

## A NEW CAVE SPECIES OF *CHAERILUS* SIMON, 1877 FROM MYANMAR (SCORPIONES: CHAERILIDAE)

Wilson R. Lourenço<sup>1</sup> & Eric Ythier<sup>2</sup>

<sup>1</sup> Muséum national d'Histoire naturelle, Sorbonne Universités, Institut de Systématique, Evolution, Biodiversité (ISYEB), UMR7205-CNRS, MNHN, UPMC, EPHE, CP 53, 57 rue Cuvier, 75005 Paris, France, e-mail: wilson.lourenco@mnhn.fr

<sup>2</sup> BYG Taxa, 382 rue des Guillates, 71570 Romanèche-Thorins, France, email: contact@bygtaxa.com

**Abstract:** A new species belonging to the genus *Chaerilus* Simon, 1877 is described from Myanmar: *Chaerilus adrianoi* sp. n., which was collected in a cave located in the East of the country. The new species is compared with some other *Chaerilus* species also described from Southeast Asia and in particular from Myanmar. The comparative study of the new species with other congeners suggests, as in previous cases, that different species do not show very marked morphological differences, but rather correspond to micro-endemic populations. The new species is the second *Chaerilus* collected from Myanmar, together with *Chaerilus birmanicus* Thorell, 1899, restored from its synonymy with *Chaerilus variegatus* Simon, 1877. *Chaerilus anneae* Lourenço, 2012 is also restored from its synonymy with *Chaerilus julietteae* Lourenço, 2011 and the validity of *Chaerilus kampuchea* Lourenço, 2012 is confirmed.

**Key-Words:** Scorpions, *Chaerilus anneae*, *Chaerilus birmanicus*, *Chaerilus kampuchea*, biospeleology, Southeast Asia.

### Una nueva especie cavernícola de *Chaerilus* Simon, 1877 de Myanmar (Scorpiones: Chaerilidae)

**Resumen:** Se describe una nueva especie perteneciente al género *Chaerilus* Simon, 1877 de Myanmar: *Chaerilus adrianoi* sp. n., que fue recolectado en una cueva ubicada en el este del país. La nueva especie se compara con otras especies de *Chaerilus* también descritas en el sudeste asiático y, en particular, en Myanmar. El estudio comparativo de las nuevas especies con otras congénicas sugiere, como en casos anteriores, que las distintas especies no presentan diferencias morfológicas muy marcadas, sino que corresponden a poblaciones microendémicas. La nueva especie es la segunda *Chaerilus* recolectada en Myanmar, junto con *Chaerilus birmanicus* Thorell, 1899, restituida de su sinonimia con *Chaerilus variegatus* Simon, 1877. *Chaerilus anneae* Lourenço, 2012 también restituida de su sinonimia con *Chaerilus julietteae* Lourenço, 2011 y la validez de *Chaerilus kampuchea* Lourenço, 2012 es confirmada.

**Palabras clave:** Scorpions, *Chaerilus anneae*, *Chaerilus birmanicus*, *Chaerilus kampuchea*, biospeleology, Southeast Asia.

**Taxonomy:** *Chaerilus adrianoi* sp. n., *Chaerilus anneae* stat. rev., *Chaerilus birmanicus* stat. rev., *Chaerilus kampuchea* stat. rev.

## Introduction

In some recent publications, the taxonomic situation and composition of the genus *Chaerilus* Simon, 1877, family Chaerilidae, was largely commented (e.g. Lourenço, 2019; Lourenço *et al.*, 2020) and consequently will not be re-discussed here. The scorpions of this family have been extensively studied in the last 25-30 years, however many questions and even gaps remain, especially concerning the validity of some 'old' species described in the 19<sup>th</sup> century. The genus *Chaerilus* was originally created to accommodate *Chaerilus variegatus* Simon 1877, a species described from Java. Subsequently, several other species have been described from quite many countries ranging from India to China and Southeast Asia. In contrast, species reported from Myanmar (Burma) remain rare. Only one species, *Chaerilus birmanicus* (Thorell, 1889), originally described in the genus *Chelomachus* Thorell, 1889, was clearly reported from Myanmar, originally from Rangoon (Yangôn), Burma. The genus *Chelomachus* was subsequently synonymised by Kraepelin (1894).

