

# Unveiling a new genus of cave-dwelling pseudoscorpion from Brazil: taxonomy and systematic relevance

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## Abstract

A new genus of pseudoscorpions, gen. nov., a new species gen. nov. 1 sp. nov. 1 and a new combination, gen. nov. 1 *orthodactylus* comb. nov. is provided. This genus exhibit distinct characteristics that differentiate them from others genus from the same family which are close related, such as *Aphrastochthonius* and *Pseudochthonius*, including variations in cheliceral and pedipalpal dentition, coxal spines and manducatory process setae arrangement, male genitalia general aspect and also variation in chelal trichobothria distribution. In addition to taxonomic and systematic details, we provide ecological observations for each species, potential threats, recommendations for future research, discussion on the troglotic status of the new genus species and comments on the status of the family Chthoniidae in Brazil.

## Resumo

Um novo gênero de pseudoescorpiões, gen. nov., uma nova espécie, sp. nov. 1, e uma nova combinação, gen. nov. 1 *orthodactylus* comb. nov., são apresentados. Este gênero apresenta características distintas que os diferenciam de outros gêneros próximos da mesma família, como *Aphrastochthonius* e *Pseudochthonius*, incluindo variações na dentição queliceral e pedipalpal, espinhos coxais, arranjo das cerdas do processo manducatório, aspecto geral da genitália masculina e distribuição dos tricobótrios da quela. Além de detalhes taxonômicos e sistemáticos, fornecemos observações ecológicas para cada espécie, potenciais ameaças, recomendações para pesquisas futuras, uma discussão sobre o status troglóbio das espécies do novo gênero e comentários sobre o status da família Chthoniidae no Brasil.

## 1. Introduction

Pseudoscorpions (Arachnida: Pseudoscorpiones) are small predatory arthropods with a global distribution across terrestrial habitats, including subterranean environments where some species exhibit troglomorphic traits (Červená et al. 2021; Harms 2018). The family Chthoniidae, one of the most diverse within the order, encompasses over 800 species across 51 genera worldwide, with 11 genera recorded in Brazil (World Pseudoscorpiones Catalog 2025). Among these, *Pseudochthonius* is notable for its distribution across four Brazilian regions and its presence in other continents. However, inconsistencies in diagnoses and phylogenetic placement have long obscured a clear understanding of its taxonomy.

This work focuses on the description of a new genus within Chthoniidae, based on a novel troglomorphic species from northern Brazil and a previously described species, *Pseudochthonius orthodactylus* Muchmore, 1970. This species, historically treated as an exception within its former genus, forms the basis for redefining generic boundaries and advancing the systematic framework of Chthoniidae. By establishing this new genus, we aim to provide a robust taxonomic foundation that enhances our understanding of subterranean biodiversity and informs conservation efforts for Brazil's threatened cave ecosystems.

## 2. Materials and methods

In the Northern region, species from a new genus of Chthoniidae were discovered in 31 caves within the National Forest of Carajás. The National Forest of Carajás is part of a mosaic of protected areas totaling 1.31 million hectares, surrounded by cattle ranches (Pellegrini et al. 2022). Its vegetation comprises predominantly ombrophilous and seasonal forests, with rocky fields (rupestrian fields) occupying about 5% of the area. These rocky fields develop on laterite plates found in the region's high-altitude zones (Campos & Castilho 2012).

The caves are located within the Serra dos Carajás, part of the Dissected Plateau of Southern Pará, characterized by residual massifs with flat or undulating summits and lower-lying terrains. The area includes Serra Norte, Serra Leste, Serra da Bocaina, Serra do Tarzan, and Serra Sul, with elevations averaging 700 meters and altitudinal differences of

300 meters (Piló & Auler 2009).

