

Selymbria Stål, 1861 (Hemiptera: Cicadidae: Tibicininae): description of a new species with notes on the genus taxonomy and distribution

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Abstract. *Selymbria amazonensis* sp. nov. is described and illustrated from Brazil. An illustrated taxonomic key for males and females is provided. We include distribution maps and comments on their morphology, geographical distribution, and life history.

Keywords. Cicadas; Auchenorrhyncha; Morphology; Taxonomy; Distribution.

INTRODUCTION

Cicadas can be found in all biogeographical regions but are most diverse in the tropics and subtropics (Moulds, 2003). The distribution of Neotropical cicadas can be influenced by many factors such as climate, vegetation, geographic barriers and food resources. Many species are restricted to small ranges or specific ecological niches, showing an affinity for particular plant communities. While most species are widespread, their distribution range, as currently circumscribed, can reflect gaps in collecting efforts (Sanborn & Phillips, 2013).

Some studies focusing on sympatric Neotropical cicadas have demonstrated that habitat selection and seasonal population emergence patterns can minimize resource competition and affect courtship strategy (Young, 1972; Wolda, 1989; Sueur, 2002). At same time, convergence in calling song period for sympatric species has been reported in a time limited window, presumably as a consequence of a confluence of abiotic and biotic factors. (Sueur, 2002). The altitude where species are found or collected can be indicative of vertical niche, habitat selection and thermal tolerance (Sanborn *et al.*, 2011a). Two species of *Selymbria*, *S. ahyetios* and *S. pluvialis*, were included

in one of these studies and details on its seasonal distribution is relatively well known (Ramos & Wolda, 1985). However, a discussion including all 16 known species of genus and distribution and altitude range data is missing.

Selymbria Stål (1861) is a genus with remarkable morphological features and taxonomic history. The genus was proposed by Stål (1861) to accommodate *Cicada stigmatica* Germar, 1834 and *Cicada subolivacea* Stål, 1862, classified previously by Distant (1905) in Taphurini, Tibicininae. Four new species were described in the following decades: *S. pandora* Distant, 1911, *S. ahyetios* Ramos & Wolda, 1985, *S. pluvialis* Ramos & Wolda, 1985, and *S. danieleae* Sanborn, 2011. As a result of the first phylogenetic analysis in Cicadidae, Moulds (2005) included Taphurini in Cicadettinae. Only recently, a new classification for *Selymbria* was proposed based on morphological and molecular data: *Selymbria* was transferred to Tibicininae, and a new monotypic tribe was erected and named Selymbriini (Marshall *et al.*, 2018). Sanborn (2019) later redescribed *Selymbria*, including ten new species and a taxonomic key for males and females. A second genus, *Prosotettix* Jacobi, 1907 was recently reassigned to Selymbriini (Sanborn, 2021), based on external morphology and features of the male genitalia. As described below,

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Selymbria is defined based on features of the head, eyes and male genitalia, and males lacking an auxiliary auditory structure.

Selymbria currently includes 16 valid species exclusively found in the Neotropics. Here, a new Brazilian species is described for *Selymbria*, and an illustrated taxonomic key to males and females is provided. Information on species distribution and altitudinal range are presented including a discussion based on the proposition of the Neotropical regionalization by Morrone (2014).

MATERIAL AND METHODS

The material examined is deposited at the Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil (INPA) and the Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP). The specimens were studied with the aid of a stereoscopic microscope. The male genitalia was dissected to inform species delimitation and identification. Genitalic structures were extracted by placing the apex of the abdomen in a vessel with boiling water (~100°C) for 15 minutes. The pygofer was then removed with a forceps, immersed in warm potassium hydroxide aqueous solution (10% KOH) for about 30 minutes, and rinsed with water. Dissections were placed in micro vials with glycerin and pinned to the corresponding specimen.

Specimens were identified based on original descriptions, identification keys (e.g., Sanborn, 2019), and type images available on the website of the Zoological Museum, Ivan Franko National University of Lviv, L'viv, Ukraine (ZMD) [http://zoomus.lviv.ua/en/germar_collection], and the Smithsonian Institution, National Museum of Natural History, Washington D.C. (NMNH) [<https://biogeodb.si.edu/bioinformatics/dfm/metas/search/?stxt=selymbria>]. Photographs of type specimens were also provided on request by the Swedish Museum of Natural History, Stockholm, Sweden (NHRS) and the Natural History Museum, London, United Kingdom (NHMUK).

Measurements of the new species were made with Vernier calipers. The terminology used in descriptions generally follows Moulds (2005, 2012), except for de-

tails of genital morphology (Marshall *et al.*, 2018; Ruschel *et al.*, 2019). Photographs were taken using a Nikon AZ100M stereomicroscope and NIS-Elements Advanced Research software available at the Departamento de Zoologia, Universidade Federal do Rio Grande do Sul (UFRGS). A vector-based illustration of the pygofer of the new species was generated based on an image of the paratype.

We used the links to figures from Sanborn (2011) and (2019) provided by Zenodo in the Biodiversity Literature Repository (<https://zenodo.org/records/7671500> and <https://zenodo.org/records/3995202>), and vector-based illustrations from sternite VII of females to improve the taxonomic key of *Selymbria*.

The distribution map of *Selymbria* species was produced in QGIS (2023) using the following set of shapefiles: altitude ranges and Neotropical regions of Morrone's (2014) with the biogeographical regionalization provided by Lowenberg-Neto (2014). Species distribution records were retrieved from the list of material examined in Ramos & Wolda (1985) and Sanborn (2019), and from labels of examined specimens. These data were georeferenced using Global Gazetteer Version 2.3 (1996-2017) and Google Earth Pro (2015), and the coordinates were converted to decimal degrees by Species Link tool (2002).

RESULTS

Cicadidae Latreille, 1802
Tibicininae Distant, 1905
Selymbriini Moulds & Marshall, 2018
***Selymbria* Stål, 1861**

Diagnosis: *Selymbria* is characterized by the triangular head in dorsal view, prominent eyes, wider than the lateral angle of the pronotal collar, auxiliary auditory structure absent in males, pygofer with upper lobes, long and undivided uncus, and an aedeagus with a short theca, resembling those in species of *Tettigarcta* White, 1845 (Tettigarctidae) (Marshall *et al.*, 2018; Sanborn, 2019).

Key to species of *Selymbria*

1. Forewings without infuscations..... 2
- Forewings with spots of infuscation..... 3
2. Basal area of fore and hindwings bluish green; lateral angle of pronotal collar strongly convex, apex directed posteriorly; sternite VII of female as Fig. 3P; (Brazil) *S. subolivacea* (Stål, 1862)
- Basal area of fore and hindwings reddish orange; lateral angle of pronotal collar not strongly convex, apex not posteriorly directed (Brazil) *S. pandora* Distant, 1911
3. Forewings with infuscation restricted to apex, not on proximal apical cell veins or crossveins..... 4
- Forewings with infuscation on apex, on proximal apical cell veins and/or crossveins 9
4. Ulnar cells 1, 2 and 3 of forewings nearly the same length, u1 e u2 with same width, u3 twice as wide as u1 and u2; cubitus anterior 1 of forewing curved between split with cubitus anterior 2 and mediocubital crossvein; sternite VII of female as Fig. 3D (French Guiana)..... *S. chevauxensis* Sanborn, 2019 (fig. 2, <https://doi.org/10.5281/zenodo.3995206>)
- Ulnar cell 1 longer than u2 and u3 of forewings, u3 slightly wider than u1 and u2; cubitus anterior 1 of forewing straight between split with cubitus anterior 2 and mediocubital crossvein; shape of sternite VII of female different from Fig. 3D..... 5