In the present contribution we describe a new species of *Chaerilus*, the first one to be collected inside a cave in Myanmar. Previously, other species of *Chaerilus* have been collected in caves; some showing some significant adaptation to cave life and considered as true troglobitic species, others showing to be only troglloxenes (refer to section treating on cave scorpions). It should be noted that from this same Birman cave a second remarkable scorpion species was collected and described: *Scorpiops (Plethoscorpiops) profusus* Louren-

ço, 2017, belonging to the family Scorpiopidae Kraepelin, 1905 (Lourenço, 2017).

## Material and Methods

Illustrations and measurements were made with the aid of a Wild M5 stereo-microscope with a drawing tube (camera lucida) and an ocular micrometer, together with a Canon EOS 7D and Adobe Photoshop software. Measurements follow Stahnke (1970) and are given in mm. Cheliceral nomenclature follows Vachon (1963) while trichobothrial notations are those of Vachon (1974) and morphological terminology mostly follows Hjelle (1990). Presented molecular results are from Arabi *et al.* (2012); refer to article for material and methods used for extraction, PCR and sequencing.

## Taxonomic treatment

Family CHAERILIDAE Pocock, 1893

Genus *Chaerilus* Simon, 1877

*Chaerilus adrianoi* sp. n. (Fig. 1-14)

**MATERIAL.** Myanmar, Burma, Kayin State, Hpa-An, Saddan Cave, 250 m a.s.l. (16.739735° - 097.718175°), about 80 m from cave entry, hidden in wall crevices, 31/VII/2015 (Giupponi A. & Kury A. leg.). Male holotype. Type material deposited in the Museu Nacional, Rio de Janeiro, Brazil.

**ETYMOLOGY.** Patronym honours our colleague Dr Adriano B. Kury, Museu Nacional, Rio de Janeiro, prominent arachnologist and one of the collectors of the new species.

#### **DIAGNOSIS (on the basis of the male holotype)**

Species of small size in relation to others in the genus, with 20.9 mm in total length. General coloration yellow to pale yellow, weakly marked with infuscations and pale brownish spots. Carapace moderately narrowed toward the anterior edge; almost acarinate and weakly granulated; anterior margin slightly convex; furrows shallow. Metasomal carinae moderately to strongly marked; ventral carinae absent from segment I, weakly marked on segments II and III; latero-ventral and ventral carinae on segment V composed of spinoid granules. Telson with a pear-like shape; aculeus weakly curved; presence of an inconspicuous subaculear protuberance. Dentate margins of fixed and movable fingers with 6-7 rows of granules. Pectinal tooth count 4-5 in male. Genital operculum plates with a sub-oval shape. Trichobothriotaxy of type B, orthobothriotaxic. No reaction to UV light (Lourenço, 2012a).

#### **RELATIONSHIPS**

The new species can be distinguished from *C. birmanicus* (restored from its synonymy with *C. variegatus*; Fig. 15-16; see "Taxonomic remarks" below) by a combination of several characters: (i) a very pale overall coloration, in particular on the ventral aspect, without spots over the genital operculum and pectines, (ii) ventral carinae absent from segment I, weakly marked on segments II and III, (iii) dentate margins of fixed and movable fingers of pedipalps with 6-7 rows of granules, (iv) telson with the presence of an inconspicuous subaculear protuberance.

Curiously, *C. adrianoi* sp. n. shows morphological similarities with *C. anneae* (Fig. 17-18; restored from its synonymy with *C. julietteae*; see "Taxonomic remarks" below). This clearly indicates a form of convergence of characters which however does not attest of some real affinities between the two species.

#### **DESCRIPTION of the male holotype**

**Coloration.** Basically yellow to pale yellow, weakly marked with brownish infuscations and some pale spots. Carapace pale-yellow, with weakly marked spots. Tergites yellow, marked with pale confluent spots. Metasomal segments yellow with pale variegated spots. Telson pale yellow with some lateral infuscations; aculeus reddish. Chelicerae pale yellow, marked with pale variegated spots; fingers light brown with teeth reddish. Pedipalps yellow; femur more intensely spotted than patella and chela, brownish; dentate margins of fingers reddish. Legs pale yellow with brownish infuscations. Venter and sternites yellow; genital operculum and pectines pale yellow, without spots.

