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EYELESS FOREST LITTER SCORPIONS; A NEW SPECIES FROM THE ISLAND OF HALMAHERA (MOLUCCAS), INDONESIA (SCORPIONES, CHAERILIDAE)

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Abstract: A new species belonging to the genus *Chaerilus* Simon, 1877, *Chaerilus telnovi* **sp. n.**, is described from the south of the island of Halmahera (Moluccas) in Indonesia. The new species is the first eyeless scorpion of the genus *Chaerilus* to be found in leaf litter. A short discussion about the evolutionary meaning of eyeless scorpions living in leaf litter or soil is also attempted.
Key words: Scorpiones, Chaerilidae, *Chaerilus*, new species, eyeless, leaf litter, Moluccas, Indonesia.

Escorpiones sin ojos de la hojarasca forestal; una especie nueva de la isla de Halmahera (Moluccas), Indonesia (Scorpiones, Chaerilidae)
Resumen: Se describe una nueva especie del género *Chaerilus* Simon, 1877, *Chaerilus telnovi* **sp. n.**, del sur de la isla de Halmahera (Molucas), en Indonesia. La nueva especie es el primer escorpion sin ojos del género *Chaerilus* que se ha encontrado en la hojarasca forestal. Se aborda una corta discusión sobre el significado ecológico de los escorpiones sin ojos que viven en la hojarasca o el suelo.
Palabras clave: Scorpiones, Chaerilidae, *Chaerilus*, nueva especie, sin ojos, hojarasca, Molucas, Indonesia.

Taxonomy/Taxonomía: *Chaerilus telnovi* **sp. n.**

Introduction

Eyeless scorpions are relatively frequent among species adapted to cave life (Lourenço & Goodman, 2008; Volschenk & Prendini, 2008). However, among the majority of the scorpion species which live in edaphic or endogean environments, this characteristic is rare. *Belisarius xambeui* Simon, 1879 was the first endogean species, with a partial regression of eyes, to be described from the Pyrenees in France (Simon, 1879). The first totally eyeless scorpion, however, to be found in litter was *Typhlochactas sylvestris* Mitchell & Peck, 1977 (Mitchell & Peck, 1977), from a montane forest habitat in Oaxaca, Mexico. Subsequently, a second eyeless species from litter *Typhlochactas mitchelli* Sissom, 1988 (Sissom, 1988), was also described from montane forest in Oaxaca, Mexico. Recent information (Francke in litt.) outlined the discovery and description of two new eyeless scorpion species from litter. The first, a *Typhlochactas* again from Mexico, and the second a *Troglotayosicus* Lourenço, 1981 from Colombia.

The exclusively Asiatic genus *Chaerilus* Simon, 1877 has recently been the subject of some discussions about the difficulties in defining precise species taxonomy (Lourenço & Ythier, 2008; Lourenço & Zhu, 2008 ; Zhu *et al*., 2008). Some of the *Chaerilus* species have been described from caves (Lourenço, 1995, 2008; Vachon & Lourenço, 1985), and at least two are troglobitic, *C. chapmani* Vachon & Lourenço, 1985 and *C. sabinae* Lourenço, 1995. The last species is, however, the only one that is totally eyeless.

Recent field research conducted by Drs. D. Telnov and K. Greke in the rain forests of the Island of Halmahera (Fig. 1), North Moluccas, Indonesia, led to the discovery of a new species of *Chaerilus*, the first one in this genus, to be found in rain forest litter, and totally eyeless.

