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Taxonomic review of the genus *Erythrocriscus* Schubart, 1962 (Diplopoda, Spirobolida, Rhinocricidae)

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Abstract. We review the genus *Erythrocriscus* Schubart, 1962 based on the type material of the species *Erythrocriscus sanguineostriatus* (Schubart, 1962). We propose a new diagnosis, redescribe the type species, and propose a new synonymy and a new combination. In addition, a male-based key to both species recognized, including *Erythrocriscus electrofasciatus* (Schubart, 1957), comb. nov. ex. *Rhinocricus*, is given.

Keywords. Millipedes, taxonomy, Brazil, Neotropical.

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Introduction

The order Spirobolida Bollman, 1893 with more than 1000 described species is divided into three suborders, Spirobolidea Bollman, 1893, Trigonulidea Attems, 1909 and Rhinocricidea Brölemann, 1913 (Enghoff *et al.* 2015). Rhinocricidea has only the family Rhinocricidae Brölemann, 1913 which is the largest family in the order Spirobolida with more than 575 species and 30 genera (Marek *et al.* 2003; Pitz & Sierwald 2010; Enghoff *et al.* 2015). These genera are grouped into three subfamilies, Rhinocricinae Brölemann, 1913, Oxypyginae Chamberlin, 1922 and Poecilocricinae Schubart, 1962. The genus *Erythrocriscus* Schubart, 1962 represents one of the Brazilian genera of the subfamily Rhinocricinae. The genus was proposed by Schubart (1962) as a subgenus of *Rhinocricus* Karsch, 1881, based on the shape of the gonopods and a transverse red line in the dorsal part of the metazonites of the body rings. Two species were described, the type species *Rhinocricus (Erythrocriscus) sanguineostriatus*

Schubart, 1962 from the states of São Paulo and Goiás and *Rhinocricus (Erythrocriscus) miniatostratus* Schubart, 1962 from the state of Goiás. In the description of both species, Schubart (1962) described the great similarity between them, with the difference based only on details of the red coloration. Hoffmann (1980) raised *Erythrocriscus* to the genus level but did not justify the proposed new status or whether he examined the species of the genus. In the present study, we revise the genus *Erythrocriscus*. The type species *Erythrocriscus sanguineostratus* Schubart, 1962 is considered a senior synonym of *Erythrocriscus miniatostratus* (Schubart, 1962), and the species *Rhinocricus electrofasciatus* (Schubart, 1957) is transferred to the genus *Erythrocriscus*. A redescription of these species, based on fresh specimens and the type material, is presented. In addition, a key to males of the genus and new illustrations of the species are presented.

Material and methods

The examined material is deposited in the institutions indicated below (curators in parentheses). The specimens are preserved in 70% ethanol. For the examination of taxonomic characters, measurements and illustrations of the gonopods, we used a stereo microscope with a measuring eyepiece coupled to a drawing tube. Photographs were taken with a Motic SMZ171 stereo microscope camera in conjunction with a Motic Moticam 5+ digital imaging system software. To edit images, we used CorelDRAW Graphics Suite X5. For the gonopod terminology and external characters, we followed Enghoff *et al.* (1993), Koch (2015) and Rodrigues *et al.* (2020).

Repositories

- CZUFMT MYR = Coleção Zoológica da Universidade Federal do Mato Grosso, Cuiabá, Mato Grosso, Brazil (A. Chagas-Jr)
MZSP = Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (R. Pinto da Rocha)
MCN = Museu de Ciências Naturais, Porto Alegre, Rio Grande do Sul, Brazil (R. Ott)

Morphological abbreviations

- Br2, Br3, ... Br9 = body ring 2, body ring 3, ... body ring 9
Co = collum
Cx = coxae
Cxt = coxite
Eb = external branch
Ep = epiproct
Hp = hypoproct
Mt = metazonites
Pr = paraproct
Sl = solenomere
St = sternite
Tl = telopodite

Results

Taxonomy

Order Spirobolida Bollman, 1893
 Suborder Rhinocricidea Brölemann, 1913
 Family Rhinocricidae Brölemann, 1913
 Subfamily Rhinocricinae Brölemann, 1913

Genus *Erythrocriscus* Schubart, 1962

Erythrocriscus Schubart, 1962: 69, as subgenus of *Rhinocricus* Karsch, 1881 (type species: *Rhinocricus* (*Erythrocriscus*) *sanguineostriatus* Schubart, 1962).

