by the head (including eyes) broader than the pronotum; from *Paharia*, *Subpsaltria*, and *Tibicina* by the pronotum long, three times longer than head, the aedeagus not elongated nor curved anteriorly; from *Subtibicina* by the fore wings being broad (less than three times the length), not tinged with yellowish brown, and by the uncus being arched and not flat; and from *Tibicinoides* by the base of wings colorless, and the medial cell of fore wings almost twice longer than ulnar cell 3.

**Description.** Head (Fig. 6) (including eyes) wide, slightly broader than pronotum (excluding the pronotal collar), and narrower than mesonotum; head short, three times shorter than pronotum in dorsal view. Lateral ocelli widely separated and almost reaching the anterior margin of pronotum. Vertex wide, the distance between the lateral ocellus and eyes greater than diameter of ocellus. Supra-antennal plates not prominent and not meeting eye. Postclypeus short and narrow in dorsal view, its width equal to the distance

between the lateral ocelli; slightly prominent relative to the anterior margin of head in dorsal view; rectangular in ventral view (Fig. 7) and obtuse in lateral view. Pronotum and mesonotum pronounced dorsally in lateral view (Fig. 5). Pronotum (Fig. 6) long, three times longer than head, not depressed laterally; anterior margin of lateral lobe of pronotum reaching the eyes; pronotal collar broad in dorsal view, as wide as diameter of eye; lateral angle of pronotal collar laterally pronounced, exceeding the lateral margin of mesonotum; lateral part of pronotal collar narrow relative to lateral angle. Mesonotal stridulatory apparatus absent. Operculum (Fig. 9) broad, the lateral and posterior margins slightly convex, and distal margins not reaching the distal margins of tympanal cavities. Meracanthus (Fig. 9) large, of the same length as operculum. Basisternum 3 flat, covered by the meso- and metacoxae. Cruciform elevation with the central and lateral areas flat. Profemora armed with two spines, the primary one the longest and parallel to the posterior margin of femur, and the secondary one sharp and straight. Tarsi three-segmented. Fore wings (Fig. 2) hyaline; broad, width almost three times the length; with eight apical cells; the median and cubitus anterior veins rising from the same point in the basal cell; medial cell almost twice longer than ulnar cell 3 and not much narrower than radial cell; hind wings (Fig. 2) about half the length of fore wings, with six apical cells. Male timbal covers absent (Fig. 10). Tergite 1 fully covered by cruciform elevation. Sternite II (Fig. 8) distant from metacoxae. Uncus longer than sternite VIII, elevated and posteriorly developed. Basal lobe of pygofer long, almost reaching the uncus (Fig. 13). Aedeagus not elongated nor curved anteriorly (Fig. 12).

**Etymology.** The name is derived from the Latin adjective *gibbus* (= humped) and the noun *cicada* (= cicada). It refers to the pronotum and mesonotum which are both pronounced dorsally in lateral view. The gender is feminine.

**Comments.** Based on the diagnosis of the subfamily proposed by MARSHALL et al. (2018), *Gibbocicada* gen. nov. clearly belongs to the Tibicininae by the metanotum concealed at dorsal midline (Fig. 2); the hind wing veins RP and M unfused at their bases (Figs 3, 4); the distal margins of male operculum not reaching the distal margins of tympanal cavities and basally not extending beyond meracanthus, but not in S-shape (Fig. 9); males lacking timbal covers (Fig. 10); pygofer distal shoulder undeveloped; pygofer upper lobe absent; uncus very long and not retractable within pygofer; claspers absent; and the presence of a ventrobasal pocket (Figs 12–14). The fore wing veins CuP and 1A are unfused in most genera of Tibicininae, but fused in *Platypedia* Uhler, 1888 and *Neoplatypedia* Davis, 1920 (*Platypediini*) (MARSHALL et al. 2018). *Gibbocicada* gen. nov. presents these veins partially fused, i.e. the basal third of CuP and 1A are unfused (Fig. 3).

