

SHORT COMMUNICATION

So far from home: first record of *Chondromorpha xanthotricha* (Diplopoda: Polydesmida: Paradoxosomatidae) in the Brazilian Amazon

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ABSTRACT

The millipede *Chondromorpha xanthotricha*, supposedly native to Sri Lanka and southern India, is considered a pantropical species occurring in Southeast Asia, North America, Mesoamerica, the Caribbean, Central America and northern South America. Here we report the first record of this species for Brazil, in the central Amazon region of the country, with taxonomic notes and images of male and female specimens.

KEYWORDS: Myriapoda, introduced species, millipede, South America, cyphopods

Tão longe de casa: primeiro registro de *Chondromorpha xanthotricha* (Diplopoda: Polydesmida: Paradoxosomatidae) para a Amazônia brasileira

RESUMO

O díplópode *Chondromorpha xanthotricha*, supostamente nativo do Sri Lanka e sul da Índia, é considerado uma espécie pantropical com ocorrência no Sudeste Asiático, América do Norte, Mesoamérica, Caribe, América Central e norte da América do Sul. Aqui nós reportamos o primeiro registro dessa espécie para o Brasil, na região central da Amazônia brasileira, com notas taxonômicas e ilustrações de espécimes macho e fêmea.

PALAVRAS-CHAVE: Myriapoda, espécie introduzida, piolho-de-cobra, América do Sul, cifopódios

The millipede family Paradoxosomatidae is rather speciose, with over 980 known species, and most diverse in Southeast Asia and in the Neotropical region (Enghoff *et al.* 2015). Several paradoxosomatid species are reported in regions where the taxon does not occur natively (Nguyen and Sierwald 2013), mainly as a result of introductions associated with seedling trade, gardening, cultivation of ornamental plants, and soil transport (Stoev *et al.* 2010; Iniesta *et al.* 2021). Among these anthropically dispersed species, *Chondromorpha xanthotricha* (Attems, 1898), supposedly native to Sri Lanka and southern India (Nguyen and Sierwald 2013; Sankaran and Sebastian 2017), has been considered an alien species occurring in Southeast Asia, North and Central America (United States, Costa Rica, Panama, and Antilles), Mesoamerica (Mexico), the Caribbean and northern South America (Ecuador, Suriname, and Venezuela) (Jeekel 1963;

Shelley and Lehtinen 1998; Hoffman 1999; Jeekel 2002; Shelley and Cupul-Magaña 2007; Decker and Tertilt 2012; Nguyen and Sierwald 2013; Golovatch and Wesener 2016; Likhitrakarn *et al.* 2017).

In Brazil, some non-native millipedes are considered agricultural pests (Schubart 1942; Lordello 1954). Nonetheless, little is known about the effect of these alien species on local communities of partially or highly preserved forests (Iniesta *et al.* 2020). To date, 12 species of millipedes are regarded as invasive in the country (Iniesta *et al.* 2021). Among these, two non-native paradoxosomatid species are known, *Orthomorpha coarctata* (Saussure 1860) and *Oxidus gracilis* (Koch 1847), both widely distributed in the northern region and in the Atlantic forest (Iniesta *et al.* 2021).

Here we report, for the first time in Brazil, the occurrence of *C. xanthotricha* in the Amazon region of the country,

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extending its distribution range in northern South America. Additionally, we provide a distribution map of the species in the Neotropics, as well as descriptive notes on male and female collected in Brazil.

Eleven specimens were collected from May to June 2013 in the municipality of Itacoatiara, Amazonas state, Brazil, in the locality Comunidade da Penha, at km 03 of BR AM-010 highway. All specimens were preserved in 70% ethanol and deposited in the collections of Instituto Nacional de Pesquisas da Amazônia (INPA) and Instituto Butantan (IBSP), Brazil. Measurements and photographs were taken with a camera (Leica DFC500) coupled to a stereomicroscope (Leica M 205C), which was connected to a computer with the Leica Application Suite LAS V3.6 software, that includes an auto montage module (Synscopy software). The images were edited with the software Adobe Lightroom (version CC 2020) for light and contrast correction. The plates were made using the Adobe Photoshop (version CC 2020) software. The species was identified following original descriptions by Attems (1898), Loomis (1948) and Likhitrakarn *et al.* (2017). External anatomy and cyphopod terminology follow Sankaran and Sebastien (2017) and Bouzan *et al.* (2018), while gonopod terminology follows Sankaran and Sebastien (2017). The distribution map of *C. xanthotricha* in the Neotropical region follows Jeekel (1963, 2002) and Shelley and Cupul-Magaña (2007), and was prepared using the free software DIVA-GIS 7.5.0. (Hijmans *et al.* 2001).