**Morphology.** Carapace moderately narrowed anteriorly; anterior margin slightly convex; almost acarinate and weakly granulated; furrows shallow. Two pairs of lateral eyes and one pair of moderate median eyes, about twice the size of lateral eyes; median eyes anterior to the centre of the carapace. Tergites moderately to weakly granulated; carinae obsolete. Sternum pentagonal, longer than wide; genital operculum plates with a sub-oval shape. Pectinal tooth count 4-5. Sternites smooth with a few minute granules on VII; spiracles small and round-shaped; carinae absent from VII. Metasomal segments I and II wider than long; segments III to V longer than wide. All the carinae moderately to strongly granular; ventral

carinae absent from segment I; weakly marked on segments II and III; dorsal and latero-dorsal carinae without spinoid granules on segments I-IV; latero-ventral and ventral carinae on segment V composed of spinoid granules. Vesicle elongated with a pear-like shape, almost smooth and with a minute protuberance at the base of the aculeus; aculeus short and weakly curved. Pedipalps weakly elongated; femur with five carinae; internal with a few spinoid granules. Patella with 6-7 vestigial carinae. Chela weakly enlarged and with 7-8 vestigial carinae. Tegument weakly granular. Fixed and movable fingers shorter than manus, with 6-7 rows of granulations on the dentate margins. Chelicerae characteristic of the family Chaerilidae (Vachon, 1963). Trichobothriotaxy of type B; orthobothriotaxic (Vachon, 1974); femur with 9 trichobothria, patella with 14 and chela with 14. Legs with pedal spurs weakly developed. Tarsi with two rows of setae.

**Morphometric values (in mm).** Total length (including telson), 20.9. Carapace: length, 3.1; anterior width, 1.6; posterior width, 2.9. Mesosoma length, 6.8. Metasomal segments. I: length, 1.0; width, 1.6; II: length, 1.2; width, 1.3; III: length, 1.3; width, 1.2; IV: length, 1.6; width, 1.1; V: length, 2.6; width, 1.0; depth, 1.0. Telson length, 3.3. Vesicle: width, 1.3; depth, 1.2. Pedipalp: femur length, 2.0, width, 1.1; patella length, 2.4, width, 1.2; chela length, 5.3, width, 1.8, depth, 2.2; movable finger length, 2.3.

#### **TAXONOMIC REMARKS**

In a general monographic book addressed to a broad public, Kovařík (1998) suggested, without any justification, that *Chaerilus birmanicus* was a synonym of *Chaerilus variegatus* (Fet, 2000). This unjustified opinion was again expressed in an approximate revision of the genus (Kovařík, 2000). It is clear that the description proposed by Thorell (1889) for the new species *C. birmanicus* was quite limited, as for most descriptions proposed by this author. Besides, the type specimen is a juvenile, necessarily leading to a lack of precise information on the species. Nevertheless, *C. variegatus* (Fig. 15-16) has a totally distinct area of distribution, being limited to the Indonesian islands (Lourenço *et al.*, 2010, 2011; Fig. 24), and *C. birmanicus* is herein considered as a valid species.

