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How to distinguish the *Xestotrachelus* Bruner, 1913
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in Minas Gerais, Brazil

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How to distinguish the *Xestotrachelus* Bruner, 1913 (Orthoptera: Romaleidae: Romaleini) from other Romaleini in South America, with a report of the first record in Minas Gerais, Brazil

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Abstract. The present study provides an important contribution to the knowledge of the geographic distribution of *Xestotrachelus* Bruner, 1913 (Orthoptera: Romaleidae: Romaleini), a monotypic genus comprised of *Xestotrachelus robustus* (Bruner, 1911) that has a wide geographic distribution in Brazil. Specimens were collected at the Panga Ecological Reserve, Uberlândia, Minas Gerais, in the Brazilian Cerrado. We provide a key to distinguish *Xestotrachelus* from other genera found in South America.

Key words. Brazilian savanna, Cerrado, grasshopper, morphology, Panga Ecological Reserve.

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Introduction

The tribe Romaleini has grasshoppers that are widely distributed almost exclusively in the Neotropical region, with few species occurring in the Nearctic region (Cigliano et al. 2021). These tribe members have very diverse morphologies, which in some specimens include adornments on the pronotal crest, presence or absence of wings, and a very colorful body. Likewise, another interesting characteristic in some species of this group is the aposematic and gregarious nymphs (Roberts and Carbonell 1982; Carbonell 1986) as found in *Chromacris speciosa* (Thunberg, 1824), one of the best known species with these attributes in Brazil.

Among the South American Romaleini, *Xestotrachelus* Bruner, 1913 is a monotypic genus that includes *Xestotrachelus robustus* (Bruner, 1911), a species very similar to, but easily distinguishable from *Chromacris* Walker, 1870 (Roberts and Carbonell 1982). *Xestotrachelus* was described by Bruner (1913) and, at that time, included *Xestotrachelus hasemani* Bruner, 1913 (currently a synonym of *X. robustus* (Bruner, 1911)) and *Zoniopoda robusta* Bruner, 1911 (now *X. robustus* (Bruner, 1911)).

The specimens of this genus are robust, their body is generally dark, with colorful and bright details; large head with whitish bands across the frontal region, clypeus and labrum; prosternal spine elongate and acuminate; antennae with 22–23 segments; pronotum with anterior margin rounded and colorful; tegmina and wings of the same size, rounded apex covering the whole abdomen or abbreviate and red hind tibia (Bruner 1913)

(Figs. 1–2). *Xestotrachelus robustus* has a wide geographic distribution, from Brazil (states of Maranhão, Espírito Santo, Bahia, Goiás, Mato Grosso, Mato Grosso do Sul) to Bolivia and Paraguay (Roberts and Carbonell 1982; Cigliano et al. 2021) (Table 1). Even though these are easily distinguished morphological characteristics, the wide geographical distribution of this genus and the poorly known comparative morphological information among Romaleini genera results in some misidentifications.

Thus, in this paper, the first record of *Xestotrachelus robustus* in the state of Minas Gerais, Brazil is provided and additionally, a taxonomic key for South American Romaleini genera is shown. Photographs of live (Fig. 1) and pinned (Fig. 2) specimens, a distribution table (Table 1) and a distribution map (Fig. 3) are also presented.

Materials and Methods

During undergraduate field studies conducted by the first author, some specimens were collected (Fig. 1) and two of them were kept pinned in a private collection (Fig. 2). These two specimens, a female and a male *X. robustus* were collected in January 2009 (Fig. 1–2) at the Panga Ecological Reserve (Reserva Ecológica do Panga), Minas Gerais, Brazil in the Brazilian Cerrado (Fig. 3). This natural environment has an area of 409.5 ha and it is located to the south of the city of Uberlândia, approximately 35km from the city center (between coordinates 19°09'20"–19°11'10" S and 48°23'20"–48°24'35" W). Since 1997 the area has received special protection guaranteed by law, being considered a protected area."

