

The genus *Rhopalurus* Thorell, 1876
(Scorpiones: Buthidae) in northeast Brazil; a possible
case of a vicariant species

O gênero *Rhopalurus* Thorell, 1876
(Scorpiones: Buthidae) no nordeste do Brasil; um
possível caso de uma espécie vicariante

WILSON R. LOURENÇO¹

As already outlined in previous publications (LOURENÇO, 1982, 1986, 2008), in South America the genus *Rhopalurus* is typical of open vegetation formations. In Brazil, its core area of distribution is composed by the 'Cerrados' and 'Caatingas' formations of Central and North-eastern regions of the country. Two species are also known from enclaves in savannah formations inside oriental Amazonia (for details see LOURENÇO, 2008), and 'a priori' at least one species is known from the savannahs of the Guayana region (*sensu* MORI, 1991).

The biogeographic pattern presented by the genus *Rhopalurus* constitutes one good example of a group showing a discontinuous distribution. This kind of pattern can be observed in different cases, among scorpions exclusively adapted to savannahs or to rainforests (LOURENÇO, 2008, 2010). These cases have an important relationship with species endemic to present islands of savannah in Amazonian and Guayanian enclaves, but also to those isolated in forest islands inside open vegetation formations (Caatingas, Cerrados and Campos). The endemic populations isolated inside savannah islands provide good evidence in support to the hypothesis of past connections between the savannahs of central Brazil and the savannah enclaves in Amazon and Guayana regions. When forest cover was reduced, open vegetation formations probably coalesced during past dry periods (AB'SABER, 1977; VAN DER HAMMEN, 1983; LOURENÇO, 1986, 2008).

¹ Muséum national d'Histoire naturelle, Département Systématique et Evolution, UMR7205, CP 053, 57 rue Cuvier, 75005 Paris, France: e-mail: arachne@mnhn.fr.

Species of the genus *Rhopalurus* most certainly exhibited a continuous distribution during Pleistocene dry periods and the present disrupted distribution is a possible consequence of the reestablishment of rainforest over the regions which previously served as corridors (LOURENÇO, 1982, 1986, 2008). Good evidence for this presumed palaeodistribution was provided with the discovery of two populations, *Rhopalurus amazonicus* Lourenço, 1986, endemic to a savannah enclave in the region of Alter do Chão and *Rhopalurus crassicauda paruensis* Lourenço, 2008 equally endemic to a savannah enclave in 'Campos de Paru', State of Pará. Both areas are totally isolated within oriental Amazon forest (MURÇA PIRES & PRANCE, 1985).

Since my revision of the genus (LOURENÇO, 1982) and my reanalysis of its distribution (LOURENÇO, 1986), very few new species have been described for Brazil: *Rhopalurus lacrau* Lourenço & Pinto da Rocha, 1997 from Bahia, *Rhopalurus piceus* Lourenço & Pinto da Rocha, 1997 from the savannahs in Roraima and *Rhopalurus guanambiensis* Lenarducci, Pinto da Rocha & Lucas, 2005 also from Bahia. These new description confirmed the biogeographic pattern of distribution already observed for the genus.

In this note I will present one new element which I was able to study, from a 'Brejo' formation located in the 'Chapada do Araripe', in the State of Ceará, Brazil. The morphological similarities of the new species with *Rhopalurus lacrau*, distributed only in the State of Bahia, strongly suggests a typical case of a vicariant species, as synthesized by BERNARDI (1986), between north and south populations in the Northeast of Brazil. Although *R. lacrau* was found inside a cave, it cannot be considered as a true troglobitic element (absence of troglomorphisms). The cave habitat, however, presents more mesic conditions than the outside arid Caatingas. The new species was found in a 'Brejo' formation which corresponds to outlying forest islands which are surrounded by xerophytic formations such as the Caatingas. These 'Brejos' hills are covered by forest, because their elevation causes humid air to cool so that condensation and consequent precipitation take place (ANDRADE-LIMA, 1982).

In face of the observed pattern of distribution and differentiation it becomes difficult to be sure about the true taxonomic status of these isolate populations. Consequently one question can be addressed: are these populations' true species, subspecies or only local morphs belonging to large to polymorphic populations? In this note, I decided for the description of a new species, however, only the study of more specimens, to be collected in the region between the 'Chapada do Araripe' and Central Bahia, will clarify the status of these two presumed distinct populations.

METHODS

Illustrations and measurements were produced using a Wild M5 stereomicroscope with a drawing tube and an ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow VACHON (1974) and morphological terminology mostly follows VACHON (1952) and HJELLE (1990).