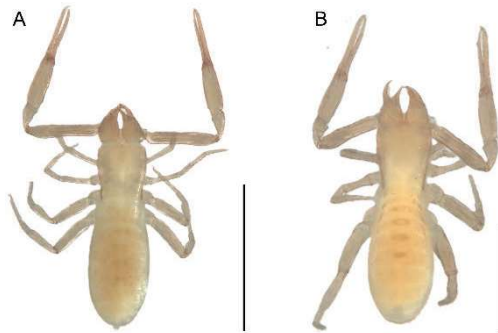
Locally called canga plateaus, the Serra dos Carajás highlands feature ferruginous duricrust overlying Archean ferriferous rocks from the Carajás Formation (Grão-Pará Group). These plateaus, renowned for their ecological and geological significance, host unique evolutionary processes and hold some of the world's largest iron ore reserves, making this region a crucial Ferruginous Geosystem (Piló & Auler 2009).

The specimens were collected from multiple incursions to the region, in October 2014; August, July and September 2015; March, April, May, June and October 2016; July 2019 and January, February and October 2020. Such material is from environmental analysis for iron mining companies, the collects were done by several consultancy companies.

The specimens were first identified using a Stemi 508 stereomi-

roscope. General observations were made using a Zeiss Axio Scope A1 optical microscope, and when possible equipped with ZEN 2012 software. Illustrations of coxae and male genitalia were produced using a drawing tube attached to an Olympus BX40 optical microscope with phase contrast.

To stabilize structures for observation and drawings, kaiser's glycerol gelatine medium was employed (Fig. 1).



**Figure 1:** *Gen. nov. Sp. nov. 1.* A male holotype B female paratype. Scale bars : A (1.0 mm.) B (0.5 mm.).

### 3. Results

Family Chthoniidae Daday, 1889

Genus *Gen. nov. 1*

**Type species.** – *Gen. nov. 1* sp. nov. 1

**Diagnosis** – *Gen. nov. 1* differs from all other chthoniids by the following combination of characters : straight chelae with well-separated teeth on both chelal fingers, movable finger with well developed apodeme, trichobothrium ist somewhere between *esb* and *est*, absence of eyes or presence of two reduced eyes, anterior margin fully serrated, epistome rounded, small and bordered by spikes, absence of intercoxal tubercle, presence of two well-developed and paired setae on the apex of the maxilla and rallum bearing seven blades.

**Description** – Vestitural setae long and acute, body mostly pale.

**Carapace:** 16 acuminate setae, microlateral setae absent; anterior margin fully serrated; epistome present as a serrated hump; eyes absent or reduced to spots.

**Chelicera:** Hand with 5 large acuminate setae; movable finger with 1 subbasal setae; rallum with 7 unilaterally pinnate blades; movable finger with small acute teeth including a separate distal one; fixed finger with small acute teeth.

**Pedipalp:** fixed chelal finger and hand with 8 trichobothria, movable finger with 4 trichobothria: *ib* and *isb* located medially on the dorsum of the hand and close together, *eb* and *esb* located at the base of the fixed chelal finger, *ist* located between *est* and *esb* (can be slightly closer to any of them), *est* and it grouped distally to *ist* and proximally to *et*, which is close to *dx*. Movable chelal finger without any specialized setae. Chelal movable finger with acute and widespread teeth, chelal fixed finger with acute and widespread teeth distally, and rounded and smooth teeth proximally.

**Coxal region:** absence of maxillary lyrifissures; 4 large setae (2 each side) with same lengths at the apex of the manducatory process. Coxae I with a projection at the distal margin, in which there bears a single small seta, presence of 2-3 plumose transversal coxal spines, coxae II with 3-4 plumose transversal coxal spines. Coxal tubercle absent.

**Legs:** Leg IV with typical Chthoniidae facies but slender and with a sensory seta medially and dorsally on the basitarsi.

**Abdomen:** Broad and not divided; tergite X with two sensory setae; sternite X with 2 sensory setae, XI with two sensory setae and 2 lyrifissures

Other structures and appendages were photographed using a Zeiss Axio Zoom V16 microscope with ZEN 2.1 software (Fig. 1B). The images were then vectorized using the Inkscape 1.1 software package (Montesanto 2015; available at inkscape.org). The holotype and paratypes have been deposited in the Coleção de Invertebrados Subterrâneos de Lavras (ISLA). Terminology follows Chamberlin (1931), Harvey (1992), Judson (2007) and Zaragoza (2017).

on each side of the anal operculum, in which bears two ventral setae; pleural membranes smooth.