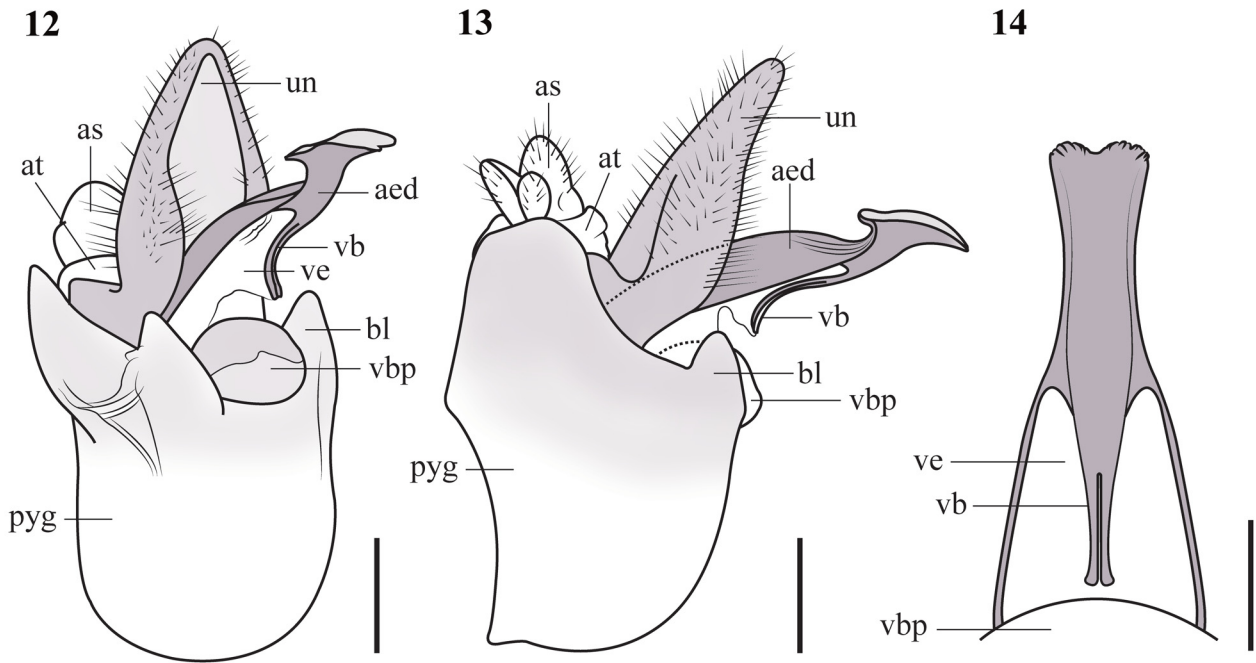
Among all tribes of Tibicininae, *Gibbocicada* gen. nov. is more similar to the genera classified in Tibicinini, with the pronotum more or less distinctly narrowed anteriorly (Fig. 6); fore wings talc-like and obscurely wrinkled, their greatest breadth more than one third of their length (Fig. 2); abdomen subcylindrical (Fig. 2); and uncus longer

than sternite VIII (DISTANT 1905). LEE (2012) listed other characteristics shared by the genera of Tibicini that I also observed in *Gibbocicada* gen. nov.: hind wing first cubital cell width at distal end about equal to second cubital cell; male operculum not reaching posterior margins of sternite II (Fig. 9); pygofer upper lobes absent, claspers absent and

