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

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**Abstract.** We review the genus *Erythrocricus* Schubart, 1962 based on the type material of the species *Erythrocricus 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 *Erythrocricus electrofasciatus* (Schubart, 1957), comb. nov. ex. *Rhinocricus*, is given.

**Keywords.** Millipedes, taxonomy, Brazil, Neotropical.


**Introduction**

The order Spirobolida Bollman, 1893 with more than 1000 described species is divided into three suborders, Spirobolidea Bollman, 1893, Trigoniulidea 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 *Erythrocricus* 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 (Erythrocricus) sanguineostriatus*
Schubart, 1962 from the states of São Paulo and Goiás and Rhinocricus (Erythrocricus) miniatostriatus 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 Erythrocricus 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 Erythrocricus. The type species Erythrocricus sanguineostriatus Schubart, 1962 is considered a senior synonym of Erythrocricus miniatostriatus (Schubart, 1962), and the species Rhinocricus electrofasciatus (Schubart, 1957) is transferred to the genus Erythrocricus. A redescriptions 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 *Erythrocricus* Schubart, 1962


Diagnosis

Species of *Erythrocricus* 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

*Erythrocricus sanguineostriatus* (Schubart, 1962)
*Erythrocricus 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 *Erythrocricus* (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) .................................................. *Erythrocricus 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) .......................................................... *Erythrocricus electrofasciatus* (Schubart, 1958) comb. nov.

*Erythrocricus sanguineostriatus* (Schubart, 1962)
Figs 1–3

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


Justification of synonymy

Schubart (1962) described two species, *Erythrocricus sanguineostriatus* and *E. miniatostriatus*, 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. miniatostriatus* 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**

*Erythrocricus 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. Erythrocricus 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.](image-url)
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,

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 lamellated 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.

_Erythrocricus electrofasciatus_ (Schubart, 1957) comb. nov.

_Figs 4–5_

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

Rhinocricus electrofasciatus — Marek et al. 2003: 55

Diagnosis

_Erythrocricus 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. Erythrocricus 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′35″ W, 9°81′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. Erythrocricus 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 *Erythrocricus*, 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 *Erythrocricus* resembles *Rhinocricus* 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 *Erythrocricus* because we provided more and new information from both males and females of the species and solved internal taxonomic problems.

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References