5. Abdominal tergites castaneous; tergite 1 and dorsum of tergites 2-3 nearly or entirely piceous; uncus stout, half its length extending beyond anal styles; sternite VII of female as Fig. 3I (French Guiana).....*S. guianensis* Sanborn, 2019 (fig. 6, <https://doi.org/10.5281/zenodo.3995214>)
- Abdominal tergites entirely piceous or fuscous; less than half uncus length extending beyond anal styles or uncus not surpassing anal style; shape of sternite VII of female different from Fig. 3I (Central America) 6
6. Abdomen with white pubescent transverse fascia on anterior margin of tergite 3 and 7 (males) and tergite 2, 3, and 7 (females); sternite VII of female as Fig. 3E (Costa Rica and Panama).....*S. cinctifera* Sanborn, 2019 (fig. 3, <https://doi.org/10.5281/zenodo.3995208>)
- Abdomen lacking white pubescent transverse fascia (both males and females); shape of sternite VII of female different from Fig. 3E (Panama, Costa Rica and Guatemala) 7
7. Lateral angle of pronotal collar convex, uncus not surpassing anal style; sternite VII of female as Fig. 3H (Guatemala).....*S. guatemalensis* Sanborn, 2019 (fig. 5, <https://doi.org/10.5281/zenodo.3995212>)
- Lateral angle of pronotal collar rectangular; uncus surpassing anal style; shape of sternite VII of female different from Fig. 3H (Costa Rica and Panama)..... 8
8. Forewing with a slightly infuscation at the tip; apex of theca forming two acute angles laterally; sternite VII of female as fig. 3A; emergence period from late November to February*S. ahyetios* Ramos & Wolda, 1985 (fig. <https://biogeodb.stri.si.edu/bioinformatics/dfm/metas/view/48661>)
- Forewing with a strongly infuscation at the tip; apex of theca rounded; sternite VII of female as Fig. 3M; emergence period from late April to mid-September...
.....*S. pluvialis* Ramos & Wolda, 1985 (fig. <https://biogeodb.stri.si.edu/bioinformatics/dfm/metas/view/48643>)
9. Forewings with infuscation slightly covering and not expanding from crossveins radial and radiomedial; male meracanthus broadly triangular, apex forming obtuse angle; sternite VII of female as Fig. 3F; (French Guiana).....*S. danieleae* Sanborn, 2011 (fig. 6, <https://doi.org/10.5281/zenodo.7671516>)
- Forewings with infuscation covering and expanding from crossvein radial and radiomedial; male meracanthus triangular with apex forming acute angle; shape of sternite VII of female different from Fig. 3F 10
10. Operculum in females shaped as scalene triangle, posterior and lateral margins forming an obtuse angle; sternite VII of female as Fig. 3N (Costa Rica)
.....*S. puntarenasensis* Sanborn, 2019 (fig. 10, <https://doi.org/10.5281/zenodo.3995222>)
- Operculum in females shaped as a right triangle with posterior and lateral margins forming a right angle; shape of sternite VII of female different from Fig. 3N
11
11. Male meracanthus longer than wide, almost reaching posterior margin of male operculum; sternite VII of female as Fig. 3C.....*S. boliviaensis* Sanborn, 2019 (fig. 1, <https://doi.org/10.5281/zenodo.3995204>)
- Male meracanthus as long as wide, not reaching posterior margin of male operculum; shape of sternite VII different from Fig. 3C 12
12. Tip of labium reaching to posterior of middle leg coxae (Brazil, Ecuador and Peru) 13
- Tip of labium not reaching to middle leg coxae (Argentina, Brazil and Peru) 15
13. Male operculum semilunar; uncus as wide as basal lobes in ventral view; sternite VII of female as Fig. 3L (Peru).....*S. madredeiosensis* Sanborn, 2019 (fig. 9, <https://doi.org/10.5281/zenodo.3995220>)
- Male operculum subrectangular; uncus narrower than basal lobes in ventral view; shape of sternite VII of female different from Fig. 3L (Brazil and Ecuador) . 14
14. Male meracanthus near operculum internal angle; uncus longer than anal style and almost the same length of dorsal beak in lateral view; theca with bifurcated apex; sternite VII of female as Fig. 3G (Ecuador).....*S. ecuadorensis* Sanborn, 2019 (fig. 4, <https://doi.org/10.5281/zenodo.3995210>)
- Male meracanthus distant to operculum internal angle; uncus shorter than anal style and dorsal beak combined in lateral view; theca without bifurcated apex; sternite VII of female as Fig. 3O (Brazil)*S. stigmatica* (Germar, 1834)
15. Male meracanthus with acute apex; uncus flat in lateral view; sternite VII of female as Fig. 3J (Argentina and Brazil)
.....*S. iguazuensis* Sanborn, 2019 (fig. 7, <https://doi.org/10.5281/zenodo.3995216>)
- Male meracanthus with rounded apex; uncus broad in lateral view; shape of sternite VII of female different from Fig. 3J (Brazil and Peru) 16
16. Male operculum semilunar; uncus shorter than anal style in lateral view; sternite VII of female as Fig. 3K (Peru)
.....*S. loretoensis* Sanborn, 2019 (fig. 8, <https://doi.org/10.5281/zenodo.3995218>)
- Male operculum subrectangular; uncus longer than anal style in lateral view; sternite VII of female as Fig. 3B (Brazil)*S. amazonensis* **sp. nov.** (Figs. 1-2)

***Selymbria amazonensis* sp. nov.**
(Figs. 1A-K; 2A-F)

Type material: Holotype male (INPA): BRASIL, AM, Benjamin / Constant, Sítio do Damião / 042441S – 700230W // 08-10.ix.2005, arm. Luz. / J.A. Rafael & F.F. Xavier F^o (Fig. 1A).

Paratype male (INPA): BRASIL, AM, Castanho- / Careiro, Ramal do Panelão / 03°50'42"S – 60°26'03"W / 04-05.xi.2010, J.A. Rafael, // D.M. Takiya, F.F.F. Xavier F^o, / M.J. Holanda & D.M.M. / Mendes; arm. luminosa / móvel, 21:00 – 00:00 h (genitalia in micro vial).

Paratype female (INPA): BRASIL, AM, Tabatinga / 041215S – 695432W / 03-08.ix.2005, arm. luz / J.A. Rafael & F.F. Xavier F^o (Fig. 2A).

Etymology: The epithet refers to the Brazilian state, Amazonas, where type specimens were collected.

Diagnosis: This species can be distinguished from other *Selymbria* by the following combination of features: vertex primarily piceous, except for space between anterior arm of epicranial suture toward supra-antennal plates; male operculum subrectangular, covering tympanal cavity, posterior margin rounded, reaching middle of sternite II, lateral margin nearly straight; forewings hyaline with infuscation on the following: distal radius anterior 1, distal radius anterior 2 and distal median vein 1; radius anterior vein extending to radial crossvein; and distal radius posterior extending to radial median crossvein; uncus shovel shaped, twice as long as anal styles, dorsal beak in lateral view almost as wide as pygofer in ventral view; lateral margins of uncus wider proximally; theca

dorsally developed with bifurcated apex, slender sclerotized pointed structure between the bifurcation, originating from vesica; ventral part of theca with vesica and slender sclerotized pointed structure at middle; female sternite VII longer than sternite VI, lateral margin concave becoming convex toward apex.

Description: Male: Holotype ground color of head and thorax greenish marked with piceous, abdomen piceous, marked castaneous and green. Paratypes tawny marked with piceous, abdomen piceous marked with castaneous

and green. Color of paratypes most faded after collection and preservation. All specimens with wax in the ventral body.