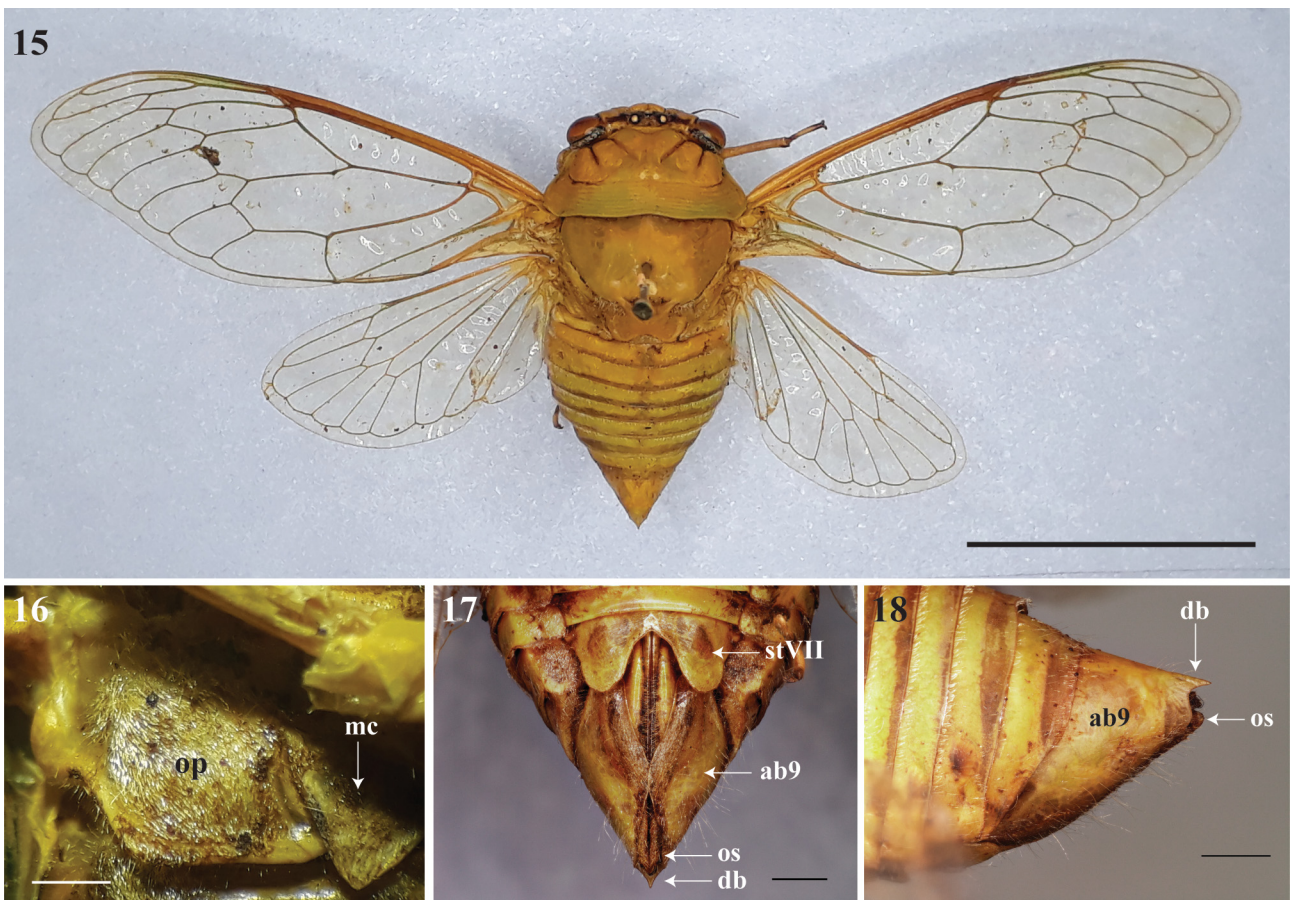
uncus very long (Figs 13, 14). The new genus cannot be placed in the other tribes of Tibicini for the lack of their diagnostic characters, i.e. Tettigadini because the species in the tribe are characterized by the lateral margins of the pronotum dilated and usually medially angulate (DISTANT 1905), and by a mesonotal stridulatory apparatus (JACOBI



Figs 2–11. *Gibbocicada brasiliensis* gen. et sp. nov., holotype, male. 2 – habitus in dorsal view; 3 – wings in dorsal view (arrow points to the basal third of CuP and 1A which are unfused); 4 – detail of hind wing veins in dorsal view (arrow points to veins RP and M which are unfused at their bases); 5 – habitus in lateral view (wings not extended); 6 – head and pronotum in dorsal view; 7 – postclypeus in ventral view; 8 – thorax in ventral view; 9 – operculum in latero-ventral view; 10 – timbal in latero-ventral view; 11 – sternites VII and VIII in ventral view. Abbreviations: 1A – anal vein, CuA – cubitus anterior vein, CuP – cubitus posterior vein, M – median vein, mc – meracanthus, op – operculum, RP – radius posterior vein, tim – timbal, tymc – tympanal cavity, st – sternite. Scale bars: 2 – 2 cm; 3, 5 – 5 mm; 6–8, 11 – 2 mm; 4, 9, 10 – 1 mm.



Figs 12–14. *Gibbocada brasiliana* gen. et sp. nov., paratype, male. 12 – Pygofer, uncus and aedeagus, in latero-ventral view; 13 – same, in lateral view; 14 – aedeagus in ventral view. Abbreviations: aed – aedeagus, as – anal styles, at – anal tube, bl – basal lobe, pyg – pygofer, un – uncus, vb – ventral branches, ve – vesica, vbp – ventrobasal pocket. Scale bars: 12, 13 – 1 mm; 14 – 0.5 mm.



