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A new species of *Bothriurus* Peters (Scorpiones: Bothriuridae) from 'Parque Estadual da Serra dos Martírios / Andorinhas' in the State of Pará, Brazil

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description;
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Abstract. – A new species *Bothriurus andorinhas* **n**. **sp**. is described from an area of transition between savanna-like formations and wet-forests in the south of the state of Pará in Brazil. The new species can be associated with other species of what can be defined as the *Bothriurus rochai* complex. The description of this new species attests once again about the existence of micro-endemic populations within different groups of *Bothriurus*. Comments are proposed on some ecological particularities of the micro-habitat of the new taxon and about the region where the new species was discovered in the state of Pará.

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Introduction

In several previous publications, it was recalled that the scorpions of the family Bothriuridae Simon, 1880 have systematically been considered to be a difficult and complex group (Lourenço, 2002, 2016; Lourenço et al., 2004; Lovato et al., 2021). This taxonomic challenge is particularly true in what concerns the genus *Bothriurus* Peters, 1861. This genus was originally described by Peters in 1861 (Peters, 1861) and by the end of the 19th century contained six valid species. However, they were difficult to identify correctly, as already suggested by Kraepelin (1899), who did not recognised several of the species which are today regarded as valid (Maury, 1981). A much more precise definition of the species of the genus *Bothriurus*, as well as of species of other genera of the family Bothriuridae, became possible with the exploration of new characters, in particular those based on the structure of the hemispermatophores, trichobothrial patterns, and carinal morphology. This new approach was originally attempted by San Martin (1963) and followed in the 1970s by Maury (1971) who described several additional bothriurid species and improved classification at the subfamily and genus level. The family Bothriuridae corresponds majorly to elements which belong to the meridional faunas of South America (*e.g.* Ojanguren Affilastro, 2005). Consequently, the total number of *Bothriurus* species known from Brazil remains less important than for other regions of South America, almost twenty (Santos-da-Silva *et al*., 2017; Lovato et al., 2021). Nevertheless, some of these species may yet require further investigation to clearly confirm their taxonomic status (Lourenço, 2002; Santos-da-Silva *et al.*, 2017).
The elements of the family Bothriuridae are largely distributed over an arid corridor which extends from Argentina and Paraguay to the Northeast regions of Brazil (Fig. 1). This corridor, also defined by De Martonne (1935) as 'the diagonal of Brazilian open formations' is mainly composed of open vegetation formations which recover the Chaco in the South, the Cerrados in the Centre and the more arid Caatingas in the Northeast (Lourenço, 1990). In the Northern regions of South America, only a limited number of bothriurid species were discovered and described from outside this corridor (Lourenço, 1986). A few exceptions were *Bothriurus rochai occidentalis* Lourenço, 2003 described from the State of Maranhão (Lourenço, 2003), from a region already considered as legal Amazonia but formed by a type of vegetation distinct from that of the Caatingas and defined as transitional between savannas and rainforest (see Eiten, 1974; Ab'Saber, 1977; Lourenço, 2003). More recently, a second species, *Bothriurus xingu* Lourenço, 2016 (Lourenço, 2016) was also described from an Amazonian region in the state of Pará. The reanalysis of some specimens also collected in the South of the state of Pará, but in Savanna-like formations led to the definition of one more new species, equally found to the West of the 'diagonal of Brazilian open formations' in a zone equally considered as legal Amazonia.

Material and methods

Illustrations and measurements were obtained using a Wild M5 stereo-microscope equipped with a drawing tube (camera lucida) and an ocular micrometre. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations are those of Vachon (1974) and morphological terminology mostly follows Hjelle (1990). The specimens studied herein are deposited in the 'Instituto Nacional de Pesquisas da Amazônia', Manaus, Brazil (INPA) and in the Muséum national d'Histoire naturelle, Paris, France (MNHN).