Erythrocriscus – Hoffman, 1980: 79 (new status).

Rhinocricus (*Erythrocriscus*) *sanguineostriatus* – Marek *et al.* 2003: 71.

Diagnosis

Species of *Erythrocriscus* differ from other rhinocricid genera by the combination of the following characters: both males and females have a transverse red line on body rings (Figs 1B, D–F, 3C–D), males present a sternite of the anterior gonopods triangular in anterior view and a rounded coxite (Figs 2A, 5A), each posterior gonopod has the external branch folded over the solenomere (Figs 2C, 5C).

Species included

Erythrocriscus sanguineostriatus (Schubart, 1962)

Erythrocriscus electrofasciatus (Schubart, 1957) comb. nov.

Distribution

Occurring in the Atlantic forest (state of São Paulo), Cerrado biome (state of Goiás), and in the Amazonian and Pantanal biomes (Mato Grosso) of Brazil.

Key to species of *Erythrocriscus* (based on males)

1. Red coloration on collum, telson and all metazonites as a transverse red line dorsally (Fig. 1B, D–F), lobe of telopodite of anterior gonopod reduced in posterior view (Fig. 2B) *E. sanguineostriatus* (Schubart, 1962)
- Red coloration as a transverse red line in dorsal portion only on anterior metazonites, lobe of telopodite of anterior gonopod well-developed in posterior view (Fig. 5B) *E. electrofasciatus* (Schubart, 1958) comb. nov.

Erythrocriscus sanguineostriatus (Schubart, 1962)

Figs 1–3

Rhinocricus (*Erythrocriscus*) *sanguineostriatus* Schubart, 1962: 70, figs 1, 2, 4.

Rhinocricus (*Erythrocriscus*) *sanguineostriatus* — Marek *et al.* 2003: 72.

Erythrocriscus miniatostratus Schubart, 1962: 71, figs 3, 5. **Syn. nov.**

Justification of synonymy

Schubart (1962) described two species, *Erythrocriscus sanguineostriatus* and *E. miniatostratus*, both similar in body pattern and gonopods structure. Despite the similarities, both species present variations in