Head (Figs. 1B, C) wider than lateral angle of pronotal collar and mesonotum, vertex piceous except for space between anterior arm of epicranial suture toward supra-antennal plates; supra-antennal plates with small piceous mark (except in the paratype female); lateral ocelli widely separated, distance between lateral ocelli greater than between each lateral ocellus to median (Fig. 1B); dorsal postclypeus as long as vertex, long and

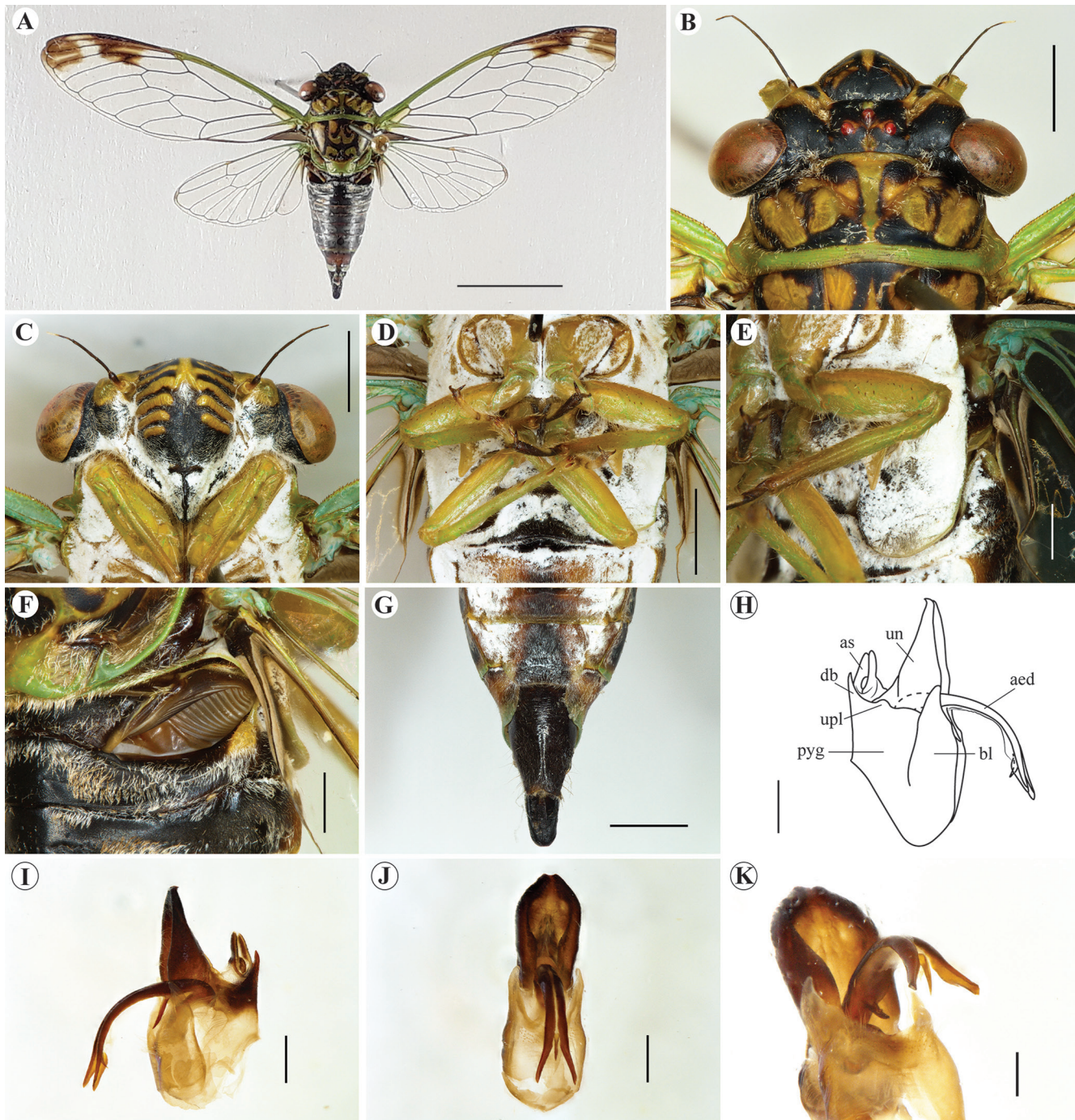


Figure 1. *Selymbria amazonensis* sp. nov., holotype male (A-G), paratype male (H-K): (A) Habitus in dorsal view; (B) Head and pronotum in dorsal view; (C) Head in ventral view; (D) Thorax in ventral view; (E) Left operculum in latero-ventral view; (F) Timbal in dorso-lateral view; (G) Terminal part of abdomen in ventral view; (H) Uncus, pygofer and aedeagus in lateral view, right side; (I) Uncus, pygofer and aedeagus in lateral view, left side; (J) Uncus and pygofer in ventral view and aedeagus in dorsal view; (K) Theca in frontal-ventral view. Scale bars: A = 1 cm; B-D, G = 2 mm; E, F, H-K = 1 mm. Abbreviations: (aed) aedeagus; (as) anal styles; (bl) basal lobe of pygofer; (db) dorsal beak; (pyg) pygofer; (un) uncus; (upl) upper pygofer lobe.

convex piceous mark reaching half length, piceous transverse grooves; golden setae in posterior margins of the eyes. Ventral postclypeus with two thirds of central sulcus piceous (holotype) or entirely piceous (paratypes), and piceous within the transverse groove; anteclypeus and carina piceous, dorsal surface tumid; lorum piceous; antenna with greenish scape, pedicel and flagellum piceous (Fig. 1C); labium reaching basisternum 3, piceous at apex.

Thorax (Figs. 1B-E). Pronotum (Fig. 1B): median lobe with two comma-shaped piceous marks opposite each other and median longitudinal space between them; paramedian and lateral lobes with longitudinal piceous mark; two piceous marks toward each other departing from ambient fissure of pronotum (marks of pronotum conspicuous in paratypes); pronotal collar greenish (holotype) unmarked, lateral margin convex, lateral part of pronotal collar not as wide as eyes. Mesonotum (Fig. 1A): margins of lateral sigillae and internal and posterior margins of submedian sigillae piceous; central piceous mark projected toward submedian sigillae connecting to lateral sigillae; scutal depression piceous; wing groove greenish with internal margin with golden pile setae, external margin almost straight becoming convex toward cruciform elevation; central area of cruciform elevation swollen, cruciform elevation greenish with the posterior margin and arc of posterior arms with golden setae; metanotum covered by golden pile setae; basisternum 3 (Fig. 1D) obtuse, not prominent relative to mesocoxae, posterior angle concave. Male opercula (Fig. 1E) covering the tympanal cavity, rounded posterior margin reaching middle of sternite II, lateral margin almost straight. Forewings (Fig. 1A) hyaline featuring eight apical cells, infuscation on the following: distal radius anterior 1, distal radius anterior 2 and distal radius posterior vein 1; proximal radius anterior veins extending to radial crossvein; proximal radius posterior extending to radial median crossvein. Costal and radius + subcostal vein green, first

with spines on margin; basal cell hyaline. Hindwings hyaline with six apical cells, infuscation absent.

Male abdomen (Figs. 1A, F, G): Timbals exposed (Fig. 1F), turned-back rim in posterior margin of timbal cavity (Fig. 1F); male abdomen (Fig. 1A) cylindrical, tergites 1 to 6 piceous, marked castaneous and covered with white setae at anterior margin. Tergites 7 and 8 piceous, marked castaneous and green. Sternites I to VII piceous and castaneous at middle, posterior margins green, lateral margins covered with wax. Sternite VII (Fig. 1G) sub-rectangular, lateral margin almost straight becoming convex, posterior margin not emarginate. Sternite VIII elongated and piceous.