Reviewer:
Eric Ythier (*France*) - ZooBank: http://zoobank.org/06FD0852-A88E-49E5-B8E6-E1494B86C4E1

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Fig. **1**. Vegetation map of Tropical South America showing the main corridors of scorpion distribution as defined by Lourenço (1986):
- Trans-Andine corridor (A),
- Brazilian diagonal corridor (B),
- Amazon corridor (C)
- Guayanan corridor (D).

The type localities of the three species of *Bothriurus* located away from the arid corridor (B) as defined by De Martonne (1935) are indicated:
- *Bothriurus rochai occidentalis* (inverted black triangle),
- *Bothriurus xingu* (circle with black star),
- *Bothriurus andorinhas* **n**. **sp**. (black circle).

Fig. **2**. *Bothriurus rochai*. ♀ collected in Ipanguaçu, state of Rio Grande do Norte by W. Lourenço in 1979. Used by Maury (1982) for the redescription of the species.

Taxonomic treatment

Family **Bothriuridae** Simon, 1880

Genus ***Bothriurus*** Peters, 1861

Comments on the status of *Bothriurus rochai* Mello-Leitão, 1932 (Fig. 2)

The species *Bothriurus rochai* was described by Mello-Leitão (1932) based on a single male specimen which he received from the director of the Museu Rocha, Prof. Dias da Rocha. The specimen was among a small collection of scorpions, previously studied by A. Borelli from Italy. In subsequent years the species remained poorly characterized, and in his monograph about South American scorpions, Mello-Leitão (1945) only proposed a copy of his original description.

The species was much better defined by Maury (1982) with the presentation of a precise description based on several specimens from the Northeast region of Brazil, including also precise illustrations of the hemispermatophores. Maury (1982) equally called attention to the fact that the 'Museu Rocha' remained unknown for him. According to Almada Carvalho (2013), the Museu Rocha was created by Dias da Rocha in 1903 in Fortaleza, state of Ceará, who in fact started to organize a natural history collection since 1884 when he was only 15 years old. Almada Carvalho (2013) confirms that most insects present in the Museu Rocha have been studied by A. Fauvel and A. Grouvelle, both of the Société Entomologique de France. Orthoptera and arachnida, however were studied by Alfredo Borelli of the Museu di Zoologia, Torino, as cited by Mello-Leitão (1932). The Museu Rocha was finally taken in charge by the state of Ceará in 1959 and the collections were distributed among several distinct official institutions. It seems that the entomological collections were, at least partially, proposed to the 'Escola de Agronomia', however it is most certain that the holotype of *B. rochai* was lost.

No precise type locality is proposed by Mello-Leitão (1932) for *B. rochai*. However, Almada Carvalho (2013) confirms that the great majority of the collections in the Museu Rocha have their origins in the state of Ceará. Therefore, it can be presumed that *B. rochai* was originally collected in this state. The presence of this species in Ceará state was confirmed by Maury (1982).

***Bothriurus andorinhas* n. sp.**

(Fig. 3-15, 19)

ZooBank: http://zoobank.org/BC6E62BE-C361-47A1-8A04-1ECFBC4BE925

Holotype, ♂, Brazil, State of Pará, Parque Estadual da Serra dos Martírios/Andorinhas (06°03'00"to 06°23'00" S – 48°22'30" to 48°36'30" W), 230-280 m alt., II/1987 (W. R. Lourenço & V. Py-Daniel) (INPA).

Paratypes:
- 2 ♂ & 1 juvenile ♀ (INPA),
- 1 ♂ & 1 juvenile ♀ (MNHN),

same data as for the holotype.

Etymology. – The specific name is placed in apposition to the generic name and refers to the Parque Estadual da Serra dos Martírios/Andorinhas, location in which the new species was collected.