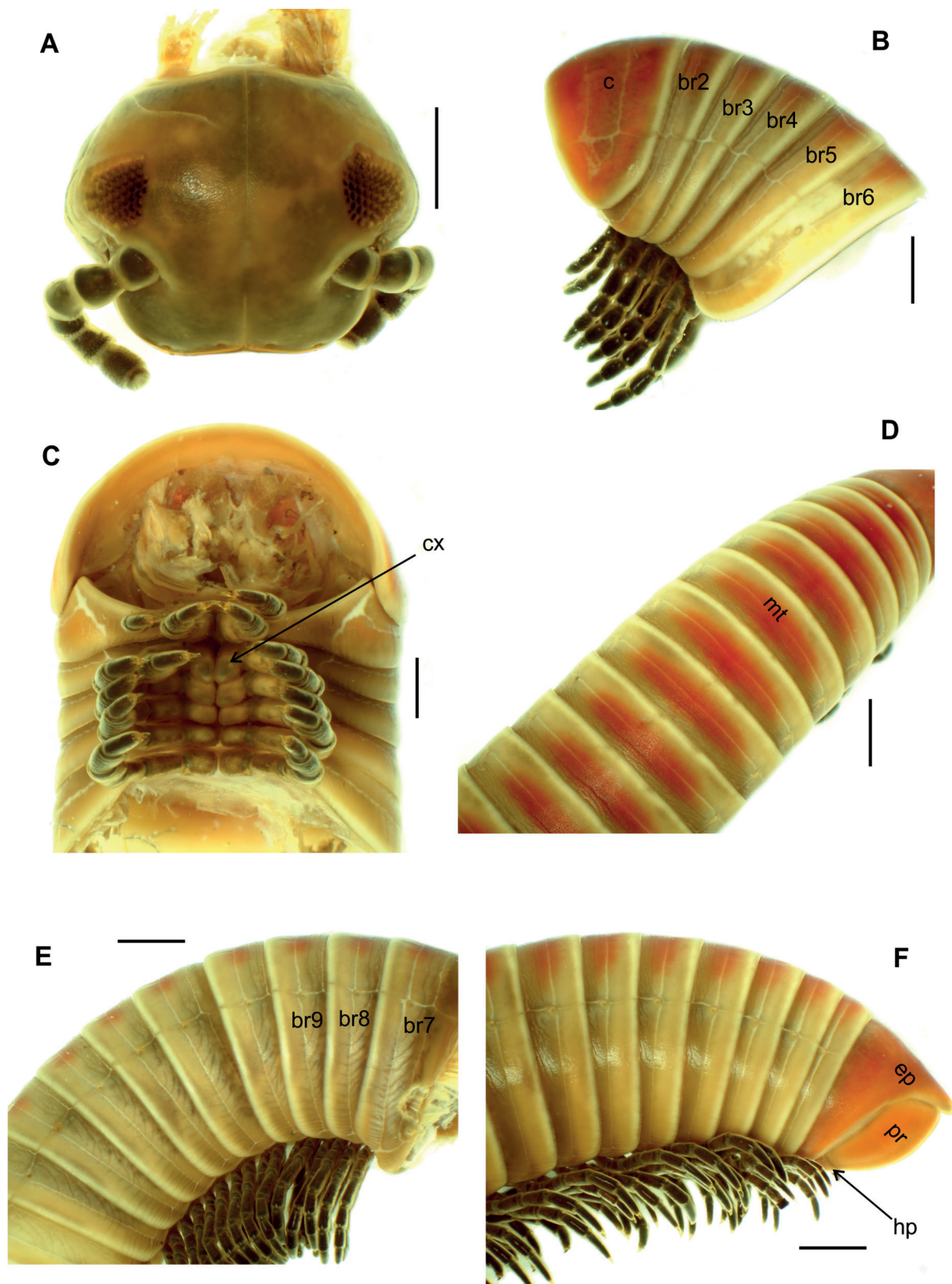


Fig. 1. *Erythrocricus sanguineostriatus* (Schubart, 1962), ♂ (MCN 406). **A.** Head. **B.** Anterior body rings, lateral view. **C.** Anterior body rings, ventral view. **D.** Posterior body rings, dorsal view. **E.** Mid-body rings, lateral view. **F.** Posterior body rings and telson, lateral view. Scale bars = 1 mm.

the red coloration on body rings which in *E. sanguineostriatus* is present dorsally and in *E. miniatostratus* dorsally and ventrolaterally. Our examination of the type species revealed that there is no significant difference either in external morphology or the structure of the gonopods between the species. Still, during examination of fresh specimens, we observed that the differences in the red coloration, seems to reflect only intraspecific variation.

Diagnosis

Erythrocriscus sanguineostriatus (Schubart, 1962) resembles *E. electrofasciatus* (Schubart, 1957) comb. nov. by the shape of the anterior gonopod (Figs 2A, 5A) with a triangular sternite having the medial portion distally rounded and the anterior gonopod wider than long but differs by the telopodite of the anterior gonopod with a reduced lobe in posterior view (Fig. 2B), and the red coloration presented as a transverse red line on all metazonites, collum and telson (Fig. 1B, D–F) and a rounded process of the coxae of leg pair 3 of the male (Fig. 1C).