Male genitalia (Figs. 1H-K): Uncus shovel shaped (Figs. 1H-K), twice as long as anal styles and dorsal beak in lateral view (Figs. 1H, I), almost as wide as pygofer in ventral view (Fig. 1J). Lateral margins of uncus wider proximally (Fig. 1J). Pygofer sub-cylindrical, upper lobes small and rounded; basal lobe surpassing posterior margin of uncus, ventral margin of basal lobe slightly straight (Figs. 1H-J). Dorsal beak shorter than anal styles in lateral view (Figs. 1H, I). Theca dorsally developed with bifurcated apex and slender sclerotized pointed process between bifurcation, originating from vesica; ventral part of theca with vesica and slender sclerotized pointed process at middle (Figs. 1J, K).

Female (Figs. 2A-F): Similar to male in terms of their external morphology (Figs. 2A-C), except in the following features: smaller and sub-triangular operculum (Fig. 2D); sternite VII longer than sternite VI, lateral margin concave becoming convex toward apex (Fig. 2E, 3B); anal styles longer than dorsal beak and ovipositor sheath in lateral view (Fig. 2F); internal margins of abdominal segment 9 piceous becoming convex at middle and converging at apex (Fig. 2E).

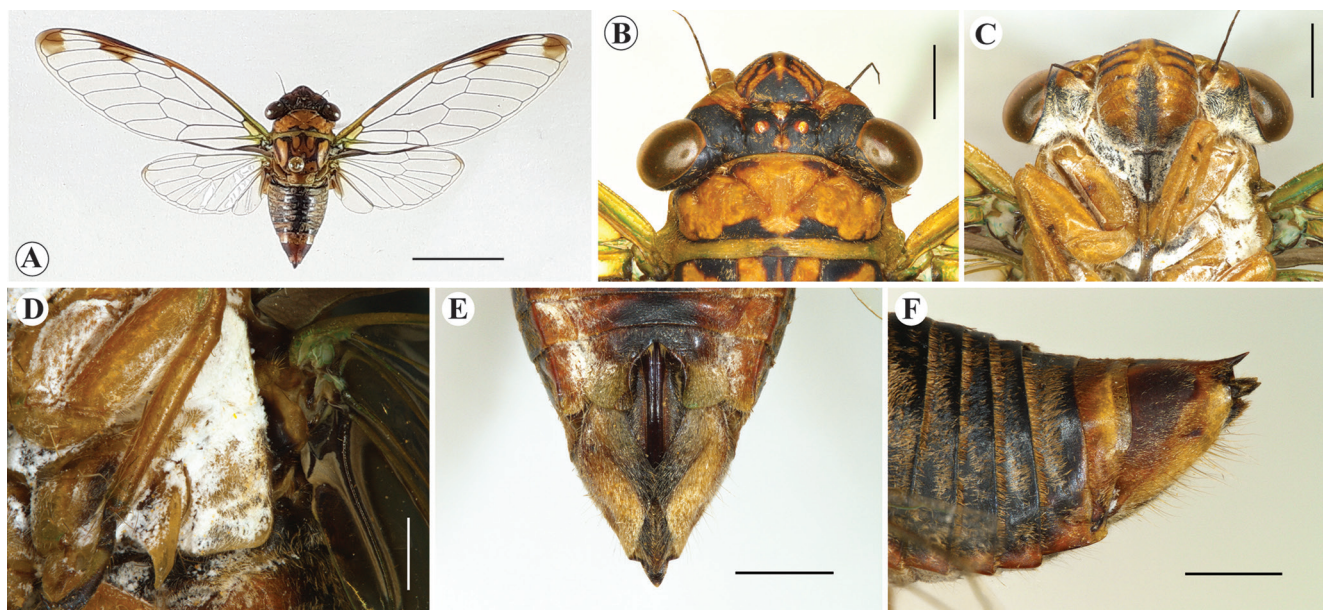


Figure 2. *Selymbria amazonensis* sp. nov., paratype female (A-F): (A) Habitus in dorsal view; (B) Head and pronotum in dorsal view; (C) Head in ventral view; (D) Operculum in latero-ventral view; (E) Terminalia in ventral view (F) Terminalia in lateral view. Scale bars: A = 1 cm; B, C, E, F = 2 mm; D = 1 mm.

Remarks: The species can be distinguished from *S. subolivacea* and *S. pandora* by the presence of infuscation in the forewings; from *S. ahyetios*, *S. chevauxensis* Sanborn, 2019, *S. cinctifera* Sanborn, 2019, *S. guatemalensis* Sanborn, 2019, *S. guianensis* Sanborn, 2019 and *S. pluvialis* by the infuscations not restricted to the forewings apex; from *S. danieleae* by the infuscations not restricted to the radiomedial crossvein; from *S. stigmatica* by the infuscations extending beyond the apex of apical cell 2, crossing the ambient vein onto the forewing margin; from *S. bolivianaensis* Sanborn, 2019 by the theca shape and meracanthus not nearly reaching the posterior margin of male operculum; from *S. iguazuensis* Sanborn, 2019 by the male operculum shape and the uncus longer than the dorsal beak of pygofer in lateral view, and from *S. loretoensis* Sanborn, 2019 and *S. madredeiosensis* Sanborn, 2019 by the same features mentioned above, including the ventral margin of basal lobe of pygofer, which is slightly straight. The new species is similar to *S. ecuadorensis* Sanborn, 2019 in having a theca with bifurcated apex, but differs in having the meracanthus more distant from the posterior margin of operculum, the posterior margin of operculum surpassing sternite II, and the uncus longer than pygofer dorsal beak in lateral view.

Comparative examined material:

Selymbria bolivianaensis Sanborn, 2019

Male (1) from MZSP: Bolivia \ tropica \ Region CHAPARE \ (400 Mtr.) \ Dirings \ Coll. Dirings \ S. Paulo – Brasil \ Z/73.

Selymbria pandora Distant, 1911

Female (2) (photographs of types from NHMUK): NHMUK 010220887 and NHMUK 010220888.

Selymbria stigmatica (Germar, 1834)

Female (1) from MZSP: CORCOVADO \ Guanabara Brasil \ I.1963 \ Alvarenga e Seabra.

Male (1) and female (1) from MZSP: Linhares \ Esp. Santo \ OUT 79.

Cicada macrophthalma Stål, 1854 [synonym junior of *Selymbria stigmatica* (Germar, 1834)]

Female (photographs of type from NHRS): Brasil \ Typus \ macro- \ phthalma \ Stål. Typ. \ stigmatica Germ. \ ex. Typ. A \ Schama misjum \ NHRS-GULI \ 000046992.

Selymbria subolivacea (Stål, 1862)

Female (photographs of type from NHRS): Rio Jan. \ F. Sahbb. \ Typus \ subolivacea Stål \ NHRS-GULI \ 000046991.

ary auditory structure (Marshall *et al.*, 2018; Sanborn, 2019), although *Prosotettix* (*Selymbriini*) also appears to lack this structure (Sanborn, 2021). Unusual morphological characteristics like the short theca resemble those in *Tettigarcta* (*Tettigarctidae*), the sister-family of *Cicadidae* with two extant species found only in Australia (Marshall *et al.*, 2018). Two structures associated with copula in males and females in *Selymbria* also show an interesting pattern of variation. The exceedingly long and undivided male uncus may be correlated to the shape of the female sternite VII. During copula, the male places the uncus into the groove of female sternite VII (Ruschel *et al.*, 2019), and the variation in the width of the groove width seems to be associated to the width of uncus. *Selymbria chevauxensis* and *S. stigmatica* males have a flat uncus (fig. 2F in https://zenodo.org/records/3995206#.Y_IChnbMKUk) and a narrow female sternite VII groove (Figs. 3D, O), unlike other congeneric species. A detailed morphological study is warranted to test this hypothesis. Morphological variation in the male uncus and the female sternite VII was also observed in other cicada genera, and the uncus includes several characters relevant for inferring phylogenies in this group (Marshall *et al.*, 2018; Ruschel *et al.*, 2023). The features described above are also important for species-level identification.