**Genitalia:** female genitalia with 8 setae; male genitalia with 6 upper setae (4 discal and 2 marginal and more robust), 4 marginal setae grouped on each side of the opening and 2 subbasal setae at the bottom of the opening, 3 vestitural setae on each side of the sternite.

**Remarks** – The new genus resembles to *Aphrastochthonius* by the shape and dentition of the chelae, by the absence of eyes or eyespots and by the shape and pattern of the epistome and anterior margin of the carapace, by the absence of microteeth at the tip of fixed or movable chelal fingers; but it differs by the absence of lateral short thin and turned medially setae at the apex of the maxilla; by the absence of intercoxal tubercle and by the arrangement of the setae in the male genitalia, characteristics that resembles the genus *Pseudochthonius* along with the presence of 7 pinnate blades on the rallum and the position of the ist trichobothrium somewhere between *esb* and *est* and not grouped as in *Aphrastochthonius*.

**Gen. nov. 1** sp. nov. 1

**Material examined.** – ISLA 49829 Holotype male (Fig. 2). Collected 04/VI/2016, preserved in 70% etanol: Brazil, Pará, Canaã dos Carajás, Serra dos Carajás, S11D\_0022 cave (570851 E/ 9291132 N) leg. Ativo Ambiental LTDA. Paratype female, same data as holotype.

**Diagnosis** – As for the genus.

**Description** – **Color:** pale beige, some parts slightly sclerotized, such as chelicerae, chelae and carapace. Setae: most acute and simple.

**Carapace:** 1.15 times longer than wide, barely constricted posteriorly, showing a difference between ocular width and posterior width of 0.04 mm (Fig. 2A); anterior margin fully serrated; eyes absent; epistome present as a hump saw-like; chaetotaxy: 4: 4: 4: 2: 2 (16).

**Chelicera:** Hand with 5 setae; movable finger with 1 subbasal seta; galea present in female as a tubercle; fixed finger with 10 well-separated, small and acute teeth, absence of isolated tooth; movable finger with 10 well-separated, acute and small teeth, including a isolated distal one; rallum with 7 blades unilaterally pinnated; serrular exterior with 14 blades.

**Tergites:** Not divided; surface smooth; chaetotaxy uniseriate, I–XI 4: 4: 4: 4: 6: 6: 4: 6 + 2 sensory setae: 3. Pleural membranes striate.

**Sternites:** Not divided; surface smooth; chaetotaxy uniseriate, 4–XI

(4)6(4): (1)6(1): (1)7(1): (1)8(1): 8: 6: 3 + 2 sensory setae: 2 + 2 sensory setae. Anal operculum with 2 ventral setae and surrounded by 2 lateral lyrifissures.

**Coxae:** Manducatory process with two large apical setae of the same size; rest of palp coxae with 3 setae arranged in a triangle; delicate lamellae outlined by 10 small spines. Pedal: coxal spines plumose, arranged in a single transverse row in coxae I (1–2) and II (3–4), coxae I–IV chaetotaxy 3–4(1): 5: 7: 8.

**Genital operculum of male:** 4 discal setae, 2 subdiscal sensory setae, 6 marginal setae on each side of the opening (including 4 apically grouped).

**Genital operculum of female:** 8 setae distributed in a single row.

**Palp (Fig. 2E):** Trochanter 1.59 times longer than wide, patella 1.86 times longer than wide, femur 4.95 times longer than wide. Femoral chaetotaxy 5: 3: 5: 2. Trichobothrial pattern: *ib* and *isb* located at the half portion of the hand, adjacent to each other and slightly dislocated to the paraxial face of the chela, *eb* proximal to *esb*, *ist* distal to *esb*, *it* proximal to *est*, *et* proximal to *dx*. Chelal fixed finger with 11 distal acute and well-separated teeth and 4 rounded and smooth proximal teeth;

movable finger with 6 acute and well-separated distal teeth and 9 small, closed together and smooth teeth (Fig. 2E).