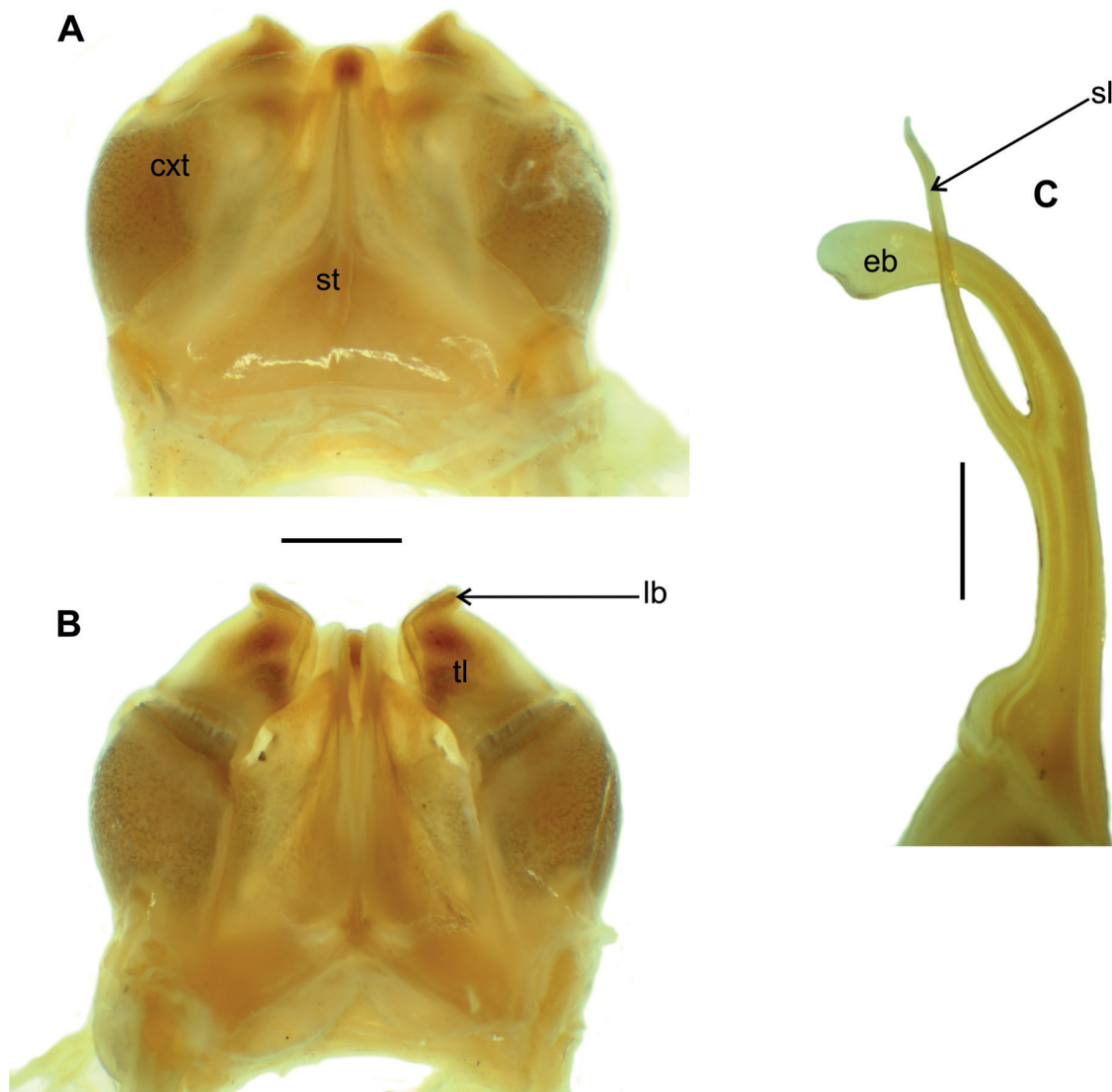


Fig. 2. *Erythrocriscus sanguineostriatus* (Schubart, 1962), ♂ (MCN 406). **A.** Anterior gonopod, anterior view. **B.** Anterior gonopod, posterior view. **C.** Left posterior gonopod, anterior view. Scale bars = 1 mm.

Material examined

Holotype

BRAZIL • 1 ♂; São Paulo, Presidente Epitácio; 52°06'56" W, 21°45'48" S; 22 January 1950, O. Schubart leg.; MZSP 2039.

Paratypes

BRAZIL • 1 ♂, 1 ♀; Goiás, Santa Helena de Goiás; 50°35'18" W, 17°49'23" S; Nov.1960, G.A. Oliveira leg.; MZSP 2114.

Other material

BRAZIL • 1 ♂; Goiás, Jataí; 51°42'52" W, 17°52'53" S; Jan. 1955; M. Carreira leg.; MZSP2038 • 1 ♀; Aragarças; 52°15'03" W, 15°53'51" S; 18 Jun. 1952; H. Sick leg.; MZSP1153 • 2 ♂♂, 1 ♀; Minaçu,