The specimens were collected during the day by using an entomological net without special methodological protocols. Recently, these specimens were studied, pinned, and the external morphological characteristics were analyzed with the aid of a Zeiss Stemi 2000 stereomicroscope and photographed were taken with a Canon EOS T3i digital camera equipped with EF 100mm f/2.8 L macro lens and MT24EX flash. Afterward, the specimens were incorporated into the Laboratory of Conservation and Animal Taxonomy (LACTA) collection at the Federal University of Viçosa, Campus Rio Paranaíba. The measurements – presented in millimeters (mm) – included the lengths of the body (including ovipositor) (bd), pronotum (pr), tegmen (t), hind femur (hf), and hind tibia (ht). The geographical coordinates for distribution were estimated using the information available in the literature (Table 1), which is represented on the map (Fig. 3), including all records of known specimens. Most of this information is from specimens housed at The Academy of Natural Sciences of Drexel University (ANSP); Zoological Reference Collection of the Federal University of Mato Grosso do Sul (ZUFMS); Laboratory of Conservation and Animal Taxonomy collection at the Federal University of Viçosa, Campus Rio Paranaíba (LACTA); Muséum National d'Histoire Naturelle, Paris (MNHN); National Museum of Rio de Janeiro (MNRJ) (Table 1).

The distribution map was built with ArcGis 10.1 and the figures were prepared using image editing software Corel Draw X6. The species identification was determined by consulting Roberts and Carbonell (1982).

Results

Xestotrachelus robustus (Bruner, 1911) (Fig. 1–2)

Minas Gerais (new state record), Uberlândia, Panga Ecological Reserve (19°09'20"–19°11'10" S and 48°23'20"–48°24'35" W); i-2009; Silva, D.S.M. leg; 1 ♀ and 1 ♂ pinned (LACTA; code SILVA DSM106 and SILVA DSM107).

Measurements. Female (bd: 40 mm, pr: 9 mm, t: 27 mm, hf: 15 mm, ht: 16 mm) and male (bd: 22 mm, pr: 6 mm, t: 16 mm, hf: 12 mm, ht: 14 mm).

Identification. Head, pronotum, and other parts of body are dark and marked with black, pale olive-yellow, and red; the red and black pattern of hind wings closely resembles red-winged species of *Chromacris*, however the head and thorax are much more robust; tegmina can be shorter, as long as or longer than the hind femur; hind tibiae are usually red (Roberts and Carbonell 1982); abdomen has red punctuations on the dorsal, lateral, and ventral regions, hind femora and tibiae possess no bands (Fig. 1–2). Phallic structures are similar to those in *Chromacris* but differing by the aedeagal valves being strongly sclerotized and larger; rami of cingulum narrow and epiphallus with ancorae well developed (Roberts and Carbonell 1982).