Rhopalurus brejo sp. n. (Figs 1-12)

Female holotype: Brazil, State of Ceará, 'Chapada (serra) do Araripe', Brejo Grande, S of Santana, II/1964 (collected by local people). Deposited in the collections of the Muséum national d'Histoire naturelle, Paris.

ETYMOLOGY — The specific name is a noun in apposition to the generic name and refers to the local 'Brejo' formations found in the 'Chapada do Araripe'.

DIAGNOSIS — Scorpion of moderate size in relation to the species of the genus, with 44.6 mm in total length. Coloration reddish-yellow to reddish-brown. Granulation moderately marked; carinae strongly marked. Subaculear tubercle conic in shape and flattened laterally. Pectinal tooth count 16-16; fixed and movable fingers of pedipalps with 7-8 rows of granules.

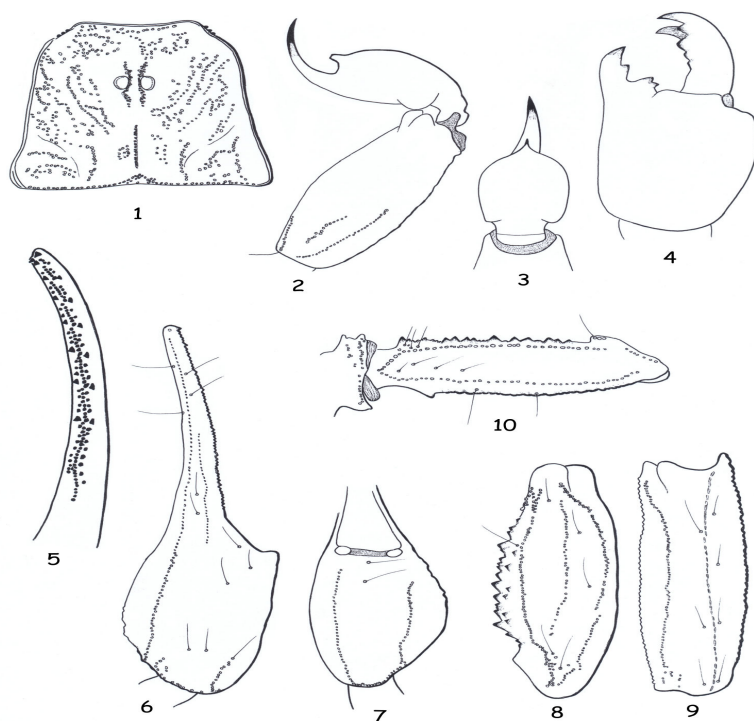
RELATIONSHIPS — This new species is clearly related to *R. lacrau* Lourenço & Pinto da Rocha, 1997, species described from a cave located in the State of Bahia, Brazil. The new species can be distinguished, however, by: (i) a darker general coloration, (ii) better marked carinae, (iii) 8 rows of granules on chela movable finger, (iv) a conic shape of subaculear tubercle, (v) some distinct morphometric values. Moreover, the two species are found in quite different habitats.

Description based on female holotype. Measurements in Table 1.

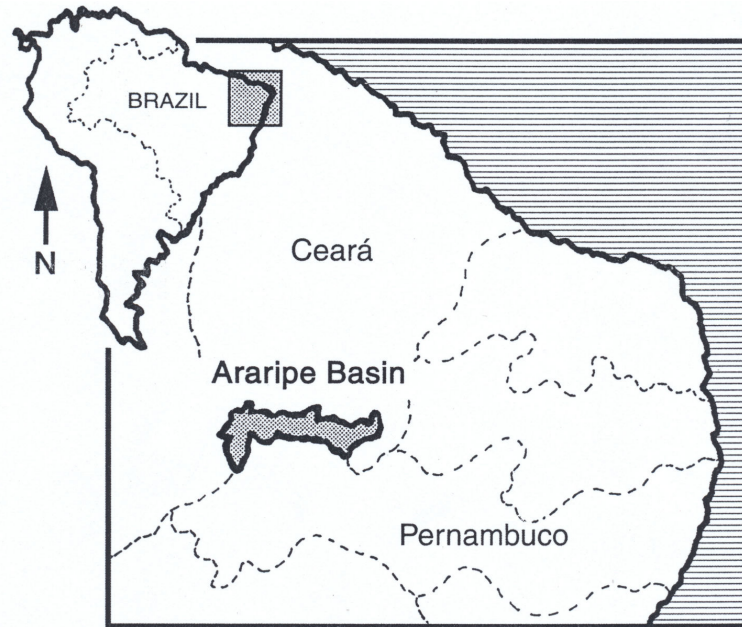
COLORATION — Basically reddish-yellow to reddish-brown. Prosoma: carapace reddish-brown; eyes surrounded with black pigment. Mesosoma: tergites reddish-yellow. Metasomal segments I to IV reddish-yellow; V reddish-brown; segments IV-V moderately infuscate; carinae dark. Vesicle of same color as segment V. Venter yellow to reddish-yellow. Chelicerae yellowish with a pale thread; fingers reddish-yellow. Pedipalps reddish-yellow; carinae and granulations on the edge of fingers reddish-brown. Legs reddish-yellow.