Order Polydesmida Leach, 1816

Family Paradoxosomatidae Daday 1889

Tribe Sulciferini Attems 1898

Genus *Chondromorpha* Silvestri 1897

***Chondromorpha xanthotricha* (Attems 1898)**

Figures 1–4

Prionopeltis xanthotrichus Attems, 1898: 359, pl. V, fig. 115.

Diagnosis. *Chondromorpha xanthotricha* can be distinguished from congeneric species by having granular and setose tegument (Figure 1a–c). Males of the species are recognized by their rather simple gonopods (Figure 2); postfemoral region curved mesad, with a leaf-shaped process and an apicoventral shelf (Figure 2a,b); solenophore (sph) with trifold lamina supporting a long, flagelliform solenomere (sl) (Figure 2d).

Description. Male and female, see Likhitrakarn *et al.* (2017: 282, figures 1–4). Other male descriptions in Attems (1937: 110, figures 145–148), Loomis (1948: 187, figures 3–6), Shelley & Lehtinen (1998: 88, figures 10–12).

Descriptive notes. *Male.* Body length 15–17 mm. Coloration (long-preserved in 70% ethanol): body dark brown, lateral edge of metazonite, paranota and legs yellowish (Figure 1).

Integument covered by microgranulae and granulae (Figure 1a–c); metaterga with three transverse rows of long setae; two additional setae located on the lateral edge of the paranota. Gonopods: coxae curved caudad (Figure 2a–c), setose distoventrally. Prefemur densely setose, about 1/2 as long as femorite plus postfemoral part (Figure 2a–c). Femorite stout, with distolateral sulcus demarcating femorite from postfemoral region; the latter well-developed, curved mesad, with basal process (b) tongue-shaped, and apicoventral shelf (as) (Figure 2a,b); solenophore composed of a conspicuous trifid lamina supporting a long flagelliform solenomere (Figure 2d).

Female. Body length 15–19 mm. Coloration and other somatic characters as in male description. Ventral projection (epigynal flange) reduced on posterior border of sternite of segment three (Figure 3b). Cyphopods situated directly behind the second pair of legs of third body ring (Figure 3a), encapsulated by long apodemetic tubes (at), with a

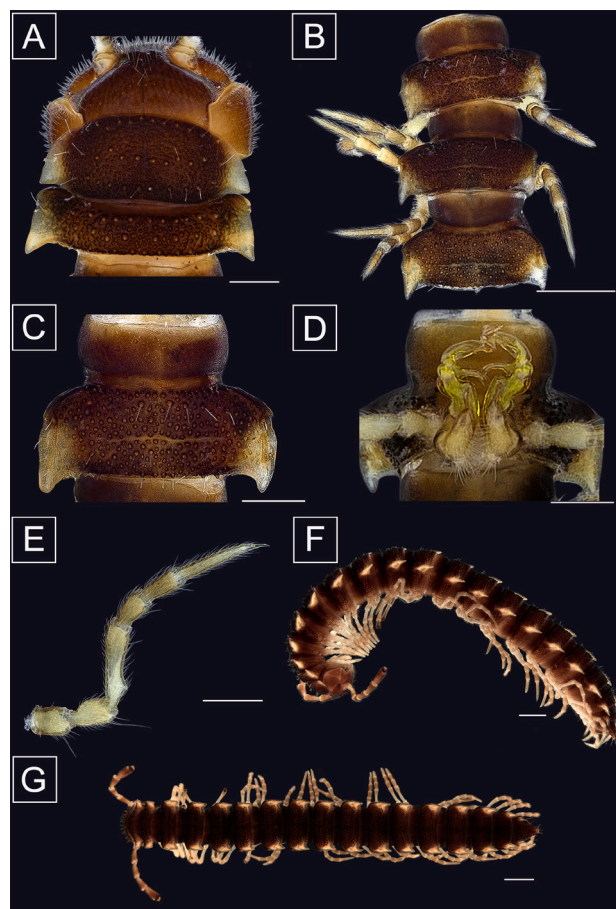


Figure 1. *Chondromorpha xanthotricha* (Attems 1898) (INPA 393). A – head and body rings 1–2, dorsal view; B – body rings 8–10, dorsal view; C – body ring 7, dorsal view; D – right gonopod, ventral view; E – anterior leg of body ring 12, lateral view; F–G – habitus, mesal view. Scale bar: 1 mm (B, E–F); 0.5 mm (A; C–E). This figure is in color in the electronic version.

collar (c) on the base region (Figure 3e), wide proximally, narrowing distally (Figure 3d–g). Cyphopods composed of three valves, with thick setae dispersed along the surface of the valves, presence of internal (iv) and external valves (ev) with a proximal operculum (op) adpressed against both larger valves (Figure 3h–j). Fertilization ducts (fd) short, apical to cyphopod, curved to apical part (Figure 3i,j).