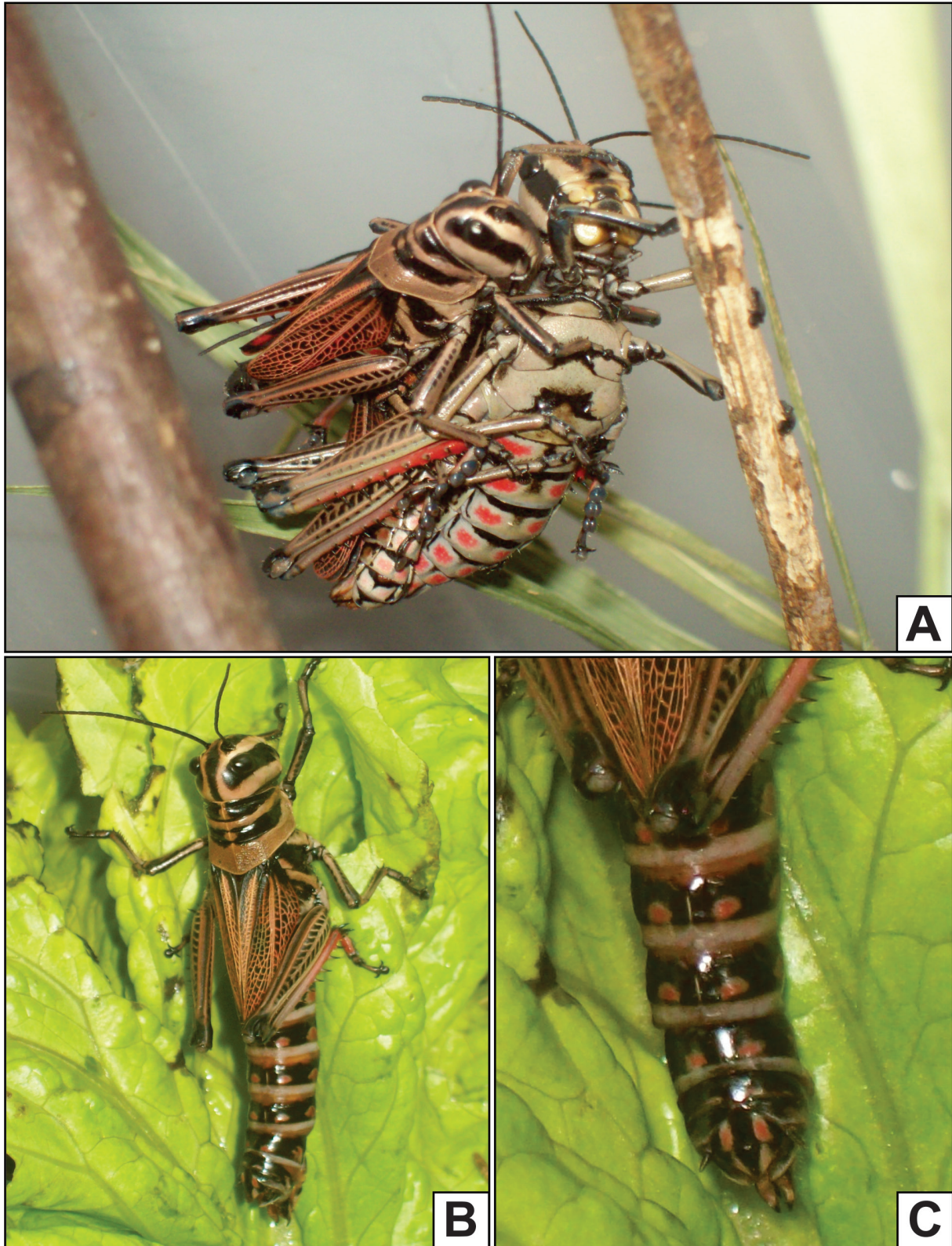


Figure 1. Live *Xestotrachelus robustus* (Bruner, 1911) specimens collected at Panga Ecological Reserve. **A)** Males trying to copulate with the female (bigger one). **B)** Female dorsal view. **C)** Female abdomen with red punctuations in the dorsal, lateral, and ventral regions.