**Leg IV (Fig. 2C):** Arolia slightly shorter than claws; absence of protuberance or hump near the large end of tarsus (Fig. D).

**Gen. nov.1** *orthodactylus* comb. nov.

*Pseudochthonius orthodactylus* Muchmore 1970 ; Mahnert 1979, 1985 ; Mahnert & Adis 1986, 2002 ; Harvey 1991.

**Diagnosis** – *Gen. nov.1* *orthodactylus* presents two weak eyes on the carapace ; chelal fixed movable finger with 7 acute and well-separated teeth.

**Description** – See Muchmore (1970).

**Remarks** – *Gen. nov.1* *orthodactylus* occurs in some regions of North of Pará, as well as in inner areas of the Amazonas. It was described from solely a single specimen and lacks a comprehensive study in order to understand its true extension of occurrence and its thorough character features, such as male genitalia morphology.

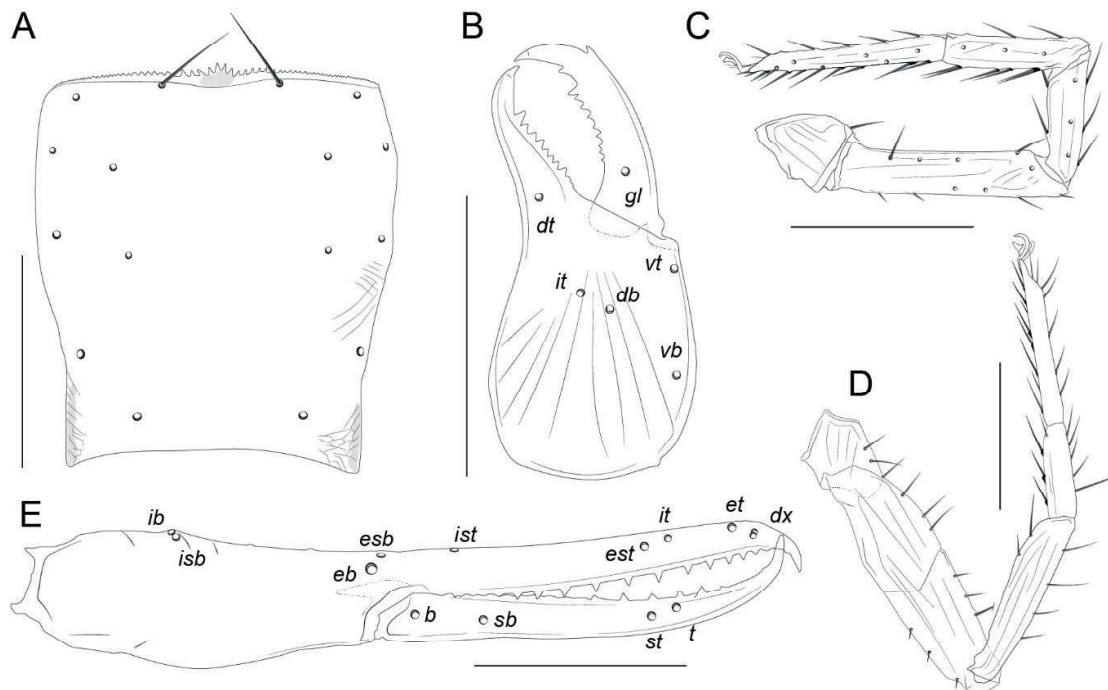


Figure 2: Some figures take up the whole width (16 cm max.). They are rather placed at the beginning or end of the section, or at the top / bottom of the page.

## 4. Discussion

The North American genus *Aphrastochthonius* was first described by Chamberlin in 1962 as an isolated taxon with no clear relationship to other genera. By the late 1980s, 12 additional species had been described from the United States, Cuba, and Mexico (World Pseudoscorpiones Catalog, 2025). These species are primarily distinguished by the arrangement of coxal spines on coxae I and II.