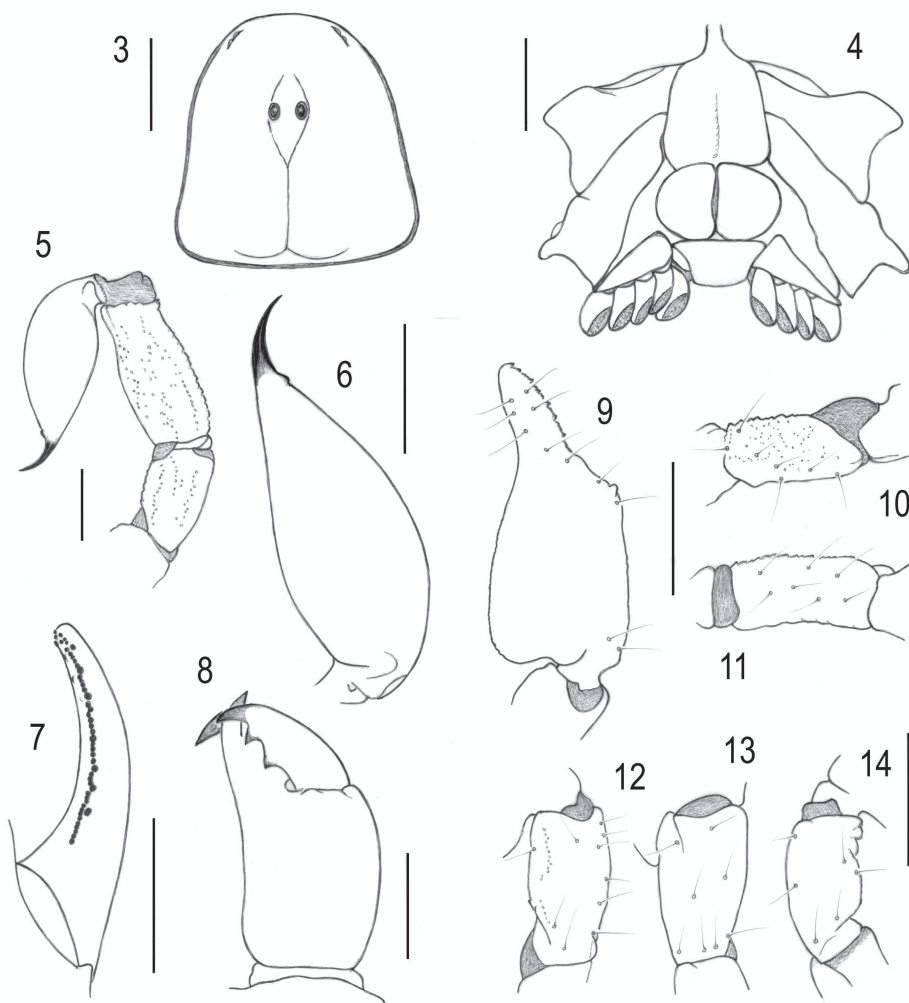
In another book on Bothriuridae, Chaerilidae and Buthidae, Kovařík & Ojanguren Affilastro (2013) suggested that *Chaerilus anneae* Lourenço, 2012 described from Vietnam (Lourenço, 2012b; Fig. 17-18, 24) was a synonym of *Chaerilus julietteae* Lourenço, 2011, also described from Vietnam, on the speculative basis that the holotype of *C. anneae* could be a juvenile of *C. julietteae*, as well as since both species are originated from the same location. As often, such decision was taken without examining any specimen of both species. After examining again the type material, we herewith confirm that the holotype of *C. anneae* is an adult female and that it is a different species from *C. julietteae*. In the same work, Kovařík & Ojanguren Affilastro (2013) also found surprising that *C. anneae* was not compared with *C. julietteae* by Lourenço (2012b), but instead with *Chaerilus petrzekai* Kovařík, 2000, also described from Vietnam. This decision was due to the fact that molecular analyses were conducted by J. Arabi (collector of both species) before the description of *C. anneae*, showing that both species were in different groups (see Fig. 2 in Arabi *et al.* (2012); *C. anneae* corresponding to *Chaerilus* sp.2).

In the same book, Kovařík & Ojanguren Affilastro (2013) equally suggested doubts about the validity of *Chaerilus*

**Fig. 1-2.** *Chaerilus adrianoi* sp. n., ♂ holotype, habitus. **1.** Dorsal aspect. **2.** Ventral aspect. Scale bar = 5 mm.



**Fig. 3-14.** *Chaerilus adrianoi* sp. n., ♂ holotype. **3.** Carapace, dorsal aspect. **4.** Ventral aspect showing coxapophysis, sternum, genital operculum and pectines. **5.** Metasomal segments IV, V and telson, lateral aspect. **6.** Telson, lateral aspect. **7.** Cutting edge of movable finger with rows of granules. **8.** Chelicera dorsal aspect. **9-14.** Trichobothrial pattern. **9.** Chela, dorso-external aspect. **10-11.** Femur, dorsal (**10**) and external (**11**) aspects. **12-14.** Patella, dorsal (**12**), external (**13**) and ventral (**14**) aspects. Scale bars = 1 mm (3-7), 0.5 mm (8), 2 mm (9-14).

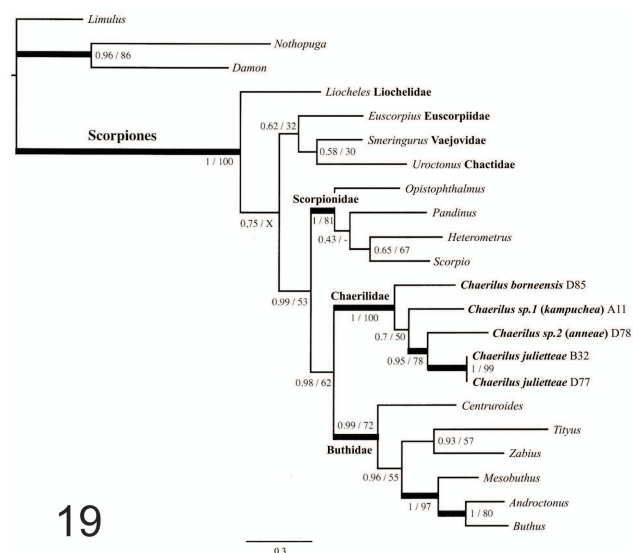




**Fig. 15-16.** *Chaerilus variegatus*, ♀ holotype, habitus. **15.** Dorsal aspect. **16.** Ventral aspect. Scale bar = 10 mm (from Lourenço *et al.* 2010).