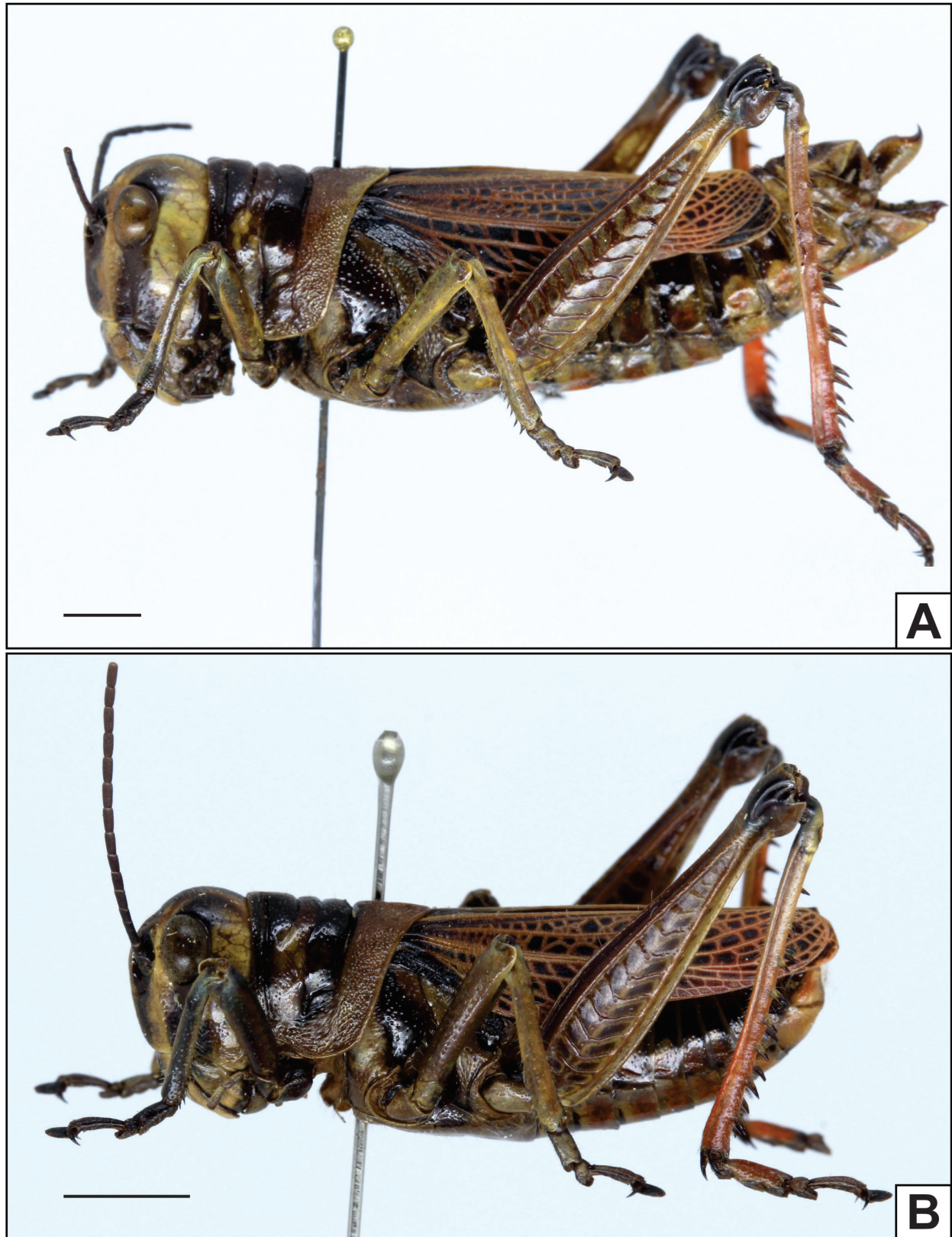


Figure 2. Pinned specimens of *Xestotrachelus robustus* (Bruner, 1911) collected at Panga Ecological Reserve. A) Female. B) Male. Scale bar = 0.5 cm.

Remarks. The tribe Romaleini is characterized by grasshoppers marked by large size and color polymorphism. There are some details about *Xestotrachelus* that allow their distinction from the other Romaleini grasshoppers found in South America:

Key to the South America Romaleini (only external morphology without genitalia)

1. Pronotum crestate, strongly arched 2
- Pronotum without crest or poorly developed, not arched 5
- 2(1). Prozona crest with tree lobes fully developed 3
- Prozona crest without lobe 4
- 3(2). Hind tibiae with spines of internal margin shorter, as a whole not surpassing in length those of external margin *Thrasydere* Bolívar, 1881
- Hind tibiae with spines of internal margin longer, most of them surpassing in length those of external margin *Aplatacris* Scudder, 1875
- 4(2). Lateral carina of pronotum well-marked; median carina with the same color of the body; tegmina short, not extending beyond the middle of the second or third abdominal segment *Eidalcamenes* Rosas Costa, 1957
- Lateral carina of pronotum not well-marked; median carina with a different color than the body; tegmina long, extending past the abdominal segments *Callonotacris* Rehn, 1909
- 5(1). Hind wings with red, orange, yellow, and black patterns 14
- Hind wings with other patterns 6
- 6(5). Hind tibia with prominent spines (some almost in the same length of third hind tarsus) 7
- Hind tibia without prominent spines (smaller than third hind tarsus) 8
- 7(6). Ensiform antennae, fastigium ‘horn-like’, prominent eyes and concave forehead .. *Alophonota* Stål, 1873
- Antennae not ensiform, fastigium prominent but not ‘horn-like’, less prominent eyes and straight forehead *Coryacris* Rehn, 1909
- 8(6). Head proportionally much longer and globose in relation to the pronotum (lateral view); lack of a pronotum median carina 9
- Head proportionally shorter and less globose in relation to the pronotum (lateral view); median carina usually present 10
- 9(8). Transverse sulcus between vertex and fastigium conspicuous; pronotum median carina vestigial on metazona *Costalimacris* Carbonell and Campos-Seabra, 1988
- Limit between fastigium and vertex barely marked; pronotum median carina lacking on metazona *Limacridium* Carbonell and Campos-Seabra, 1988
- 10(8). Specimens brachypterous or without wings 11
- Specimens macropterous 12
- 11(10). Specimens without tegmina; dorsal and ventral margin of hind femur with small denticles *Antandrus* Stål, 1878
- Specimens brachypterous; dorsal and ventral margin of hind femur without small denticles *Radacridium* Carbonell, 1984
- 12(10). Body ornament with colorful thin lines and bands; black thin line throughout the hind femur and tibia *Gurneyacris* Liebermann, 1958
- Body ornament with spots and bands; hind femur centerline in some species but absent in hind tibia or specimen without any brand in the legs 13
- 13(12). Fastigium and frons are usually angulated (lateral view); prozona almost the same size as the metazona; subgenital plate forked, terminalia less robust *Zoniopoda* Stål, 1873
- Fastigium and frons are usually quite rounded (lateral view); prozona shorter than metazona; subgenital plate no forked, terminalia robust *Diponthus* Stål, 1861