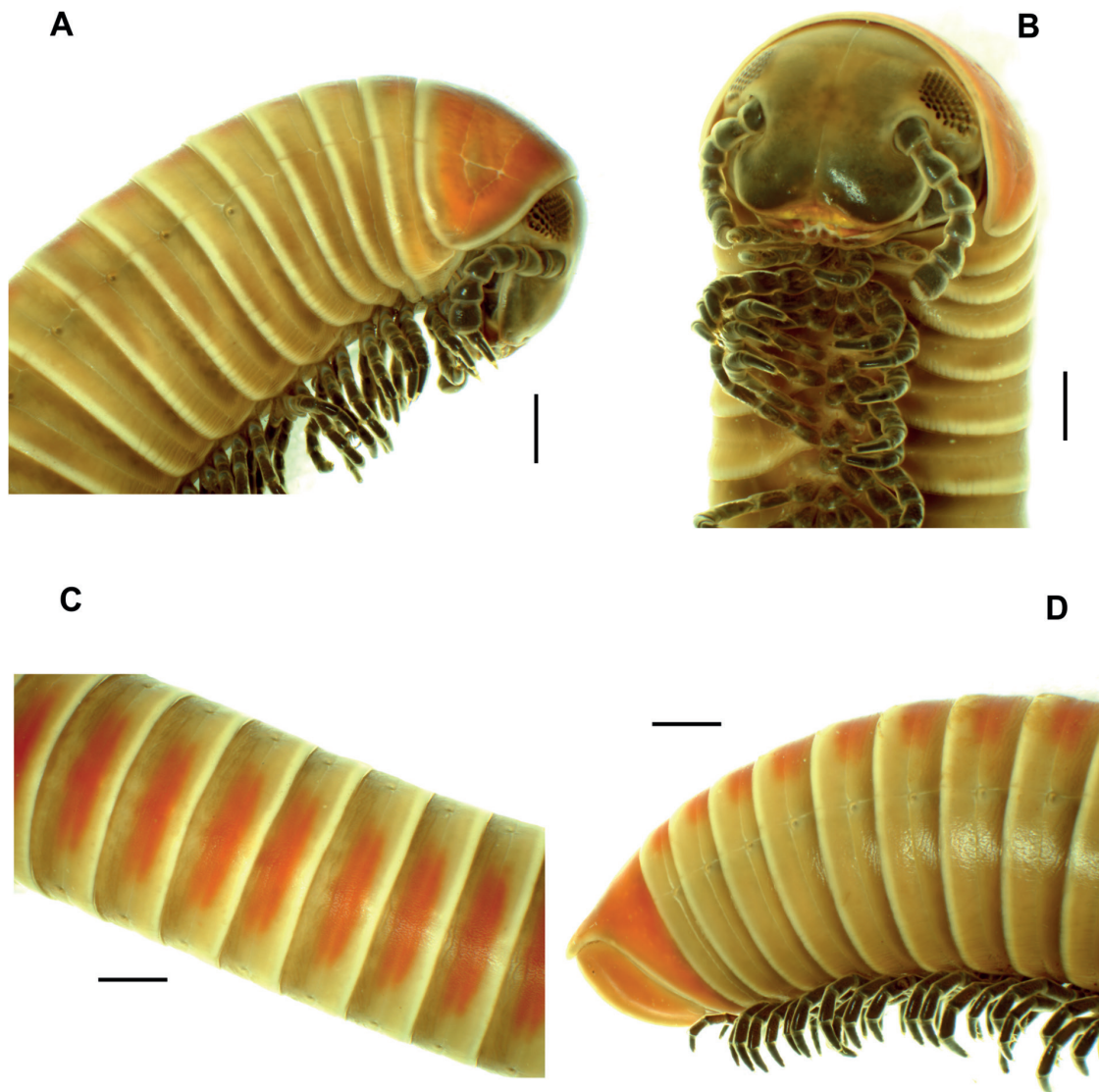


Fig. 3. *Erythrocriscus sanguineostriatus* (Schubart, 1962), ♀ (MCN 406). **A.** Head and anterior body rings, lateral view. **B.** Head and anterior body rings, ventral view. **C.** Posterior body rings, dorsal view. **D.** Posterior body rings and telson, lateral view. Scale bars = 1 mm.

Usina Hidrelétrica Serra da Mesa; 48°13'12" W, 13°31'59" S; 1–10 Oct. 1990; A.B. Bonaldo and L.A. Moura leg.; MCN406.

Redescription

Male (MCN 406)

MEASUREMENTS. With 52p+1a+T. Total length 55.0 mm, maximum width of midbody body rings 5.1 mm.

COLORATION (in 70% alcohol) (Fig. 1). Antennae and legs dark brown. Collum red with yellowish margins. Prozonites grey; metazonites in dorsal portion with transverse red line on all body rings, posterior margins whitish. Telson red.

HEAD AND BODY RINGS (Fig. 1). Antennae with numerous apical sensory cones. Collum rounded laterally. Tegument smooth, without setae. Ozopores starting from 6th ring. Scobinae starting from 7th ring, semi-circular and small.

LEGS (Fig. 1C). Coxae of leg pairs 3–5 of male expanded into a process. Coxae of leg pair 3 rounded.

TELSON (Fig. F). Epiproct short, not extended over paraprocts. Hypoproct subtriangular.