**Fig. 17-18.** *Chaerilus anaeae*, ♀ holotype, habitus. **17.** Dorsal aspect. **18.** Ventral aspect. Scale bar = 5 mm.



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**Fig. 19.** Phylogenetic tree produced by J. Arabi, on the basis of molecular analyses performed in Arabi *et al.* (2012) based on CO1, 18S and 28S rRNA sequences, showing the validity of *C. anneae* and *C. kampuchea*. Numbers at branches indicate Bayesian posterior probabilities and maximum likelihood bootstrap percentages. **Fig. 20-23.** Habitat of *Chaerilus adrianoi* sp. n. **20.** Region near Hpa-An, Kayin State, Myanmar, showing the karstic formation where the Saddam Cave is located (photo F. Bréhier). **21.** Entry of the Saddam Cave seen from the interior (photo A. Kury). **22.** Interior view of the Saddam Cave (photo A. Kury). **23.** Interior view of the Saddam Cave, showing the limestone walls with crevices where the new species was found (photo A. Kury). **Fig. 24.** Map of Southeast Asia showing the distribution of *Chaerilus* species discussed in this work: *C. adrianoi* sp. n. (red star), *C. birmanicus* (yellow circle), *C. variegatus* (blue square), *C. anneae* (green triangle) and *C. kampuchea* (orange rhombus).

*kampuchea* Lourenço, 2012, and placed it as *nomem dubium*, again without examining any specimen. After examining again the type material, we herewith confirm that the holotype of *C. kampuchea* is an adult male, and that it is a valid species, as also confirmed by the molecular analysis conducted by Arabi *et al.* (2012) (*C. kampuchea* corresponding to *Chaerilus* sp.1 in Fig. 2).

Following the general work of Arabi *et al.* (2012) on Chelicerata, and on basis of analyses performed in this work, a more specific phylogenetic tree on Scorpiones was made by J. Arabi but was never published. This tree is presented here (Fig. 19), confirming again the validity of *C. anneae* and *C. kampuchea*.

## Comments on cave scorpions

As previously discussed, cave or, precisely, true troglobitic scorpions are relatively rare. True troglobitic species were only discovered by the late 1960s from Mexican caves; namely *Typhlochactas rhodesi* Mitchell, 1968 and *Typhlochactas reddelli* Mitchell, 1968 (Mitchell, 1968). Following these pioneer discoveries, the available data on cave scorpions was synthesized by a number of authors, in particular Lourenço & Francke (1985) and Volschenk & Prendini (2008). True troglobitic scorpions proved to belong to quite distinct lineages, namely the families Akraividae Levy, 2007, Belisaridae Lourenço, 1998, Buthidae C. L. Koch, 1845, Chaerilidae Pocock, 1893, Diplocentridae Karsch, 1880, Euscorpiidae Laurie, 1896, Hormuridae Laurie 1896, Pseudochactidae Gromov 1998, Typhlochactidae Mitchell, 1971, Troglotayosicidae Lourenço, 1998, Urodacidae Pocock, 1893 and Vaejovidae Thorell, 1876 (Lourenço & Francke, 1985; Volschenk & Prendini, 2008).

A number of species of the family Chaerilidae had been reported inhabiting cave environments, and some were classified as true troglobitic elements: namely *Chaerilus chapmani* Vachon & Lourenço, 1985 from Sarawak (Borneo), *Chaerilus sabinae* Lourenço, 1995 from Celebes (Sulawesi) Island and *Chaerilus agnellivanniorum* Lourenço & Rossi, 2019 from the Philippines. A soil anophthalmic species, *Chaerilus telnovi* Lourenço, 2009 was also described from the Moluccas Islands (Vachon & Lourenço, 1985; Lourenço, 1995, 2009; Lourenço & Rossi, 2019;).

Nevertheless, other *Chaerilus* species found in Vietnamese caves, such as *Chaerilus pathom* Lourenço & Pham, 2014 or *Chaerilus chubluk* Lourenço, Tram & Pham, 2020 as well as the new species described here, are certainly not true troglobitic elements, being merely troglloxenes (Lourenço & Pham, 2014; Lourenço *et al.*, 2020).

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\* Reference available at [www.sea-entomologia.org](http://www.sea-entomologia.org)