Diagnosis. – Adult male with a total length of 37.20 mm, including the telson. General coloration yellow to slightly brownish-yellow. Tegument of carapace, tergites and metasomal segments rather smooth; almost all metasomal carinae absent, with only the dorsal and latero-dorsal weak to moderate, represented by a few distal granules. Pectines with 22 to 24 teeth in males and 20-21 in females. Telson flattened dorso-ventrally. Chelicerae with the most basal tooth on fixed finger reduced. Trichobothriotaxy of type C: neobothriotaxy (Vachon, 1974). Chela with 6 trichobothria on the ventral aspect; internal trichobothrium on patella strongly displaced anteriorly. Hemispermatophore with

Fig. **3**-**4**. *Bothriurus andorinhas* **n**. **sp**., ♂ holotype. Habitus, dorsal (**3**) and ventral (**4**) aspects.

Fig. **5**-**6**. *Bothriurus andorinhas* **n**. **sp**., ♀ juvenile paratype. Habitus, dorsal (**5**) and ventral (**6**) aspects.

a similar morphology to that of *B. rochai* and *B. cerradoensis* Lourenço et al., 2004 but with the distal lamina shorter and the basal portion less enlarged (Fig. 16 - 19).

Description (based on male holotype and paratypes) – measurements after the description.

Coloration. – Body generally yellow to brownish-yellow. Prosoma: carapace yellow with brownish spots mostly laterally and posteriorly, less marked anteriorly on females; eyes marked by dark pigment. Mesosoma: tergites brownish-yellow with a longitudinal yellow strip; venter and sternites yellow without spots; pectines and genital operculum pale yellow. Metasomal segments yellow to slightly reddish-yellow, without spots but with carinae more to reddish; telson reddish with the extremity of aculeus dark. Chelicerae yellow to reddish-yellow without spots; fingers yellow with reddish teeth. Pedipalps reddish-yellow, with darker carinae. Legs pale yellow without any spots on segments.

Morphology. – Carapace punctate to smooth; some minor granules on the posterior edge; anterior margin slightly concave to straight; carinae absent; all furrows weakly pronounced. Median ocular tubercle distinctly in the centre of the carapace. Three pairs of lateral eyes, the posterior being reduced. Sternum slit-like. Mesosomal tergites I - VI punctate without granules. Tergite VII with four indistinct carinae and some thin granulations. Venter: genital operculum divided longitudinally, each half with a roughly triangular shape. Pectines: pectinal tooth count 22 - 22 teeth for male holotype (see diagnosis for variation). Sternites smooth to punctate, with small, elongated oval-shaped spiracles; VII without carinae. Metasomal segments 1 to IV with almost all the carinae absent; only the dorsal and latero-dorsal are represented by a few distal granules; ventral carinae present and shaped like an incomplete arc on segment V; intercarinal spaces smooth, with scattered granules on the ventral face of segment V. Telson granular, mostly on ventral aspect; granules better marked on male; aculeus short and moderately curved. Cheliceral dentition characteristic of the family Bothriuridae (Vachon, 1963); most ventral tooth on fixed finger reduced. Pedipalps weakly to moderately granular; femur with four carinae moderate to strong and several granules on the dorsal and internal faces; patella with dorso-internal and ventro-internal carinae; chela smooth but not punctate; fixed and movable fingers with a line of granules not clearly divided into rows. A large apophysis is present on inner aspect of male chela at the base of the movable finger. Trichobothriotaxy of type C: neobothriotaxy (Vachon, 1974). Chela with 6 trichobothria on the ventral aspect. Legs: tarsi of legs III and IV with 2 rows of 2 - 3 spines and several very thin setae on the ventral surface. Hemispermatophore, as in Fig. 19.

Morphometric values (mm) (male holotype).

– ***Total length*** (including telson) 37.20.

– ***Carapace***
length, 4.40;
anterior width, 3.20;
posterior width, 5.20.

– ***Mesosoma***: length, 10.80.

– ***Metasomal segments***
I: length, 2.20; width, 3.00;
II: length, 2.60; width, 2.90;
III: length, 2.80; width, 2.80;
IV: length, 3.50; width, 2.80;
V: length, 5.50; width, 2.70; depth, 2.40.