Scorpions living in leaf litter or soil and the regression of eyes

The fossil record shows that scorpions became adapted to terrestrial environments between the Carboniferous and Triassic periods, 355 to 210 million years ago (Jeran, 2001; Lourenço & Gall, 2004). Undoubtedly transitional forms existed then, although these are difficult to identify (Jeran, 2001). These early terrestrial forms would have been unable to survive in extreme environments, such as savannas and deserts, which are today colonized by numerous species. According to their degree of adaptation to life on land, different types of soil-litter biotopes would have been utilized at different stages in the evolution and adaptation of early scorpions. The evaporative power of the air is the most important physical environmental factor affecting the distribution of cryptozoic animals. This is because small creatures have a very large surface in proportion to their mass; consequently, the conservation of water is the prime physiological problem of their existence (Cloudsley-Thompson, 1967, 1988; Little, 1983). The majority of cryptozoic animals are restricted to moist conditions, although these must not be so wet that they engender waterlogging. It is probable that the evolutionary transition of many invertebrates from aquatic to terrestrial life may have taken place via the soil-litter habitats where aerial respiration is not associated with desiccation (Cloudsley-Thompson, 1967, 1988; Little, 1983). The present eco-physiological properties of several scorpion species suggest that some lineages were originally and exclusively composed of soil-litter dwellers. During evolutionary time, certain species came to explore the more open and exposed epigean environment, while others remained endogean.

With the description of *T. sylvestris*, the first eyeless scorpion to be found in leaf litter, Mitchell & Peck (1977) suggested that ancestral species of the 'subterranean' genus *Typhlochactas* had probably partially or wholly lost their eyes and pigment as a consequence of adaptation to a cool, moist, litter habitat. Their argument was partly based on the fact that the lower montane moist forest litter habitats of Mexico have been environmentally stable, buffered against seasonal variation through evolutionary time. This environmental stability, like that of caves, allowed the regressive evolution of characters in the cool, dark, moist litter habitats. According to these authors, this line of argument is supported by the fact that these regressive characteristics appear frequently in many other taxa containing 'litter adapted' species, such as beetles, collembolans, and millipedes. They also suggested that this form of 'preadaptation' in litter faunas could have assisted them in the ability to colonize caves, provided that they were also behaviorally and physiologically suited to withstand the different set of selection pressures in cave environments.

The two points stressed in the argument of these authors are highly interesting. However, in the case of scorpions in general, and in that of litter/soil-humicolous species in particular, it can be observed that the majority of known species do not show any regression of the eyes or loss of pigmentation (Lourenço, 2005; Lourenço *et al.*, 2006). Eyeless scorpions inhabiting leaf litter still remain somewhat exceptional within the group. Based on the analysis of several comparative characters, Volschenk and Prendini (2008), have recently suggested that the ancestors of the two eyeless leaf litter species of *Typhlochactas* - *T. sylvestris* and *T. mitchelli* - were troglobites that had recolonised the endogean environment. In other words, they suggested the possibility of the recolonisation of endogean environments by hypogean species. Naturally, they admitted that this kind of hypothesis requires yet more rigorous testing. It appears, however, that Volschenk and Prendini (2008) did not differentiate between regressive characters that are phylogenetically useful from those that are phylogenetically meaningless, consequently neglecting the huge amount of homoplasy in the latter. It is much more parsimonious to assume that litter-preadaptation comes first. There are no strong cases that indicate that troglobites have formed a pathway of adaptation to litter habitats. If preadaptation has occurred, it must be in the sense of species moving from enclosed litter habitats into caves, which entails obvious additional adaptations, such as appendage elongation and sensory hair hypertrophy (Vandel, 1964; Culver, 1982; Chapman, 1993).

In the case of the new, eyeless, litter-dwelling *Chaerilus* species described here, nothing is known about other possibly related troglobitic species inhabiting the island of Halmahera. Only *Chaerilus sabinae* shares some common features with the new species, such as small size, absence of eyes, and a poorly pigmented body. However, the latter species, a true troglobite, is only found in the cave of Gua Atas in the hills of Matampa on the island of Sulawesi. According to Peck & Finston (1993), some eyeless soil arthropods are naturally able to cross oceanic water gaps, given sufficient time, probably by rafting. This mode of dispersal is most certainly an opportunistic one. Long-distance over-water dispersal seems to be uncommon in scorpions in general, but must be possible for litter/soil species. It seems much less likely, however, for troglobitic species.