Figs 15–18. *Gibbocada brasiliana* gen. et sp. nov., paratype, female. 15 – habitus in dorsal view; 16 – operculum in latero-ventral view; 17 – sternite VII, abdominal segment 9 and ovipositor sheath in ventral view; 18 – tergites 5–9 in lateral view. Abbreviations: ab9 – abdominal segment 9, db – dorsal beak, mc – meracanthus, op – operculum, os – ovipositor sheath, st – sternite. Scale bars: 15 – 2 cm; 16 – 1 mm; 17, 18 – 2 mm.

1907, BOULARD 1976, MOULDS 2005); Selymbriini because they have supra-antennal plates almost reaching the eye, a rounded postclypeus, hind coxae without lateral protruberance and a very short theca laterally expanded and distally ornamented (MARSHALL et al. 2018); Chilecicadini Sanborn, 2014 because they have the anterior pronotum about as wide as the posterior pronotum, the lateral angle of the pronotal collar anterior to the hind margin, and the partially excavated lateral margin of the pronotal collar (SANBORN 2014); and Platypediini Kato, 1932 because the tribe includes only species without timbal organs (MOULDS 2005).

***Gibbocicada brasiliiana* sp. nov.**

(Figs 2–18)

**Type locality.** Brazil, Ceará state, Mucambo municipality, Carquejo village, ca. 3°52'S, 40°44'W.

**Type material.** HOLOTYPE: ♂, 'BRAZIL / Carquejo / Est Ceará / Dirings // IV 1960' (MZSP, dry-mounted on a pin; Fig. 2). PARATYPES: 2 ♂♂ 1 ♀, same data as the holotype (MZSP).

**Description. Male.** *Body coloration* greenish yellow (Fig. 2), only the head with black markings.

*Head.* Vertex with transverse black band departing from each eye, surrounding the ocelli and extending to the posterior area behind the eyes. Eyes rounded, slightly projecting laterally beyond anterior angles of pronotum. Lateral ocelli widely separated and laterally projected, higher than median ocellus in frontal view (Fig. 6). Postclypeus unstained, with ten transverse grooves. Central sulcus shallow and slender. Anteclypeus and carina tawny, apex half-moon shaped. Lorum with several silver setae (Fig. 7). Labium long, reaching the metacoxae (Fig. 8).

*Thorax.* Pronotum (Fig. 6) with lateral and sub-lateral lobes with wrinkles. Mesonotum (Fig. 2) with submedian and lateral sigillae slightly stained in pale green. Operculum (Fig. 9) broad, widely spaced by the metacoxae, and laterally directed; posterior margin slightly convex, lateral margin very short. Meracanthus large, covering the internal angle of operculum in dorsal view. Proximal margins of metacoxae forming acute projections (Fig. 8). Wings hyaline. Fore wings (Figs 2–3): basal cell slightly smoky, twice as long as wide; posterior vein of basal cell arched; cubitus anterior vein slightly concave; cubital cell wider than clavus; medial cell twice as long as the ulnar cell 3, almost half of the length of fore wing; radius anterior vein closely aligned with subcosta for its length, divergent at apex; median vein long, reaching half the length of radial cell proximal to M3+4 fork; apical cell 1 longer than any other apical cell.

*Abdomen* (Fig. 2) subcylindrical, fusiform, short, the length equal to the combined length of head and thorax in dorsal view. Timbals elongate laterally, posteriorly directed, anterior margin of the same length as anterior margin of tergite 1 (Fig. 10). Sternite VII subrectangular, with posterior margin concave and slightly emarginated; sternite VIII triangular (Fig. 11).

*Genitalia* (Figs 12–14). Pygofer distal shoulder undeveloped. Basal lobe of pygofer long, reaching uncus. Uncus long with setae, tapering to apex, the lateral margins folding to aedeagus. Aedeagus broad, tapering to apex. Theca with ventral branches, apex of theca beak-shaped in lateral view,

dorsally grooved and bifurcated on the anterior margin, with wrinkles. Vesica originating in a fissure from basal plate to the distal third of the theca. Apex of theca with two slender sclerotized branches closely spaced on the fissure of vesica.