– ***Telson***: length, 5.40; width, 2.10; depth, 1.60.

– ***Pedipalp***
femur length, 3.10, width, 1.20;
patella length, 3.40, width, 1.40;
chela length, 6.30, width, 2.60, depth, 3.00;

– ***Movable finger***: length, 3.00.

Note: morphometric values are not proposed for females because all the studied specimens are juveniles.

Relationships. – The general morphology of the new species is somewhat similar to that of both *Bothriurus rochai* and *Bothriurus cerradoensis* (Fig. 2, 20 - 21).
The new species can however, be distinguished from these two species by a number of features:

(**i**) a distinct coloration pattern with the presence of brownish spots on carapace and tergites; tergites however, divided by a longitudinal yellow strip,

(**ii**) internal trichobothrium on patella strongly displaced anteriorly,

(**iii**) most basal tooth on fixed finger of chelicerae reduced,

(**iv**) hemispermatophore with a shorter distal lamina and a weakly enlarged basal portion; hook inconspicuous (Fig. 19).

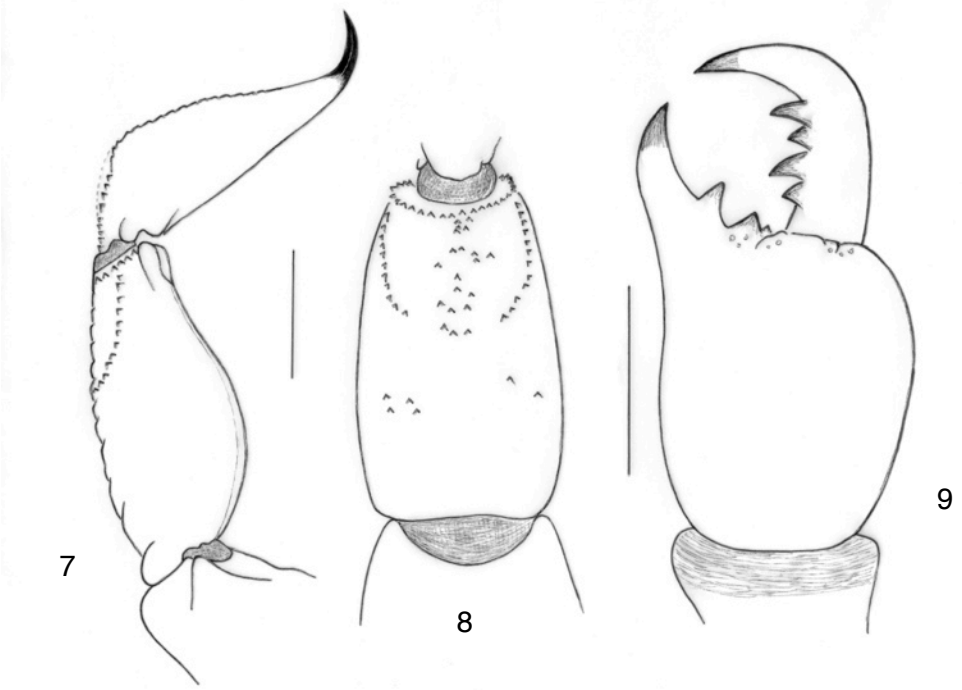

Fig. **7-9**. *Bothriurus andorinhas* **n**. **sp**., ♂ holotype.
7. Metasomal segment V and telson, lateral aspect. **8**. Metasomal segment V, ventral aspect. **9**. Chelicera, dorsal aspect. Scale bars = 2 mm (**7**, **8**); 1 mm (**9**).