Distribution and altitude ranges

In total, 50 records were georeferenced for 17 species, and these include nine countries in Central and South America (Argentina, Bolivia, Brazil, Costa Rica, Ecuador, French Guiana, Guatemala, Panama, and Peru). Our findings show that *Selymbria* is distributed across five Neotropical dominions and 12 provinces *sensu* Morrone (2014). These distribution records encompass a wide elevation gradient, ranging from 5 to 1,430 m (Figs. 4-5, Supplementary Figure, Supplementary Table).

The Boreal Brazilian and the Pacific dominion include the highest number of species records in *Selymbria*. The former dominion includes records from seven species: three species, *S. danieleae*, *S. guianensis* and *S. chevauxensis* are found in the French Guiana in the Guianan Lowland province (40-115 m). These sympatric species are currently recorded for the northeast coast of French Guiana and the Montagne des Chevax, and the adults emerge around the same time in May (Sanborn, 2019). They can be easily distinguished by their external morphology and the male and female genitalia (Sanborn, 2019). *Selymbria ecuadorensis* is endemic to Ecuador and includes records from the Napo province, the Estación Científica Yasuni and the Reserva Etnica Waorani, between an altitudinal range of 200-500 m and a maximum distance of 87 km. This species is known only from the type series locality and is distributed in the Ecuadorian amazon rainforest at an altitude range of 200-500 m. *Selymbria amazonensis* **sp. nov.** occurs in the Imeri province in Brazil (Boreal Brazilian dominion), but also includes records from the east and west Amazon forest in the Madeira province (South Brazilian dominion) which are ~1,000 km apart. The dis-

DISCUSSION

Morphology

Selymbria is a morphologically distinct genus that is widely distributed in the Neotropical region. The genus is unique in Tibicininae due to the absence of an auxil-

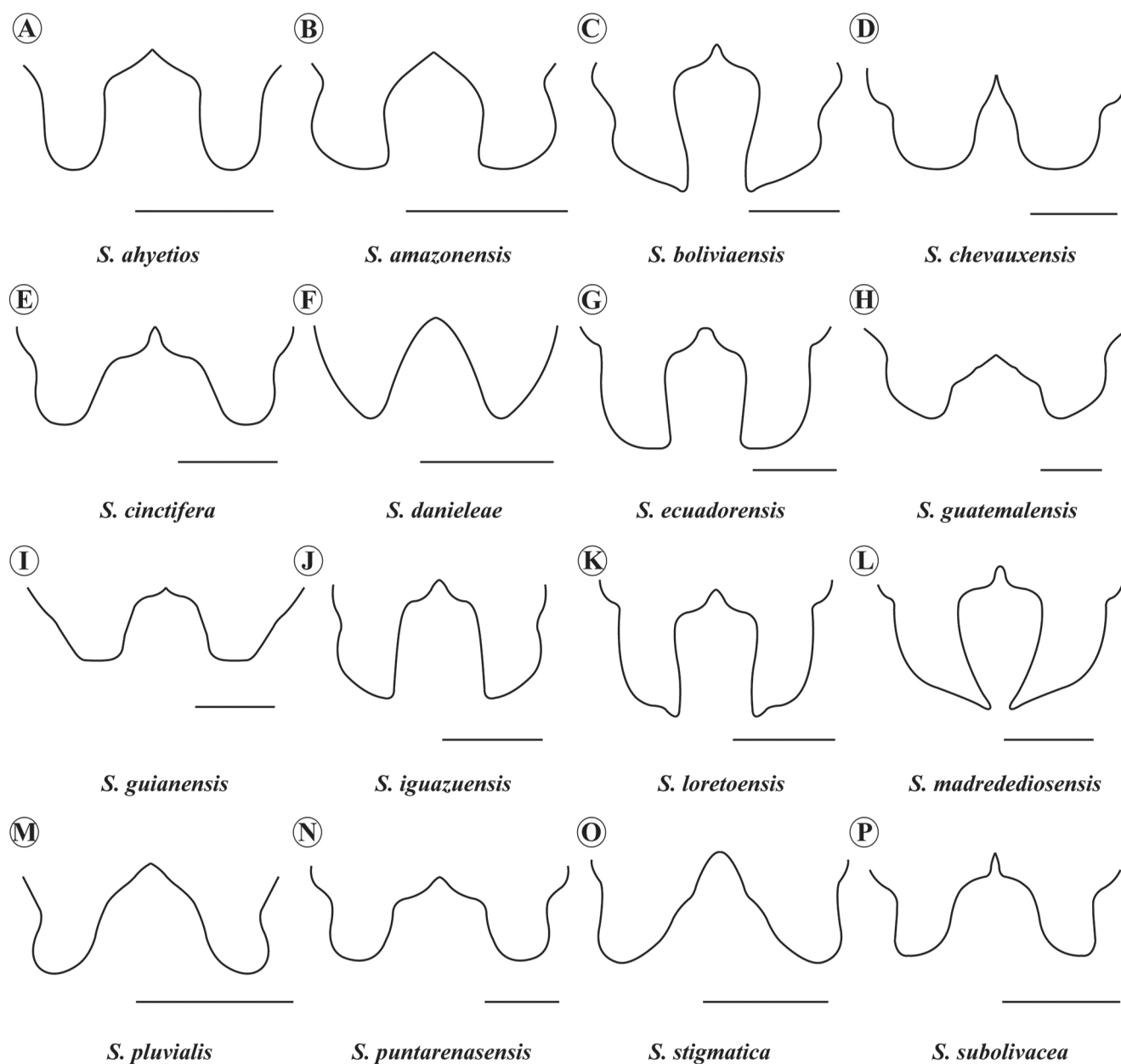


Figure 3. Female sternite VII of *Selymbria* species in ventral view (A-P). Scale bar: 2 mm.

persal capacity in cicadas is thought to be relatively low with current dispersal estimates below a one-kilometer radius (Karban, 1981; Andrade *et al.*, 2020). Most of the distance observed between the locality data collected here is due to low collecting efforts. *Selymbria amazonensis* **sp. nov.** is found in lowland forests between 26 and 84 m of altitude. *Selymbria madredediosensis* has four collecting records in Peru: three of them in the South Brazilian dominion specifically in the Rondônia province in areas varying between 200 and 464 m of altitude. The other record for the species is found in Boreal Brazilian dominion in the Napo province. This specimen was collected in an area in the northeast of Iquito city near the Amazon river at 100 m altitude. This locality coincides with that of *S. loretoensis* and both species are very similar in their external morphology but can be distinguished by the male and female genitalia (Sanborn, 2019). The distribution currently known could be a result of low sampling and both species may occur in sympatry. The other record of

S. loretoensis is in the Imerí province in the margin of the Amazon River at 110 m altitude. *Selymbria amazonensis* **sp. nov.** and *S. madredediosensis* occur in the Boreal Brazilian and in the South Brazilian dominions, but *S. boliviaensis* is exclusive from the last mentioned. *Selymbria boliviaensis* occurs in the Rondônia province on the margin of the Bolivian Andean Cordillera. The species is found in lowland areas of the cordillera varying from 400-1,300 m of altitude.