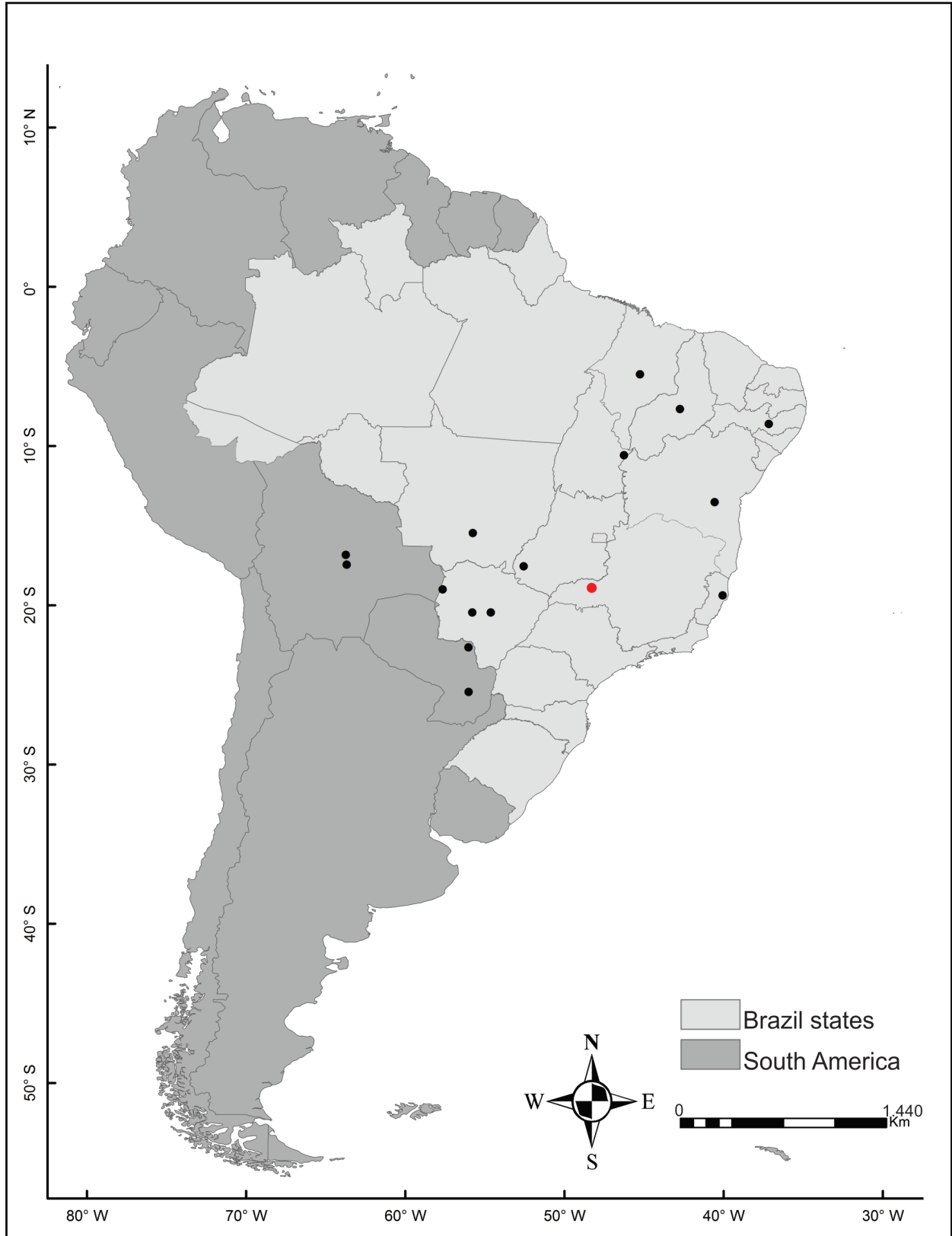


Figure 3. South America distribution map of *Xestotrachelus robustus* (Bruner, 1911) specimens. Black circles indicate previously known records (Table 1) and the red circle indicates the new record from Minas Gerais state.

- 14(5). Robust body and head; abdomen with conspicuous red punctuations in the dorsal, lateral, and ventral regions; hind tibiae usually red, hind femur and tibiae without bands *Xestotrachelus* Bruner, 1913 (Fig.1– 2)
- Body and head not so robust; abdomen without red punctuations; hind tibiae not red, hind femur and tibiae usually with colorful bands *Chromacris* Walker, 1870

Table 1. Data for all records made for *Xestotrachelus robustus* (Bruner, 1911) including information presented in this study. Specimens from the Museu Nacional do Rio de Janeiro (MNRJ) were probably destroyed in the 2018 fire.

Locality	Specimen information	Date	Depository	Reference
Bolívia, Santa Cruz de La Sierra (province of Sara)	16♀, 8♂	January–February 1922	Not recorded	Roberts and Carbonell (1982)
Bolívia, Buena Vista	1♀	03 February 1922	Not recorded	Roberts and Carbonell (1982)
Paraguay, Caaguazú (near Ihú)	2♀, 1♂	March 1965	ANSP	Roberts and Carbonell (1982)
Paraguay, Amambay (Cerro Corá)	5♀, 8♂, 1 last instar nymph	January 1972	MNRJ - Campos Seabra Collection	Roberts and Carbonell (1982)