Ecological considerations on the natural environment of 'Parque Estadual da Serra dos Martírios/Andorinhas' in the State of Pará

According to Figueiredo and Gorayeb (2009), the Serra dos Martírios/Andorinhas corresponds to a rather small massif composed of quarzitic stones which are strongly resistant to the erosion process. The massif represents a conspicuous formation in the southeast region of the state of Pará with maximum altitudes of almost 600 m, whereas the average altitudes range from 200 to 590 m. The global surface of the massif reaches 36 km in length and 18 km in width (cover figure).

The climate is Equatorial hot and wet with annual average temperatures of 24°C with variations ranging from 20 to 30°C. The average yearly rain precipitation is 1750 mm. The hydrographic system is composed of small rivers which are effluents of the Araguaia River located in the southeast zone of the massif. The vegetation formations are marked by the transition zone between the wet Amazonian forest and the open Cerrado formations.

Consequently, different gradients can be observed such as:

(i) dense wet forest with large trees,
(ii) more open forests,
(iii) carrasco vegetation,
(iv) gallery forests along small river systems,
(v) cerrados

(Figueiredo & Gorayeb, 2009; Alencar & Vidal, 2018).

The new species was collected under bark and stones in the transition zone between cerrados and open forests (Fig. 22, cover figure).

As for *Bothriurus rochai occidentalis,* described from the State of Maranhão, the new species was also collected from a region considered as legal Amazonia, but where the main type of vegetation can be defined as transitional between savannas and rainforest (Eiten, 1974; Ab'Saber, 1977; Lourenço, 2003). Consequently, the new *Bothriurus* described here can be considered as the third element to be found in an Amazonian environment.

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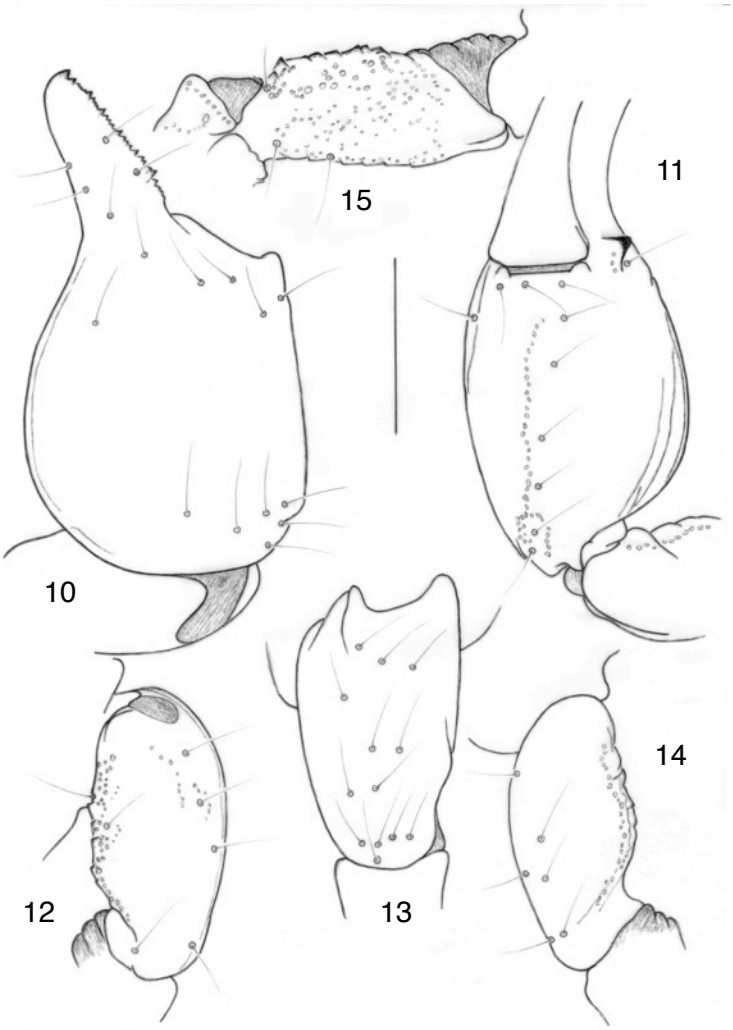

Fig. **10-15**. *Bothriurus andorinhas* **n**. **sp**., ♂ holotype. Trichobothrial pattern.