Four species of *Selymbria* are present in the Pacific dominion, which covers Southern Central America and Northwestern South America: *S. cinctifera* (Choco-Darién and Gatuso-Talamanca province); *S. puntarenasensis* (Puntaneras-Chiriquí province in Costa Rica); *Selymbria pluvialis* (Gatuso-Talamanca – Puntaneras-Chiriquí province), and *Selymbria ahyetios* (Gatuso-Talamanca province). The nymphs of *S. pluvialis* emerge from the ground when the rains begin, and they remain active during the early and mid-rainy season between late April and

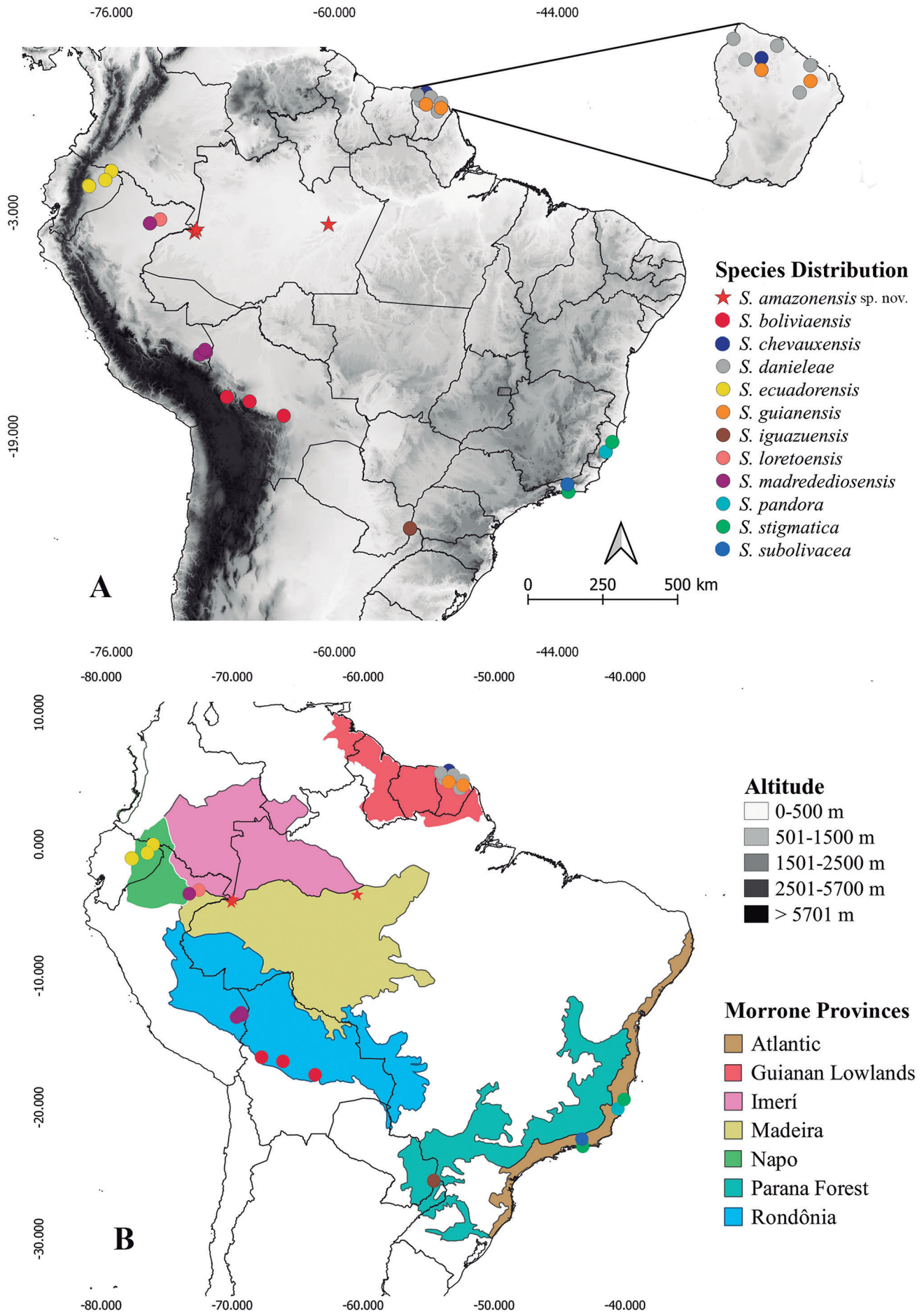


Figure 4. Distribution map of *Selymbria* in the Brazilian and Chocoan subregion. (A) Altitude ranges. (B) Biogeographical provinces *sensu* Morrone (2014).

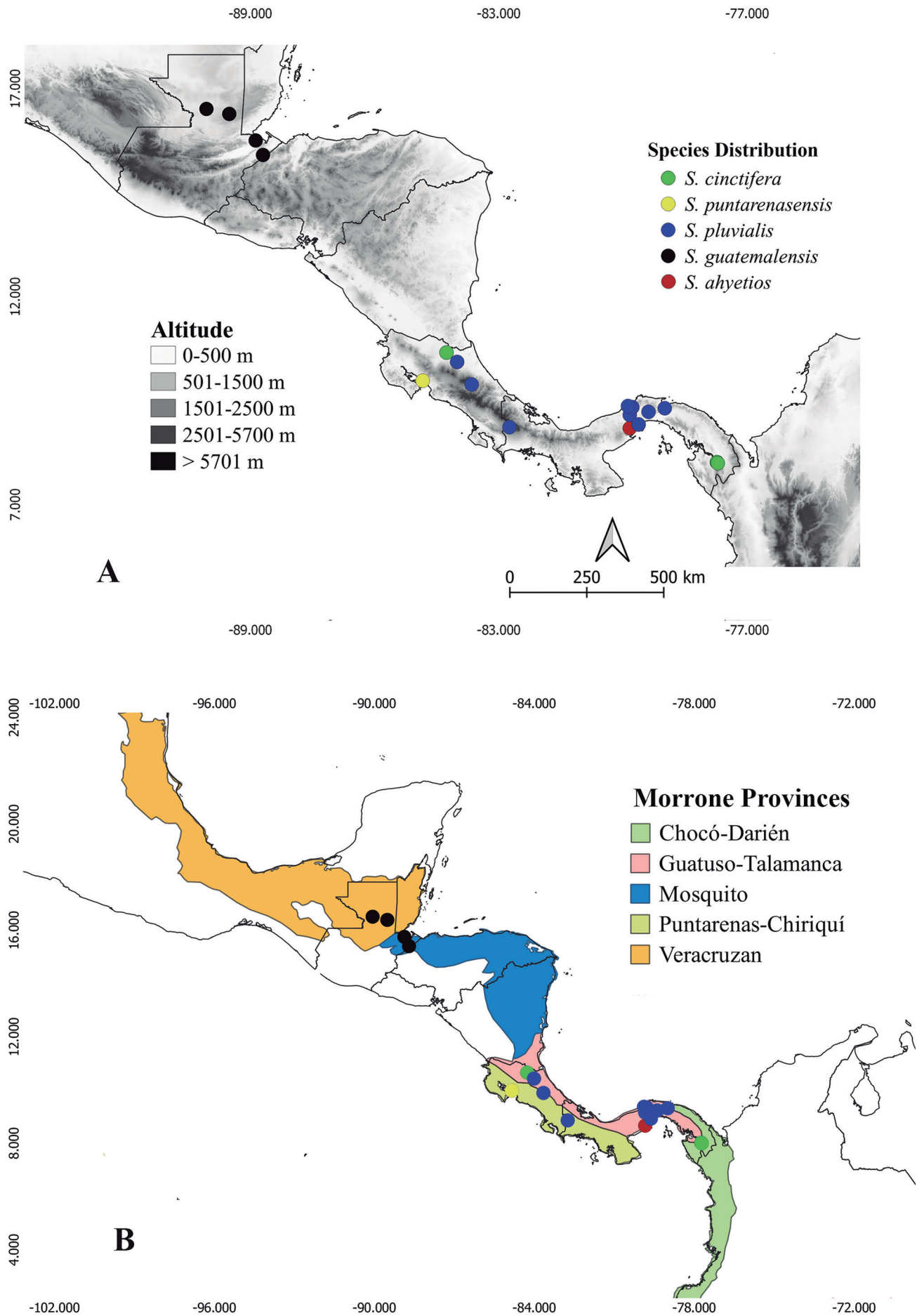


Figure 5. Distribution map of *Selymbria* on the Mexican transition zone. (A) Altitude ranges. (B) Biogeographical provinces *sensu* Morrone (2014).

mid-September (Ramos & Wolda, 1985). The type series was collected in canopy traps, which suggests that they fly to higher altitude in the forest (Sanborn, 2019). *Selymbria pluvialis* is observed in the early and mid-rainy season and *S. ahyetios* from late November through February, specifically from the last month of the rainy season until the first half of the dry season. There is no indication that the populations of these species overlap in time (Ramos & Wolda, 1985).

