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The genus *Vietbocap* Lourenço & Pham, 2010 in the Thien Duong cave, Vietnam: A possible case of subterranean speciation in scorpions (Scorpiones: Pseudochactidae)

Le genre Vietbocap *Lourenço & Pham, 2010 dans la grotte Thien Duong, Vietnam : un cas possible de spéciation souterraine chez les scorpions (Scorpiones : Pseudochactidae)*

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ABSTRACT

Two new species of scorpion belonging to the family Pseudochactidae and to the genus *Vietbocap* are described based on specimens collected in the Thien Duong cave, which belongs to the Vom cave system, in the Phong Nha–Ke Bang National Park, Quang Binh Province, Vietnam. The previously described species from this cave, *Vietbocap thienduongensis* Lourenço & Pham, 2012 was collected in the initial section of the cave (1500 to 1800 m from the cave entrance) and proved to be a true troglobitic element. The diagnosis of this species, only known from males, is completed based on females collected at 750 m from the cave entrance. The two new species described here were collected respectively at 3000 and 5000 m from the cave entrance and are also true troglobitic elements, very similar to *V. thienduongensis*, but showing some clear morphological differences. This observed situation suggests a possible case of speciation within the cave system, the first one ever reported for scorpions. The population found at 5000 m from the entrance of the cave is a total new record of distance from a cave entrance for scorpions.

Mots clés :
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RÉSUMÉ

Deux nouvelles espèces de scorpion appartenant à la famille des Pseudochactidae et au genre *Vietbocap* sont décrites à partir d'exemplaires collectés dans la grotte Thien Duong, laquelle appartient au système des grottes Vom dans le parc national Phong Nha–Ke Bang dans la province de Quang Binh, Vietnam. La seule espèce déjà décrite de cette grotte, *Vietbocap thienduongensis* Lourenço & Pham, 2012, a été collectée dans la partie initiale de celle-ci (entre 1500 et 1800 mètres de l'entrée) et a été confirmée comme un véritable élément troglobie. La diagnose de cette espèce, connue uniquement à partir des mâles, est

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complétée à partir de femelles collectées à 750 m de l'entrée de la grotte. Les deux nouvelles espèces décrites à présent ont été collectées respectivement à 3000 et 5000 m de l'entrée de la grotte et sont également des éléments troglobies, plutôt similaires à *V. thienduongensis*, mais avec des différences morphologiques bien nettes. La situation observée suggère un possible cas de spéciation à l'intérieur de la grotte, le premier signalé chez les scorpions. La population trouvée à 5000 m de l'entrée de la grotte représente un record absolu de distance de l'entrée d'une grotte pour des scorpions.

1. Introduction

As already outlined in several previous publications [1–5], the family Pseudochactidae Gromov, 1998 most certainly contains the most remarkable scorpions described in the last twenty years. The first species to be discovered was *Pseudochactas ovchinnikovi* Gromov, 1998, found in an isolated mountainous region of southeastern Uzbekistan and southwestern Tajikistan, in Central Asia [6]. A second genus and species, *Troglokhammouanus steineri* Lourenço, 2007, was described from karst caves in Laos [1]. Although this species was found inside a cave, its morphological characteristics do not correspond to a totally troglobitic element. This Laotian species reopened the question about the origins and affinities of the Pseudochactidae and led to new biogeographical interpretations [1].

In the following years, scorpions have been prospected in karst cave systems in Vietnam, and several specimens of a new pseudochactid scorpion were collected in the Tien Son cave, which belongs to the Phong Nha system. These were described as a new genus and species, *Vietbocap canhi* Lourenço & Pham, 2010, which represents a true troglobitic element [4]. Subsequent surveys in the cave systems of Vietnam have been carried out and another species of pseudochactid scorpion was collected in the Thien Duong cave, which belongs to the Vom cave system. The new species, *Vietbocap thienduongensis* Lourenço & Pham, 2012 showed features of a totally troglobitic element [5]. Almost simultaneously, one more new species of *Vietbocap* was collected in a cave in Laos; *Vietbocap lao* Lourenço, 2012, once again proved to be a true troglobitic element [2]

Only several years after the description of the first species belonging to the genus *Troglokhammouanus* Lourenço, 2007, a second species was found and described from another cave in Laos [3]. The description of *Troglokhammouanus louisanneorum* Lourenço, 2017 was based on a single female specimen and the elements of this genus are apparently less common than those of the genus *Vietbocap*.

The fact that several pseudochactid elements originating from caves within the same major karst system have been found in Laos and Vietnam suggest that this region of Southeast Asia may represent a refuge or centre of endemism for this family.

In recent years, more intense research was concentrate in the Thien Duong cave, which is a major cave in this karst system (see next section). Prospections were carried on much deeper distances from the entrance of the cave and further elements belonging to the genus *Vietbocap* were located. The study of the specimens collected respectively at 3000 and 5000 m from the cave entrance showed that these were new species; similar to *V. thienduongensis*, but presenting some clear morphological differences. This observed situation could suggest a possible case of speciation within the cave system, the first one ever reported for scorpions. Moreover, the population found at 5000 m from the entrance of the cave represent a new record of distance from a cave entrance for scorpions.

We will not re-discuss here the controversial phylogenetic and biogeographical aspects concerning this peculiar scorpion family, since most basic points have already been largely discussed by Lourenço [1]. Using molecular tools, Sharma et al. [7] strongly supported the monophyly of pseudochactids, chaerilids, and buthids. The precise relationships among these three families remain however strongly ambiguous. More detailed information on the orogeny and geodynamics of South East Asia, and on the location, ecology and climate of the national park and caves, can be found in Lourenço and Pham [4].

2. The Thien Duong cave in the Vom cave system

The Thien Duong cave (also called Paradise cave) where the new species were found is located in the Phong Nha–Ke Bang National Park, 60 km northwest of Dông Hói city (Figs. 1–2). The Thien Duong cave is at an elevation of 200 m above sea level, near the west branch of Ho Chi Minh Highway, in Son Trach Commune, Bo Trach District, Quang Binh Province, Vietnam. The cave was discovered by a local people in 2005, and initially the first 5 km of this cave were explored by scientists from the British Cave Research Association in 2005. More recently, the whole extension of the cave was explored by the same Association. The cave is 31 km long, and in parts can reach 100 m in height and 150 m in width. There are two cave systems in Phong Nha Ke Bang region: Phong Nha cave system and Vom cave system. However, these systems are globally isolated, with no geological connections being known between them [8].

The Phong Nha–Ke Bang karst is the oldest major karst area in Asia. It has been subject to massive tectonic

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