10-11. Chela, dorso-external (**10**) and ventral (**11**) aspects.
12-14. Patella, dorsal (**12**), external (**13**) and ventral (**14**) aspects.
15. Femur, dorsal aspect. Scale bar = 2 mm.

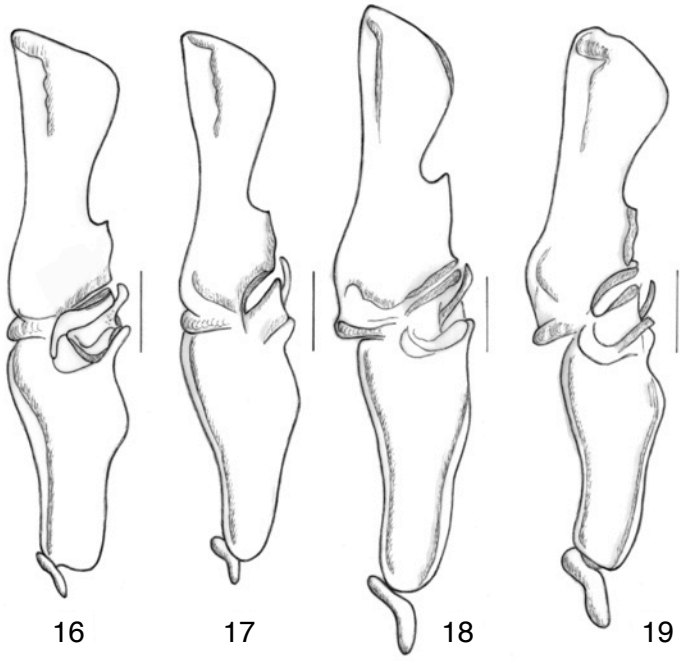

Fig. **16-19**. Right hemispermatophore, external aspect.

16. *Bothriurus rochai*. **17**. *Bothriurus rochai occidentalis*. **18**. *Bothriurus cerradoensis*. **19**. *Bothriurus andorinhas* **n**. **sp**. Scales bars = 1 mm.

Fig. **20**-**21**. *Bothriurus cerradoensis*. ♂ paratype. Habitus, dorsal (**20**) and ventral (**21**) aspects.

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Fig. **22**. Cerrado formation in the lower area of the park, near to the Araguaia River (photo W. Lourenço)

Résumé

Lourenço W. R., 2023. – Une nouvelle espèce de *Bothriurus* Peters (Scorpiones: Bothriuridae) pour le 'Parque Estadual da Serra dos Martírios/Andorinhas' dans l'état du Pará, Brésil. *Faunitaxys*, 11(4): 1 – 7.

Une nouvelle espèce, *Bothriurus andorinhas* **n**. **sp**. est décrite d'une zone de transition entre des formations de type savanicole et des forêts humides, situées dans le sud de l'état du Pará au Brésil. La nouvelle espèce peut être associée à d'autres espèces appartenant à un complexe qui peut être défini comme celui de *Bothriurus rochai*. La description de la nouvelle espèce apporte un nouveau soutien à l'existence de populations micro-endémiques au sein des différents groupes de *Bothriurus*. Des commentaires sont proposés sur certaines particularités écologiques du micro-habitat du nouveau taxon ainsi que sur la région où la nouvelle espèce a été trouvée au sud de l'état du Pará.

Mots-clés. – Scorpion, Bothriuridae, *Bothriurus*, *andorinhas*, nouvelle espèce, taxonomie, description, zone de transition, Amazonie.

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Illustration de la couverture :

Zone de transition de végétation dans les parcelles les plus hautes du parc. Le relief typique du massif peut être observé (photo P. S. S. Gorayeb).

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