Selymbria cinctifera is distributed in the Choco-Darién and the Gatuso-Talamanca provinces. The distance between the two localities is approximately 789 km and this could be a consequence of low sampling and this distribution can be extended with additional collecting efforts (Sanborn, 2019). One of the collecting sites is the Parque Nacional del Darién in Panamá, one of the major natural protected areas of Central America, where *S. cinctifera* is found at an altitude area varying from 200 to 342 m. The other collecting site is Costa Rica. The species is probably sympatric with *S. puntarenasensis* and *S. pluvialis* but can be distinguished by the presence of a transverse stripe of white pubescence located near the abdomen apex (Sanborn, 2019). *Selymbria puntarenasensis* occurs in Puntaneras-Chiriquí province in Costa Rica. This species is known only by the female holotype and can be distinguished from the other congeneric species by the shape of female sternite VII (Fig. 3N). *Selymbria pluvialis* is distributed in the Pacific dominion in the Gatuso-Talamanca and Puntaneras-Chiriquí provinces. The distribution in Panamá is concentrated in the vicinity of Parque Nacional de Chagras and Camino de Cruces. One of the distribution points is on the border between Panama and Costa Rica at an altitude of 1,430 m. In Costa Rica, the species is found at the La Selva Biological Station and at the Centro Agronomico Tropical de Pesquisa e Ensino. *Selymbria ahyetios* was collected in lowland forest of Panama at 120 m altitude in Barro Colorado Island. This species is sympatric with *S. pluvialis* and similar in habitus and coloration but without the dark spot at the tip of forewings, although some specimens can have a lighter infuscation at the tip of forewing. The male genitalia and female VII sternite are different and variable between the two species. *Selymbria ahyetios* usually flies lower in the forest compared to *S. pluvialis*, and the emergence time of the two species is also variable (Ramos & Wolda, 1985).

Four species of *Selymbria* are found in the Paraná dominion and the Atlantic province in Brazil (*S. pandora*, *S. stigmatica* e *S. subolivacea*), ranging between 20-150 m. *Selymbria stigmatica* and *S. pandora* are reported from localities in the state of Espírito Santo that are only 93 km apart (20-150 m of altitude), suggesting that these species could be sympatric which suggests they may be sympatric. *Selymbria stigmatica* is known from the Corcovado mountain, in Rio de Janeiro, at an altitude of 261 m. *Selymbria subolivacea* is known only from the state of Rio de Janeiro, however, the collecting site is unknown. This species doesn't have infuscation in the forewings, and is larger in size (Sanborn, 2019). *Selymbria pandora* can be easily distinguished from *S. stigmatica* as it lacks infuscation in the forewings. *Selymbria*

iguazuensis occurs in the Parana forest province, with one record from the state of Paraná (Iguaçu Falls) and a second one nearby in Misiones, Argentina. Both specimens were collected in areas at approximately 150 m altitude.

The Mesoamerican dominion includes only one species, *S. guatemalensis*, recorded for the Veracruz province in Guatemala (5-540 m). The species is known only from the type series and all specimens were collected in forest areas near or inside National parks.

Selymbria species occur throughout a wide elevation gradient, ranging from 5 to 1,430 m. Cicadas are known to be adapted to certain thermal conditions and even be able to regulate their thermal response in some cases. Neotropical species inhabiting floristically diverse tropical environments show a high diversity of thermal preferences (Sanborn *et al.*, 2011b). *Selymbria* is distributed in 13 different provinces across a multitude of landscapes in a wide elevation range. These species may have evolved a level of thermal adaptation as a result of the different environments and elevation in which they are found. Some species inhabit tropical forest regions and yet these insects may exhibit a preference in terms of vegetation stratification. There are multiple examples of diverse insect groups that exhibit a vertical stratification, in different layers of vegetation, of species and populations within tropical ecosystems (Sanborn *et al.*, 2011b). Further studies and collecting efforts are needed to better understand the genus morphology, distribution and evolutionary history with special attention to thermal adaptation strategies across altitudinal gradients.

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- Sanborn, A.F. 2019. Figure 1. *Selymbria boliviaensis*. In: The cicada genus *Selymbria* Stål, 1861 (Hemiptera: Cicadidae: Tibicininae: Selymbriini): redescription including ten new species and a key to the genus. In *Zootaxa*, 4614(3): 401-448. <https://doi.org/10.5281/zenodo.3995204>.
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SUPPLEMENTARY TABLE

Distribution records of *Selymbria* species. Data retrieved from museum specimens marked with an asterisk.