**Female** (Figs 15–18). Same characteristics as in the male, but body a little more yellowish (Fig. 15). Operculum similar to that of the male, with the lateral margin very short and posterior margin slightly convex (Fig. 16). Meracanthus large, longer than operculum, covering the internal angle of operculum in dorsal view (Fig. 16). Sternite VII longer than any other, posterior margin with an obtuse middle groove reaching more than half of sternite, forming two lobes (Fig. 17). Lateral margins of abdominal segment 9 touching medially (Fig. 17). Ovipositor sheath shorter than tip of dorsal beak (Fig. 18).

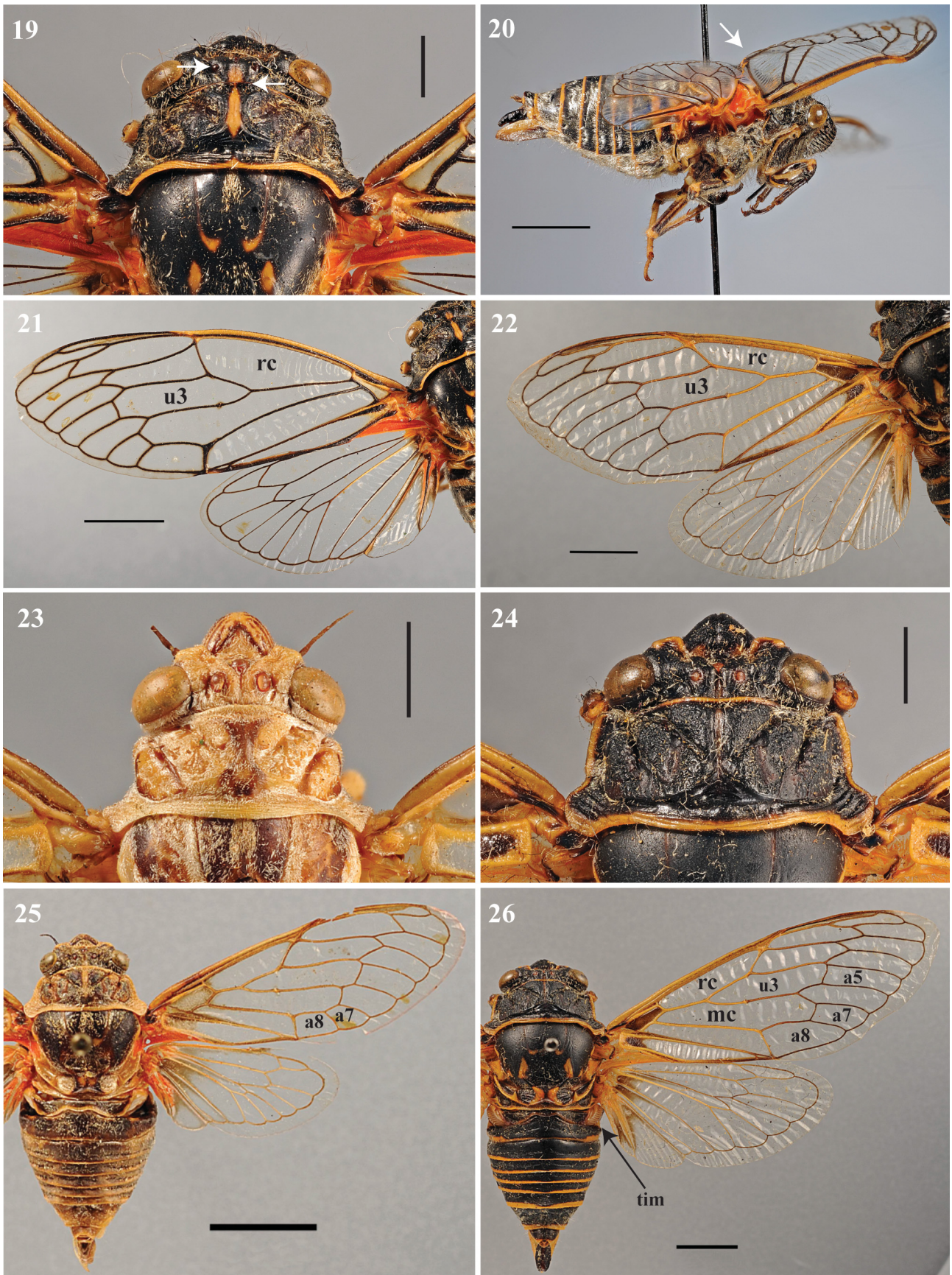
**Measurements** (in mm). Males (n = 3, values for the holotype in parentheses) lb 23.0–25.1 (25.1); wh 6.21–6.66 (6.48); lh 1.08–1.26 (1.17); wp 7.56–8.28 (8.28); lp 3.33–3.96 (3.96); wm 6.48–6.93 (6.93); lm 4.23–4.77 (4.77); lfw 31.1–34.6 (34.6); wfw 11.3–12.9 (12.9); lhw 18.3–20.3 (20.3); whw 7.7–8.8 (8.6). Female (n = 1): lb 26.8; wh 6.66; lh 1.26; wp 8.46; lp 3.78; wm 7.2; lm 5.13; lfw 34; wfw 13; lhw 19.6; whw 8.8.