Methods

Illustrations and measurements were produce using a Wild M5 stereo-microscope with a drawing tube (camera lucida) and an ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Hjelle (1990).

Taxonomic treatment

Chaerilidae Pocock, 1893

Chaerilus Simon, 1877

***Chaerilus telnovi* sp. n.** (Fig. 2-13)

MATERIAL: Indonesia, Prov. Maluku Utara (North Moluccas), Halmahera, Halmahera tengah (Central), Weda Selatan dist., Loleo vill. S env., Tilope vill., 10-15 km SW, between Gunung Talaga rt. and Oham, Talaga hill (0°13'56"N – 127°53'28"E), 12/IX/2007, secondary lowland forest, 50 m alt. (D. Telnov & K. Greke leg.). Female holotype, deposited in the collections of the Muséum national d'Histoire naturelle, Paris.

ETYMOLOGY: The specific name is a patronym of Dr. Dimitry Telnov, who collected the type specimen, and provided facilities for its study.

DIAGNOSIS. Species of small size compared with the other species of the genus, total length of female 13.6 mm. Carapace with the anterior margin straight, almost acarinate and smooth; furrows shallow. Median and lateral eyes absent. Metasomal carinae moderately marked; ventral carinae absent on segments I to III, vestigial on segment IV. Dentate margins of fixed and movable fingers of pedipalp chela with 6-7 rows of granules, not well delimited. Pectinal tooth count 3-3 in female. Genital operculum plates have a sub-oval shape. Trichobothriotaxy of Type B, orthobothriotaxic.

RELATIONSHIPS: In its general morphology, total absence of eyes and pale pigmentation, *Chaerilus telnovi* sp. n., is unique among the epigean and/or endogean species of the genus. Only *Chaerilus sabinae*, a troglobitic species found in the cave of Gua Atas, in the hills of Matampa in Sulawesi Island, also has eyes totally absent.

DESCRIPTION, BASED ON FEMALE HOLOTYPE.

Coloration: Basically pale yellow to reddish-yellow. Carapace reddish-yellow; anterior half and the central zone reddish. Tergites pale yellow. Metasoma: All segments pale yellow; carinae slightly darker than the tegument. Telson yellowish; aculeus yellowish at the base and reddish at the extremity. Chelicerae pale yellow; fingers with reddish teeth. Pedipalps: reddish-yellow carinae reddish; chela fingers darker than chela hand. Legs pale yellow. Venter and sternites pale yellow.

Morphology: Carapace with anterior margin straight, almost acarinate and smooth; furrows shallow. Median and lateral eyes absent. Tergites with only very minute granulation, almost smooth; carinae vestigial on tergite VII, absent from the others. Sternum pentagonal, longer than wide; genital operculum plates with a sub-oval shape. Pectinal tooth count 3-3 in female holotype. Sternites smooth with


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Fig. 1. The typical rain forest vegetation in the limestone massif where the new species was collected.

Fig. 2-3. *Chaerilus telnovi* sp. n., female holotype, dorsal and ventral aspects.