MORPHOLOGY — Carapace strongly granular; anterior margin with a median concavity. Anterior median and posterior median carinae

moderate. All furrows moderately deep. Median ocular tubercle distinctly anterior to the centre of the carapace. Eyes separated by one ocular diameter. Three pairs of lateral eyes. Sternum subtriangular to subpentagonal. Mesosoma: tergites moderately to strongly granular. Median carina moderate to strong in all tergites. Tergite VII pentacarinata. Venter: genital operculum divided longitudinally, forming two oval plates. Pectines: pectinal tooth count 16-16. Sternites smooth with elongate spiracles; sternite VII with four carinae and a thin granulation. Metasoma: segment I with 10 carinae; II to IV with 8 carinae; V with 5 carinae. Intercarinal spaces moderately granular on segments I to IV; strongly granular on V. Telson roughly granular with a moderately long and curved



Figs. 1-9. *Rhopalurus brejo* sp. n. Female holotype. 1, carapace; 2-3, metasomal segment V and telson, lateral and ventral aspects; 4, chelicera; 5, cutting edge of movable chelal finger; 6-10, trichobothrial pattern; 6-7, chela, dorso-external and ventral aspects; 8-9, patella, dorsal and external aspects; 10, Femur, dorsal aspect.



Figs 11 e 12. Above, map of Northeast of Brazil, showing the location of 'Chapada do Araripe' (above). 12 (below) idem, showing the type localities of *Rhopalurus lacrau* (circle with black dot) and *Rhopalurus brejo* sp. n. (black circle).

aculeus, shorter than vesicle. Subaculear tooth with a conic shape and flattened laterally. Cheliceral dentition characteristic of the family Buthidae; basal teeth on movable finger reduced but not fused; ventral aspect of both fingers and manus with dense, long setae (VACHON, 1963). Pedipalps: femur pentacarinata; patella with 7 carinae; chela with 9 carinae, moderately marked; internal aspects of femur and patella with several spinoid granules; all faces moderately to weakly granular. Fixed and movable fingers with 7-8 oblique rows of granules. Internal and external accessory granules strongly marked. Trichobothriotaxy; orthobothriotaxy A- α (alpha) (VACHON, 1974, 1975). Legs: tarsus ventrally with numerous short fine setae; pedal spurs moderate; tibial spurs absent.

MORPHOMETRIC VALUES (IN MM) OF THE FEMALE HOLOTYPE — Total length, 44.6 (including telson). Carapace: length, 4.8; anterior width, 3.0; posterior width, 5.3. Mesosoma length, 13.4. Metasomal segments. I: length, 3.3; width, 2.8; II: length, 3.8; width, 2.8; III: length, 4.3; width, 2.9; IV: length, 4.7; width, 2.9; V: length, 5.6; width, 2.6; depth, 2.3. Telson: length, 4.7; width, 1.8; depth, 1.7. Pedipalp: femur length, 5.1, width, 1.3; patella length, 5.7, width, 1.8; chela length, 9.1, width, 2.3, depth, 2.0; movable finger length, 5.7.

RÉSUMÉ

Une nouvelle espèce, *Rhopalurus brejo* sp. n. (Buthidae) est décrite d'une formation du type 'Brejo' localisée dans la 'Chapada do Araripe', dans l'Etat du Ceará, Brésil. La nouvelle espèce est morphologiquement similaire à d'autres espèces du genre *Rhopalurus* et en particulier à l'espèce *Rhopalurus lacrau* Lourenço & Pinto da Rocha, laquelle est distribuée dans des formations arides plus méridionales dans l'Etat de Bahia, Brésil. Le modèle de distribution observé suggère un cas d'espèces vicariantes entre les populations septentrionales et méridionales du nord-est du Brésil.

MOTS-CLÉS: *Rhopalurus*; Buthidae; nouvelle espèce; Caatingas; formations du type 'Brejo'; espèces vicariantes.