Paraguay, Amambay (Cerro Corá)	1♂	18 January 1972	Not recorded	Cigliano et al. (2021)
Paraguay, Amambay: (Cerro Corá)	1♂	18 January 1972	Not recorded	Cigliano et al. (2021)
Paraguay, Caaguazú (Carayao)	—	January 1972	MNHN	Cigliano et al. (2021)
Brazil, Maranhão (Barra do Corda)	1♀	February 1955	ANSP	Roberts and Carbonell (1982)
Brazil, Bahia (Maracás)	3♀	February 1963	ANSP	Roberts and Carbonell (1982)
Brazil, Tocantins (formerly northern Goiás) (Rio Galvão)	1♀	February 1908	ANSP	Bruner (1913)
Pernambuco Buíque (Sitio das Palmeiras)	1♀	—	—	Cigliano et al. (2021)
Brazil, Piauí	1♀	17 March 1986	—	Cigliano et al. (2021)
Brazil, Espírito Santo (Linhares)	1♂	March 1981	ANSP	Roberts and Carbonell (1982)
Brazil, Goiás (Mineiros)	1♂	10 March 1980	Not recorded	Roberts and Carbonell (1982)
Brazil, Mato Grosso (Chapada dos Guimarães)	1♂	2 January 1972	Not recorded	Cigliano et al. (2021)
Brazil, Mato Grosso (Chapada dos Guimarães)	1♂ and 1♀	not recorded	ANSP	Cigliano et al. (2021), Roberts and Carbonell (1982)
Brazil, Mato Grosso (Corumbá, Urucum)	14♀, 18♂, 4 nymphs	23–29 December 1919	Not recorded	Roberts and Carbonell (1982)
Brazil, Mato Grosso do Sul (Campo Grande)	1♂	27–28 February 2017	ZUFMS	Cigliano et al. (2021)
Brazil, Mato Grosso do Sul (Aquidauana)	1♂	16 March 1980	—	Roberts and Carbonell (1982)
Brazil, Minas Gerais (Uberlândia)	1♂ and 1♀	January 2009	LACTA	Silva et al. (2021)