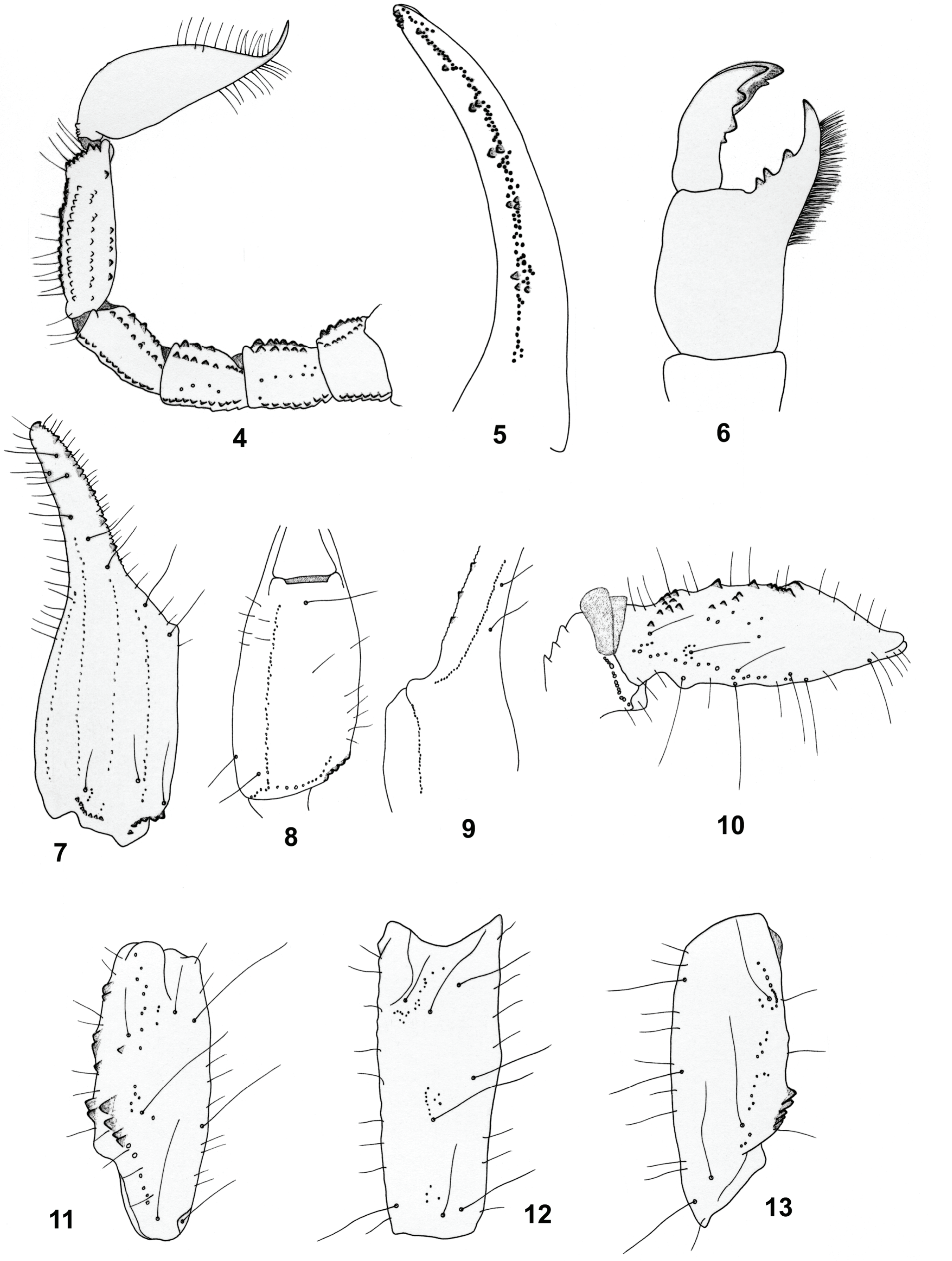

Fig. 4-13. *Chaerilus telnovi* sp. n., female holotype. **4.** Metasomal segments I to V and telson, lateral aspect. **5.** Disposition of granulations on the dentate margins of the pedipalp chela movable finger. **6.** Chelicera, dorsal aspect. **7-13.** Trichobothrial pattern. **7-9.** Chela, dorso-external, ventral and internal aspects. **10.** Femur, dorsal aspect. **11-13.** Patella, dorsal, external and ventral aspects.

spiracles small and round; carinae absent from VII. Metasoma: Segments I and II wider than long; III to V longer than wide. Carinae moderately granular; ventral carinae absent on segments I to III, vestigial on segment IV; dorsal and latero-dorsal carinae on segments I to IV with posterior spinoid granules; segment V with five carinae and spinoid granules on ventral surface. Vesicle globular and smooth with a very short aculeus. Pedipalps: Femur with five carinae; dorsal internal and dorsal external moderately granular; ventral internal weakly granular; others obsolete. Patella with five to six carinae; dorso and ventro-internal weakly granular; others smooth. Chela with seven to eight carinae, all weakly granular; ventral median carinae weak. Tegument with very few granulations, almost smooth. Fixed and movable fingers longer than manus with 6-7 rows of granules on the dentate margins, not well delimited. 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 thin setae.