GONOPODS (Fig. 2). Anterior gonopod wider than long, sternite triangular, medial portion with rounded apex. Sternite as long as coxite and shorter than telopodite (Fig. 2A). Coxite rounded, in posterior view with margins projected medially. Telopodite thickened with reduced distal lobe (Fig. 2B). Posterior gonopod distally bifid. External branch laminated and folded over solenomere. Solenomere long and thin (Fig. 2C).

Female (MCN 406)

Coloration (Fig. 3) as in male, with 52p+T. Total length 56.0 mm. Width 5.2 mm.

Distribution

Known from Presidente Epitácio, state of São Paulo, and Santa Helena de Goiás, Minaçu, Aragarças, state of Goiás.

Erythrocriscus electrofasciatus (Schubart, 1957) comb. nov. Figs 4–5

Rhinocriscus electrofasciatus Schubart, 1957: 309, figs 1–6.

Rhinocriscus electrofasciatus — Marek *et al.* 2003: 55

Diagnosis

Erythrocriscus electrofasciatus resembles *E. sanguineostriatus* in the characteristics cited above for the diagnosis of *E. sanguineostriatus* but differs by the general coloration (Fig. 4) and by the transverse red line only on the posterior metazonites. Coxae of leg pair 3 with a pointed apex (Fig. 4B); the telopodite of the anterior gonopod is well developed in posterior view (Fig. 5B), the external branch of the posterior gonopod lamellated and narrow, distally long and slender (Fig. 5C).