**Etymology.** The name refers to the country of the type locality. Adjective.

**Distribution.** Brazil (Ceará).

**Key to the genera of Tibicini**

- 1 Head short, three times shorter than pronotum in dorsal view; lateral ocelli almost reaching the anterior margin of pronotum (Fig. 6); pronotum and mesonotum pronounced dorsally in lateral view (Fig. 5). ..... ***Gibbocicada* gen. nov.**
- Head long, its length less than three times the pronotum (Fig. 19); lateral ocelli not reaching the anterior margin of pronotum (Fig. 19); pronotum and mesonotum not pronounced dorsally in lateral view (Fig. 20). ..... 2
- 2 Radial cell of fore wings wider than ulnar cell 3 (Fig. 21). ..... ***Clidophleps* Van Duzee, 1915**
- Radial cell of fore wings about as wide as ulnar cell 3 (Fig. 22). ..... 3
- 3 Wings hyaline but tinged in yellowish brown; fore wing slender, median and cubitus anterior veins subparallel. .... ***Subtibicina* Lee, 2012**
- Wings hyaline, not tinged; fore wing broad, median and cubitus anterior veins divergent. .... 4
- 4 Vertex short; supra-antennal plates meeting the eyes laterally; eyes protruding laterally, as wide as vertex; postclypeus prominent in dorsal view, as long as vertex (Fig. 23). ..... ***Okanagodes* Davis, 1919**
- Vertex wide; supra-antennal plates not meeting the eyes laterally; eyes not protruding laterally, narrower than vertex; postclypeus not prominent, shorter than vertex (Fig. 24). ..... 5
- 5 Fore wing slender, its width almost twice the length, apical cells 7 and 8 as long as wide, base of wings



Figs 19–26. Diagnostic characters of the genera of Tibicinini. 19–21 – *Clidophleps wrighti* Davis, 1926; 22, 24, 26 – *Okanagana annulata* Davis, 1935; 23 – *Okanagodes gracilis* Davis, 1919; 25 – *Tibicinoides minuta* (Davis, 1915). 19, 23, 24 – Head and pronotum in dorsal view; 20 – habitus in lateral view; 21, 22 – fore and hind wings; 25, 26 – habitus, in dorsal view. Abbreviations: a – apical cell, mc – medial cell, rc – radial cell, tim – timbal, u – ulnar cell. Scale bars: 19, 23, 24 – 2 mm; 21, 22, 25, 26 – 5 mm. Photographs by Steve Thurston (AMNH).

- usually reddish orange (Fig. 25). .....  
 ..... *Tibicinoides* Distant, 1914
- Fore wing broad, its width almost three times the length, apical cells 7 and 8 longer than wide, base of wings usually yellow orange (Fig. 26). ..... 6
  - 6 Veins of fore wings fuscous black; female with a pair of striated areas on the antero-lateral sides of mesonotum. .... *Subpsaltria* Chen, 1943
  - Veins of fore wings not outlined in fuscous black; female without striated areas on the antero-lateral sides of mesonotum. .... 7
  - 7 Fore wing ulnar cell 3 longer than radial cell; apical cell 5 shorter than the others. ....  
 ..... *Paharia* Distant, 1905
  - Fore wing ulnar cell 3 nearly as long as radial cell; apical cell 5 as long as the others. .... 8
  - 8 Fore wing radial cell usually as long as medial cell; timbals of male elongated laterally and directed posteriad. .... *Tibicina* Kolenati, 1857
  - Fore wing radial cell usually shorter than medial cell; timbals of male not elongated laterally, directed anterolaterad (Fig. 26). .... *Okanagana* Distant, 1905

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