Material examined. BRAZIL: Amazonas: near the city of Itacoatiara, Comunidade da Penha, km 03 of BR AM-010 highway (03°03'05,7"S; 58°27'02,7"W), v-vi.2013, Rougles Pereira Braga coll., 3♂♂ 5♀♀ (INPA 393), 1♂ 2♀♀ (IBSP 13726).

The fauna of paradoxosomatid species in Brazil is mostly represented by the tribe Catharosomatini (Nguyen and Sierwald 2013). The records of the tribe Sulciferini in the country belong mostly to two synanthropic species *Orthomorpha* (= *Asiomorpha*) *coarctata* and *O. gracilis* (see Brolemann 1904; Hoffman *et al.* 2002; Adis *et al.* 2002; Iniesta *et al.* 2020, 2021). Both species are reported in the Amazon region, with *O. gracilis* occurring only in preserved forests, and *O. coarctata* widely distributed, both in urban and rural areas, and in partially preserved forests (Brolemann 1904; Iniesta *et al.* 2021).

The specimens of *C. xanthotricha* were collected in a floodplain forest inundated by a whitewater river. As reported in Thailand (Likhitrakan *et al.* 2017), *C. xanthotricha* was collected in Amazonas state in an anthropized area of pasture

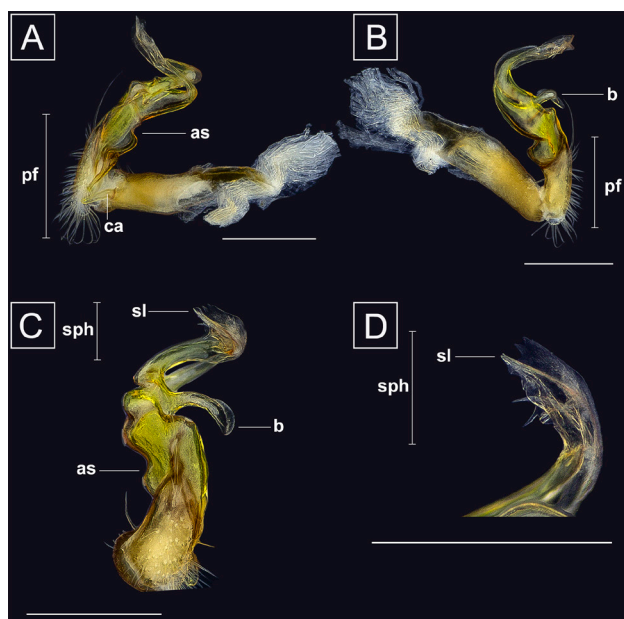


Figure 2. Right gonopod of *Chondromorpha xanthotricha* (Attems 1898) (INPA 393). A – mesal view; B – ectal view; C – dorsal view; D – distal part, dorsal view. Abbreviations: as = apicoventral shelf; b = basal process; ca = cannula; pf = prefemur; sl = solenomere; sph = solenophore. Scale bar: 0.5 mm. This figure is in color in the electronic version.

used for sheep breeding at the time. This new record of *C. xanthotricha* in Brazil indicates a recent introduction, as it was recorded in one of the most intensively studied regions in the central Brazilian Amazon, including the long-term invertebrate surveys within the collaboration framework of the Max-Planck-Institute for Limnology (Germany) and INPA, with no previous record of this species (Adis *et al.* 2002; Hoffman *et al.* 2002).

So far, there is no published record of *C. xanthotricha* in any other Brazilian state, which suggests that the occurrence in Amazonas is a consequence of its geographic expansion from northern South America. On the other hand, it is possible that *C. xanthotricha* was accidentally introduced to the state via river transport, as Itacoatiara and nearby Manaus have major fluvial ports linked to a large industrial sector (Beasley