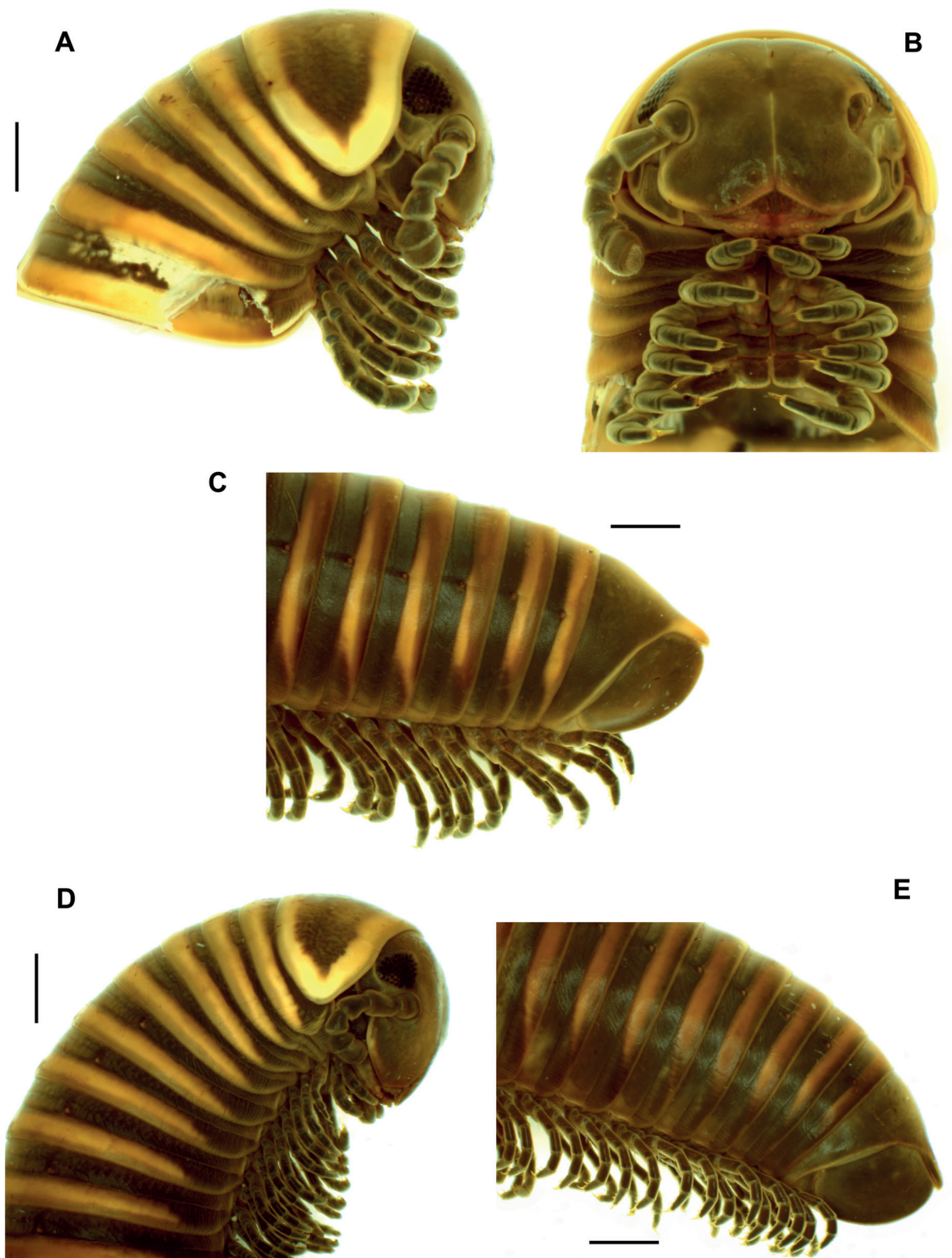


Fig. 4. *Erythrocriscus electrofasciatus* (Schubart, 1957). **A–C.** ♂ (MZUFMT-MYR0481). **D–E.** ♀ (MZUFMT-MYR0481). **A.** Head and anterior body rings, lateral view. **B.** Head and anterior body rings, ventral view. **C.** Posterior body rings and telson, lateral view. **D.** Head and anterior body rings, lateral view. **E.** Posterior body rings and telson, lateral view. Scale bars = 1 mm.

Material examined

Holotype

BRAZIL • ♂; Pará, Serra do Cachimbo; 54°41'18.94" W, 9°0'39.85" S; 22 Sep. 1953; H. Sick leg.; MZSP 2, MZSP 3, MZSP 4, MZSP 081.

Other material

BRAZIL • 1 ♂, 1 ♀; Mato Grosso, Cotriguaçu; 58°25'53" W, 9°8'19.26" S; 2 Nov. 2014; M. Karam-Gemael leg.; MZUFMT-MYR 0481 • 1 ♂, 1 ♀; UHE Guaporé; 58°57' W, 15°07' S; 28 Sep. 2002; S.I. Golovatch *et al.* leg.; MZUFMT-MYR • 1 ♂, 1 ♀; 3 Oct. 2002; S.I. Golovatch *et al.* leg.; MZUFMT-MYR.