SUMMARY

A new species, *Rhopalurus brejo* sp. n. (Buthidae) is described from a 'Brejo' formation located in the 'Chapada do Araripe', in the State of Ceará, Brazil. The new species is morphologically similar to other *Rhopalurus* species and, in particular to *Rhopalurus lacrau* Lourenço & Pinto da Rocha, which is distributed in the more southern arid formations of the State of Bahia, Brazil. The observed pattern of distribution suggests a case of a vicariant species between northern and southern populations in Northeast of Brazil.

KEY-WORDS: *Rhopalurus*; Buthidae; new species; Caatingas; 'Brejo' formations, vicariant species

SUMÁRIO

Uma nova espécie, *Rhopalurus brejo* sp. n. (Buthidae) é descrita de uma formação do tipo 'Brejo' localizada na 'Chapada do Araripe', no Estado do Ceará, Brasil. A nova espécie é morfologicamente similar a outras espécies de *Rhopalurus* e em particular a *Rhopalurus lacrau* Lourenço & Pinto da Rocha, a qual é distribuída em formações áridas mais meridionais no Estado da Bahia, Brasil. O modelo de distribuição observado sugere um caso de espécies vicariantes entre as populações setentrionais e meridionais no nordeste do Brasil.

KEYWORDS: *Rhopalurus*; Buthidae; espécie nova; Caatingas; formações do tipo 'Brejo' formations; espécies vicariantes

ACKNOWLEDGMENTS — I am grateful to Elise-Anne Leguin (Muséum, Paris) for her contribution to the preparation of the plates.

BIBLIOGRAPHY

- AB'SABER, A. N. 1977. Espaços ocupados pela expansão dos climas secos na América do Sul, por ocasião dos períodos glaciais quaternários. *Paleoclimas*. IGEOG-USP. 3: 1-19.
- ANDRADE-LIMA, D. 1982. Present-Day Forest Refuges in Northeastern Brazil. Pp. 245-251, In: G. T. Prance (ed.), *Biological Diversification in the Tropics*. Columbia University Press, New York.
- BERNARDI, G. 1986. La vicariance, la pseudovicariance et la convergence allopatrique, *Bull. Ecologie*, 17: 145-154.
- HJELLE, J. T. 1990. Anatomy and morphology. Pp. 9-63, In: G. A. Polis (ed.), *The Biology of Scorpions*. Stanford University Press, Stanford.
- LOURENÇO, W. R. 1982. Révision du genre *Rhopalurus* Thorell, 1876 (Scorpiones, Buthidae). *Revue Arachnol.*, 4: 107-141.
- LOURENÇO, W. R. 1986. Biogéographie et phylogénie des Scorpions du genre *Rhopalurus* Thorell, 1876 (Scorpiones, Buthidae). *Mém. Soc. Royale Belge d'Entomol.*, 33: 129-137.
- LOURENÇO, W. R. 2008. The geographic pattern of distribution of the genus *Rhopalurus* Thorell, 1876 in the Guayana-Amazon region (Scorpiones: Buthidae). *Euscorpius*, 73: 1-14.
- LOURENÇO W. R. 2010. The disrupted pattern of distribution of the genus *Hadrurochactas* Pocock; evidence of past connections between Amazon and the Brazilian Atlantic forest. *C. R. Biologies*, 333: 41-47.
- MORI, S. A. 1991. The Guayana lowland floristic Province. *C. R. Séances Soc. Biogéo.*, 67(2): 67-75.

- MURÇA PIRES, J. & G. T. PRANCE. 1985. *The vegetation types of the Brazilian Amazon*. Pp. 109-145, In: G. T. Prance & T. E. Lovejoy (eds), Amazonia. Pergamon Press, Oxford.
- STAHNKE, H. L. 1970. Scorpion nomenclature and mensuration. *Entomol. News*, 81: 297-316.
- VACHON, M. 1952. *Etudes sur les Scorpions*. Institut Pasteur d'Algérie, Alger, 482 pp.
- VACHON, M. 1963. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les Scorpions. *Bull. Mus. natl. Hist. Nat., Paris*, 2e sér., 35 (2): 161-166.
- VACHON, M. 1974. Etude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bull. Mus. natl. Hist. Nat., Paris* 3e sér., n° 140, *Zool.* 104: 857-958.
- VACHON, M. 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de la famille des Buthidae Simon. *C. R. Séanc. Acad. Sc., Paris*, sér. D, 281: 1597-1599.
- VAN DER HAMMEN, T. 1983. *The palaeoecology and palaeogeography of savannas*. Pp. 19-35, In; F. Bourlière (ed.), Tropical Savannas. Elsevier Scientific Publishing Company, Amsterdam.