*Pseudochthonius*, an emblematic chthoniid genus in Brazil, was originally described in 1892 by Balzan as a subgenus of *Chthonius*, with *Pseudochthonius simoni* Balzan 1892 as the type species. Sharing general morphological traits with other chthoniids, such as trichobothrial arrangement and typical chthoniid genitalia, *Pseudochthonius* was elevated to genus status by Chamberlin, who identified synapomorphies like coxal spines on coxae I and II and the characteristic S-shaped chelae. Later, Mahnert described several cave-dwelling species of *Pseudochthonius* in Brazil, including the first troglitic pseudoscorpion recorded in South

America (Mahnert, 2001).

In 1970, Muchmore described *Pseudochthonius orthodactylus*, a species from northern Brazil, noting its unusual traits, such as a lack of S-shaped chelae and differences in chelal dentition. Although he suggested its close affinity with *Aphrastochthonius*, the species was conservatively assigned to *Pseudochthonius* to avoid disrupting the taxonomy. Muchmore explicitly stated: “The pseudoscorpion described above is placed in the genus *Pseudochthonius* for the present, although strong arguments could be made for placing it in a separate, new genus.” He anticipated that future research would address its systematic position, yet no such study materialized. Mahnert (2001) later acknowledged the species’ anomalous classification, but the issue remained unresolved. In this study, we reassign *Pseudochthonius orthodactylus* to a new genus, based on its clear resemblance to newly described species.

The newly described species, along with the diagnosis of the genus,

represents a taxonomic intermediary between the North American genus *Aphrastochthonius* and the Brazilian genus *Pseudochthonius*. While the chelae shape resembles *Aphrastochthonius*, the new genus lacks the lateral transverse short seta at the apex of the manducatory process and the bisetose intercoxal tubercle. However, in some specimens, two tiny spurs were observed, potentially indicating a regression of these traits.

The trichobothrial arrangement in the new genus differs significantly from that of *Aphrastochthonius*, resembling *Pseudochthonius* instead. Similarly, the distribution of setae on the cheliceral hand in many *Aphrastochthonius* species is linear (Muchmore, 1970), the new species bears a pattern also observed in *Pseudochthonius* and mirrored in the new genus.

Traits shared with *Pseudochthonius* include the trichobothrial arrangement on the chelae and the coxal chaetotaxy, including the manducatory process. However, the new genus differs from *Pseudochthonius* in the shape and dentition of the chelae, as well as the morphology of

the male genitalia, which lacks the discal semicircle of setae along the posterior margin of sternite II (Prado & Ferreira, 2024).

On the matter of conservation, it is essential to address the frequent misinterpretation of *Pseudochthonius* orthodactylus and its characteristics, which have often been perceived as non-trogomorphic due to its significant morphological differences from its former relatives in *Pseudochthonius*. This misconception, based on the absence of pronounced troglomorphic traits, has historically led to the erroneous classification of similar morphotypes found in caves as entirely non-troglobiontic. Moving forward, it is crucial to reassess these interpretations, especially considering the discovery of similar species in northern Brazil. Future research should prioritize identifying potential troglomorphic characteristics in the new genus, as these traits may reveal degrees of subterranean adaptation and suggest a more specialized, strictly subterranean lifestyle.

## 5. Conclusion

In conclusion, the discovery and description of a new genus and species of pseudoscorpions, along with the reallocation of *Pseudochthonius orthodactylus*, significantly advances our understanding of the systematics and taxonomy within Chthoniidae. The new genus bridges a morphological and evolutionary gap between the North American *Aphrastochthonius* and the Brazilian *Pseudochthonius*, highlighting distinct characteristics such as the unique trichobothrial arrangement, cheliceral setation, and male genitalia morphology. These findings not only emphasize the taxonomic complexity within Chthoniidae but also underscore the importance of continued exploration and revision in

understudied arachnid groups.

Moreover, the ecological observations and discussion on the troglomorphic status of the new species shed light on its potential adaptations to cave environments. This work reinforces the significance of integrating morphological, ecological, and biogeographical data to better understand species' evolutionary relationships and ecological roles. Future studies should focus on further clarifying the phylogenetic placement of these taxa, exploring their ecological interactions, and addressing the broader implications for conservation in fragile subterranean ecosystems.

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