Discussion

The new record reported here for *Xestotrachelus robustus* contributes fundamental knowledge about the geographic distributions of insects in Brazil. Species distributional data have important applications for taxonomy and biogeographical research (McCafferty 2001), mainly in taxa with unresolved taxonomic issues such as Romaleinae.

Even though Rehn and Grant (1959a, b) conducted extensive morphological and taxonomies studies, the diagnosis of Romaleini appears to consist only of all those Romaleinae fitting no other tribe (Rowell 2013) and the present arrangement of the tribe needs to be revised and redefined (Cadena-Castañeda and Cardona 2015). To provide examples of this situation, some Romaleini genera need more studies: (i) *Thrasyderes* Bolívar, 1881, which is likely a synonym for *Aplatacris* Scudder, 1874 (see Kirby 1910; Cigliano et al. 2021) since the characteristics used to distinguish these genera (see Rehn 1944) are very similar and certainly doubtful; (ii) *Eidalcamenes* Rosas Costa, 1957 that is probably a synonym of *Securigera* Bolívar, 1909 or *Prionolopha* Stål, 1873 but no formal revision has been done (see Cigliano et al. 2021).

Likewise, most Romaleini genera are easily distinguished from each other and the color patterns of some of them are very important tools in the taxonomy of this group: (i) *Gurneyacris* possess thin dark lines and bands, yellow and white ornaments (Cigliano et al. 2021); (ii) *Zoniopoda*, with the colorful Tarsata group, whereas the Iheringi group is all rather uniformly green or pale-colored (Carbonell 2007); (iii) *Chromacris*, usually dark green with yellow and red markings on the body (Roberts and Carbonell 1982) and whose species which are readily distinguished by their color patterns, especially those of the wings, hind femur and antennae (Rowell 2013); and finally (iv) *Xestotrachelus* and their dark body with black, pale olive-yellow, and red markings (Roberts and Carbonell 1982).

These color patterns also have a relation with the distribution of species such as *Zoniopoda*, for which there is a north-south color gradient: the northern specimens are darker and with brighter red and yellow bands whereas the southern ones are paler having less intense colors (Carbonell 2007). In the genus *Chromacris*, mostly in *Chromacris speciosa* (Thunberg, 1824), the colors also differ geographically (Roberts and Carbonell 1982). Likewise, the geographic and color distributions of *Xestotrachelus* seem to be related in some way: colors with different body pattern and morphological variations found in the tegmina (shorter, as long as, or longer than hind femur) and phallic complex (aedeagus may be shorter and broader) are found among specimens from geographically distant locations (Roberts and Carbonell 1982).

Among the Romaleini genera with pronotum without crest, only *Xestotrachelus* and *Chromacris* have hind wings with several shades of red, orange, or yellow contrasting with a dark body pattern (Roberts and Carbonell 1982). Furthermore, *Chromacris* is the most closely related South American genus to *Xestotrachelus* and it has nymphs that exhibit gregarious behavior at lower levels of vegetation and let themselves fall to the ground when disturbed, while adults usually go to higher levels of shrubs and trees (Roberts and Carbonell 1982; Carbonell 1986). The biology of *Xestotrachelus* is poorly known and there is no information regarding juveniles but, in contrast with *Chromacris* species which show a relative cryptic coloration in the adult stage, *Xestotrachelus* adults have a much more conspicuous color that may well serve as a warning to predators (Roberts and Carbonell 1982). According to Roberts and Carbonell (1982) there is probably no necessity for the *Xestotrachelus* nymphs to develop a different coloration in the nymphal phases as seen in *Chromacris*.

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