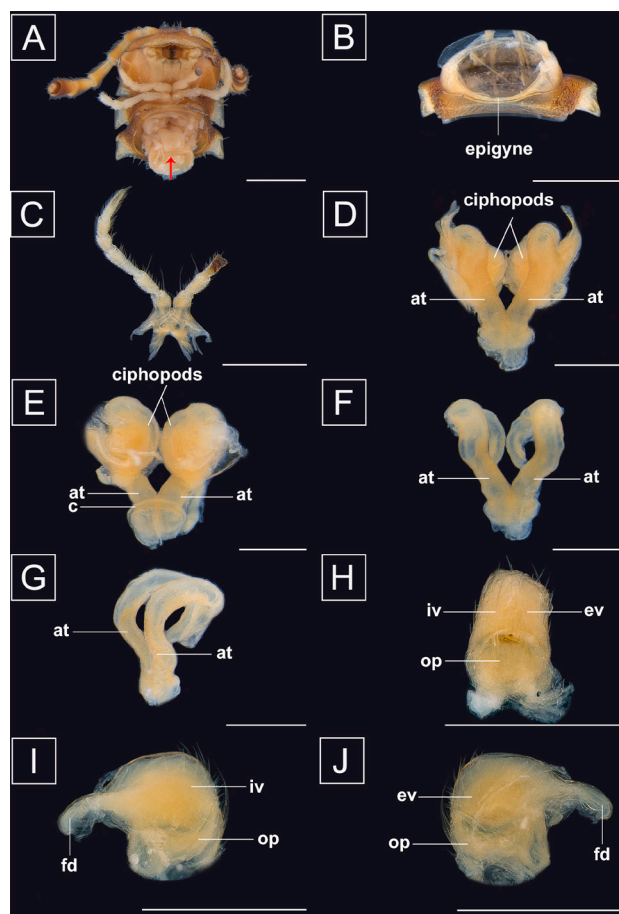


Figure 3. Female of *Chondromorpha xanthotricha* (Attems 1898) (INPA 393). A – cross section of ring 3, ventral view; B – anterior ventral edge of ring 3 (showing a reduced epigyne); C – leg pair 2, ventral view; D – cyphopods, dorsal view; E – cyphopods, ventral view; F – apodemetic tubes, dorsal view (cyphopods removed); G – apodemetic tubes, mesal view; H – right cyphopod, dorsal view; I – right cyphopod, mesal view; J – right cyphopod, ectal view. Abbreviations: at = apodemetic tubes; c = collar; ev = external valves; fd = fertilization ducts; iv = internal valves; op = operculum. Scale bar: 1 mm (A–C); 0.5 mm (D–J). This figure is in color in the electronic version.

et al. 2003), with commercial interchange with China, Ecuador, Japan, and USA (SEDECTI 2022). *Chondromorpha xanthotricha* is known to occur in all the latter countries (Jeekel 1963; Jeekel 2002; Shelley and Cupul-Magaña 2007).

Based on the wide distribution of *C. xanthotricha* in northern South America (Figure 4), further studies are needed to evaluate the effect of this alien species on native local communities, as the introduction of exotic species is one of the most worrying factors in conservation biology (Recuero and García-París 2016). Due to the increasingly intense and globalized movement of people and goods, invasive species are now recognized as a major problem (Didham et al. 2005; Pysek and Richardson 2010; Iniesta et al. 2020). Invasive species can affect forest regeneration, especially soil arthropods (Hartshorn 2021), but the actual and potential impacts of introduced millipedes in the Amazon rainforest remain unknown.

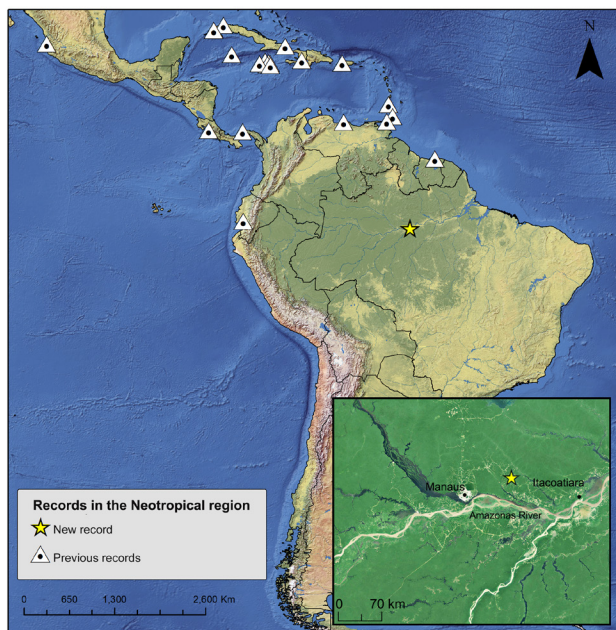


Figure 4. Distribution map of *Chondromorpha xanthotricha* (Attems 1898) in the Neotropical region. This figure is in color in the electronic version.

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