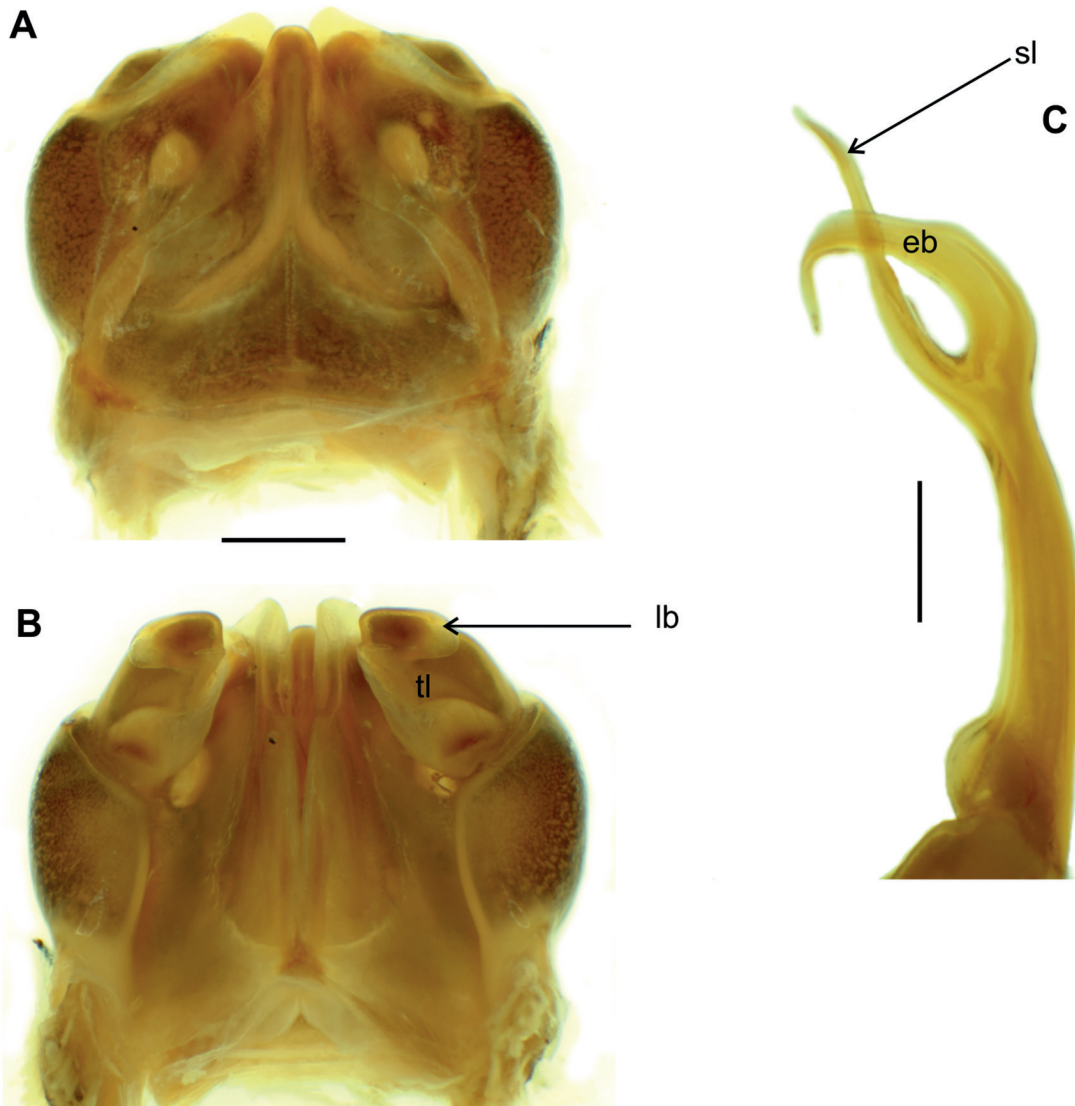


Fig. 5. *Erythrocriscus electrofasciatus* (Schubart, 1957), ♂ (MZUFMT-MYR0481). **A.** Anterior gonopod, anterior view. **B.** Anterior gonopod, posterior view. **C.** Right posterior gonopod, posterior view. Scale bars = 1 mm.

Redescription

Male

MEASUREMENTS. 1 ♂, MZUFMT-MYR 0481: with 52p+T. Total length 60.0 mm, maximum width of midbody rings 5.7 mm.

COLORATION (in 70% alcohol) (Fig. 4). Antennae and legs dark brown. Collum in medial portion dark brown with yellowish margins (Fig. 4A). Prozonites dark brown; anterior metazonites yellowish with transverse red-ochre line in dorsal portion (not visible in Fig. 4A, but see Schubart 1957: 310), posterior metazonites amber (Fig. 4C). Telson dark brown (Fig. 4C).

HEAD AND BODY RING (Fig. 4). Antennae with numerous apical sensory cones. Collum rounded laterally. Tegument smooth, without setae. Ozopores starting from 6th ring. Scobinae starting from 7th ring, concave.

LEGS (Fig. 4B). Coxae of leg pairs 3–5 of male expanded into a process. Coxae of leg pair 3 pointed.

TELSON (Fig. 4C). Epiproct short, not extended over paraprocts. Hypoproct subtriangular.

GONOPODS (Fig. 5). Anterior gonopod wider than long, sternite triangular, medial portion with rounded apex. Sternite shorter than coxite, longer than telopodite (Fig. 5A). Coxite rounded, in posterior view apically with margins projected medially. Telopodite thickened, with well-developed distal lobe (Fig. 5B). Posterior gonopod distally bifid. External branch laminar and narrow, apically long and slender, folded over solenomere. Solenomere long and thin (Fig. 5C).

Female (MZUFMT-MYR 0481)

Coloration as in male (Fig. 4D–E), with 50p+T. Total length 61.0 mm. Width 5.4 mm.

Distribution

Known from Serra do Cachimbo, states of Pará, and state of Mato Grosso.

Discussion

Currently, two species are known to compose the millipede genus *Erythrocriscus*, which is distributed in the Central-West and Southeast regions of Brazil. According to Schubart (1962), the genus is “purely Brazilian”. As suggested by Schubart (1962), the genus *Erythrocriscus* resembles *Rhinocriscus* in the external morphology and gonopods. However, our review of the specimens revealed that details of the gonopods support the status of the genus as proposed by Hoffman (1980). Based on this examination, we proposed a new diagnosis for the genus. This work contributes to the knowledge of the full genus *Erythrocriscus* because we provided more and new information from both males and females of the species and solved internal taxonomic problems.

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