Species	Countries	Dominion (Morrone, 2014)	Provinces (Morrone, 2014)	Locality	Coordinates (long, lat)
<i>S. ahyetios</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Guatuso-Talamanca province	Barro Colorado Island, Panama	−79.837500, 9.155278
<i>S. amazonensis</i> sp. nov.*	Brazil	South Brazilian dominion	Madeira province	Brasil, AM, Benjamin Constant, Sítio do Damião	−70.041667, −4.411389
<i>S. amazonensis</i> sp. nov.*	Brazil	South Brazilian dominion	Madeira province	Brasil, AM, Castanho-Careiro, Ramal do Panelão	−60.434167, −3.845000
<i>S. amazonensis</i> sp. nov.*	Brazil	Boreal Brazilian dominion	Imerí province	Brasil, AM, Tabatinga	−69.908889, −4.204167
<i>S. boliviaensis</i> Sanborn, 2019	Bolivia	South Brazilian dominion	Rondônia province	Santa Cruz, 3.7 km SSE Buena Vista, Hotel Flora & Fauna, 430 m, Bolivia	−63.647457, −17.515776
<i>S. boliviaensis</i> Sanborn, 2019	Bolivia	South Brazilian dominion	Rondônia province	Guanay, Coroico, La Paz Prov., Bolivia	−67.730000, −16.180000
<i>S. boliviaensis</i> Sanborn, 2019*	Bolivia	South Brazilian dominion	Rondônia province	Bolivia, tropica, Region Chapare (400 Mtr.)	−66.096000, −16.495999
<i>S. chevauxensis</i> Sanborn, 2019	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	Montagne des Chevaux, French Guiana	−53.431389, 4.742222
<i>S. cinctifera</i> Sanborn, 2019	Panama	Pacific dominion	Chocó-Darién province	Darién Prov., P.N. Darién Rancho, Panama	−77.732200, 8.019800
<i>S. cinctifera</i> Sanborn, 2019	Panama	Pacific dominion	Chocó-Darién province	Darién Prov., P.N. Darién Cerro Pirre, Panama	−77.712900, 7.997300
<i>S. cinctifera</i> Sanborn, 2019	Costa Rica	Pacific dominion	Guatuso-Talamanca province	Alajuela, Rio San Carlos, near Tres Amigos, Costa Rica	−84.263732, 10.656406
<i>S. danieleae</i> Sanborn, 2011	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	Belizone, Montagues de Tortue, French Guiana	−52.585000, 4.245000
<i>S. danieleae</i> Sanborn, 2011	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	Saut Dalles, French Guiana	−53.784339, 4.970789
<i>S. danieleae</i> Sanborn, 2011	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	Piste de Saint-Elie, French Guiana	−53.085200, 5.275000
<i>S. danieleae</i> Sanborn, 2011	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	Montagne des Chevaux, French Guiana	−53.431389, 4.742222
<i>S. danieleae</i> Sanborn, 2011	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	La Désirée, Commune de Matoury, French Guiana	−52.348333, 4.845000
<i>S. danieleae</i> Sanborn, 2011	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	Espérance, Commune de St. Laurent	−54.050000, 5.427778
<i>S. ecuadorensis</i> Sanborn, 2019	Ecuador	Boreal Brazilian dominion	Napo province	Prov. Napo, vic. Puerto Misahuali, Ecuador	−77.663667, −1.034500
<i>S. ecuadorensis</i> Sanborn, 2019	Ecuador	Boreal Brazilian dominion	Napo province	Napo Prov., Estación Científica Yasuni, Ecuador	−76.010694, −0.011189
<i>S. ecuadorensis</i> Sanborn, 2019	Ecuador	Boreal Brazilian dominion	Napo province	Napo Prov. 25 km E Puerto, Jatun Sacha, Ecuador	−77.616946, −1.088596
<i>S. ecuadorensis</i> Sanborn, 2019	Ecuador	Boreal Brazilian dominion	Napo province	1231 Ecuador Orellana, Erwin Transect, Onkone Gare Camp, Reserva Etnica Waorani	−76.453000, −0.657139
<i>S. guatemalensis</i> Sanborn, 2019	Guatemala	Mesoamerican dominion	Mosquito province	Izabal Dept., Finca Firmeza, Reserva de Anfíbios, SE of Morales, Guatemala	−88.696030, 15.406890
<i>S. guatemalensis</i> Sanborn, 2019	Guatemala	Mesoamerican dominion	Mosquito province	Dept. Izabal, Biotopo Chocon Machacas, Guatemala	−88.873243, 15.755464
<i>S. guatemalensis</i> Sanborn, 2019	Guatemala	Mesoamerican dominion	Veracruzán province	Peten Dept. "el Bosque" along Rio Machaquila ca 9 km W of Machaquila	−89.511930, 16.393520
<i>S. guatemalensis</i> Sanborn, 2019	Guatemala	Mesoamerican dominion	Veracruzán province	Peten Dept. Parque Arqueológico El Ceibal E of Sayaxche	−90.062560, 16.512970
<i>S. guianensis</i> Sanborn, 2019	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	Montagne des Chevaux, French Guiana	−53.431389, 4.742222
<i>S. guianensis</i> Sanborn, 2019	French Guiana	Boreal Brazilian dominion	Guianan Lowlands province	Orapu, RN 2 pk 65, Commune de Régina, Abattis de 7 ha en pente, French Guiana	−52.345361, 4.496192
<i>S. iguazuensis</i> Sanborn, 2019	Argentina	Parana dominion	Parana Forest province	Prov. Misiones, Puerto Iguazú, Argentina	−54.580000, −25.600000
<i>S. iguazuensis</i> Sanborn, 2019	Brazil	Parana dominion	Parana Forest province	Iguassu (sic), Brazil	−54.580000, −25.550000
<i>S. loretoensis</i> Sanborn, 2019	Peru	Boreal Brazilian dominion	Napo province	Dept. Loreto, 40 km NE Iquitos on Amazon River, Explorama Inn, Peru	−73.250000, −3.750000
<i>S. loretoensis</i> Sanborn, 2019	Peru	Boreal Brazilian dominion	Imerí province	Dpto. Loreto, Quebrada Orán ca 5 km N Rio Amazonas, 85 km NE Iquitos, el. 110 m, Peru	−72.517000, −3.475000
<i>S. madredeiosensis</i> Sanborn, 2019	Peru	South Brazilian dominion	Rondônia province	Madre de Dios, Rio Tambopata Res. 30 km (air) SW Puerto Maldonado, Peru	−69.225712, −12.967826
<i>S. madredeiosensis</i> Sanborn, 2019	Peru	South Brazilian dominion	Rondônia province	Madre de Dios, Tambopata Res. Zone, Tambopata Research Cntr on Rio Tambopata, Peru	−69.650000, −13.133333
<i>S. madredeiosensis</i> Sanborn, 2019	Peru	South Brazilian dominion	Rondônia province	Madre de Dios, nr Puerto Maldonado, Posada Amazonas, lodge@Rio Tambopata, Peru	−69.300000, −12.800000
<i>S. madredeiosensis</i> Sanborn, 2019	Peru	Boreal Brazilian dominion	Napo province	Dept. Loreto, 40 km NE Iquitos on Amazon River, Explorama Inn, Peru	−73.250000, −3.750000
<i>S. pandora</i> Distant, 1911	Brazil	Parana dominion	Atlantic province	Leopoldina, Esp. Santo, Brazil	−40.530000, −20.100000
<i>S. pluvialis</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Guatuso-Talamanca province	Barro Colorado Island, Panama	−79.837500, 9.155278
<i>S. pluvialis</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Guatuso-Talamanca province	Canal Zone, Base of Cerro Galera, Panama	−79.623355, 8.927999
<i>S. pluvialis</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Puntarenas Chiriquí province	Chiriquí Prov., Ojo de Agua, Fca. Hartmann, Panama	−82.743390, 8.861590
<i>S. pluvialis</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Guatuso Talamanca province	Panamá Prov., Llano-Carti Rd., Burbayar	−78.992120, 9.317530
<i>S. pluvialis</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Guatuso Talamanca province	Colón, Sierra Llorona Lodge 225 m, Cerro Sta. Rita, Panama	−79.775896, 9.341945
<i>S. pluvialis</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Guatuso Talamanca province	Colón Prov. Sta. Rita Arriba, Sierra Llorona, Panama	−79.790000, 9.330000
<i>S. pluvialis</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Guatuso Talamanca province	Cerro Jefe, Panama	−79.384167, 9.230833
<i>S. pluvialis</i> Ramos & Wolda, 1985	Panama	Pacific dominion	Guatuso Talamanca province	Coco Solo Tank Farm CZ, Panama	−79.880000, 9.370000
<i>S. pluvialis</i> Ramos & Wolda, 1985	Costa Rica	Pacific dominion	Guatuso Talamanca province	Heredia nr Puerto Viejo, LaSelvaBiol., Sta., Costa Rica	−84.006992, 10.430475
<i>S. pluvialis</i> Ramos & Wolda, 1985	Costa Rica	Pacific dominion	Puntarenas Chiriquí province	Catie, Costa Rica	−83.655579, 9.890850
<i>S. puntarenasensis</i> Sanborn, 2019	Costa Rica	Pacific dominion	Puntarenas Chiriquí province	Puntarenas Prov.: Puntarenas Co, Costa Rica	−84.840000, 9.980000
<i>S. stigmatica</i> (Germa, 1834)*	Brazil	Parana dominion	Atlantic province	Linhares, Espírito Santo	−40.060000, −19.390000
<i>S. stigmatica</i> (Germa, 1834)*	Brazil	Parana dominion	Atlantic province	Corcovado, Guanabara, Brasil	−43.211461, −22.952423
<i>S. subolivaeca</i> (Stål, 1862)*	Brazil	Parana dominion	Atlantic province	Rio de Janeiro, Brazil	−43.280000, −22.880000

SUPPLEMENTARY FIGURE

Distribution map of *Selymbria* on Morrone's Dominions. (A) Brazilian and Chocoan subregion. (B) Mexican transition zone.