Morphometric values (in mm) of the female holotype. Total length, 13.6 (without the vesicle). Carapace: length, 2.6; anterior width, 1.6; posterior width, 2.7. Metasomal segments. I: length, 0.9; width, 1.3; II: length, 1.1; width, 1.2; III: length, 1.2; width, 1.0; IV: length, 1.4; width, 1.0; V: length, 2.4; width, 1.0; depth, 0.8. Vesicle: width, 1.3; depth, 1.1. Pedipalp: femur length, 2.5, width, 1.0; patella length, 2.8, width, 1.0; chela length, 5.6, width, 1.7, depth, 1.5; movable finger length, 2.9.

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References

CHAPMAN, P. 1993. *Caves and cave life*. The New Naturalist, Harper Collins, London.

CLOUDSLEY-THOMPSON, J. L. 1967. *Microecology*. Studies in Biology n° 6. E. Arnold (Publs.), London, 49 pp.

CLOUDSLEY-THOMPSON, J. L. 1988. *Evolution and adaptation of terrestrial arthropods*. Spring-Verlag Berlin, 141 pp.

CULVER, D. 1982. *Cave life, evolution and ecology*. Harvard Univ. Press, Cambridge, Mass.

HJELLE, J. T. 1990. Anatomy and morphology. Pp. 9-63, In: Polis, G. A. (ed.). *The Biology of Scorpions*. Stanford Univ. Press, Stanford.

JERAN, J. J. 2001. Paleontology. Pp. 370-392, In: Brownell, P. & Polis, G. A. (eds), *Scorpion Biology and Research*. Oxford University Press.

LITTLE, C. 1983. *The colonisation of land. Origins and adaptations of terrestrial animals*. Cambridge Univ. Press, London, 290 pp.

LOURENÇO, W. R. 1995. *Chaerilus sabinae*, nouvelle espèce de scorpion anophthalme des grottes de Matampa en Inde (Scorpiones, Chaerilidae). *Revue Suisse de Zoologie*, **102**: 847-850.

LOURENÇO, W. R. 2005. Humicolous buthoid scorpions: a new species from Brazilian Amazon. *Comptes Rendus Biologies*, **328**: 949-954.

LOURENÇO, W. R. 2008. Description du mâle de *Chaerilus agilis* Pocock, 1899 (Scorpiones, Chaerilidae). *Boletin de la Sociedad Entomologica Aragonesa*, **42**: 139-142.

LOURENÇO, W. R. & J.-C. GALL 2004. Fossil scorpions from the Buntsandstein (Early Triassic) of France. *Comptes Rendus Palevol*, **3**: 369-378.

LOURENÇO, W. R. & S. M. GOODMAN 2008. Scorpions of the Réserve spéciale d'Ankarana, Madagascar, with particular reference to cave-dwelling animals and the description of two new species (Arachnida, Scorpiones). *Zoosystema*, **30**: 665-679.

LOURENÇO, W. R. & E. YTHIER 2008. A new species of *Chaerilus* Simon, 1877 (Scorpiones, Chaerilidae) from the Philippines. *Boletin de la Sociedad Entomologica Aragonesa*, **42**: 27-31.

LOURENÇO, W. R. & M.-S. ZHU 2008. Description of two new species of the genus *Chaerilus* Simon, 1877 (Scorpiones, Chaerilidae) from Laos and Vietnam. *Acta Zootaxonomica Sinica*, **33**: 462-474.

LOURENÇO, W. R., S. M. GOODMAN & B. L. FISHER 2006. A reappraisal of the geographical distribution of the endemic family Microcharmidae Lourenço (Scorpiones) in Madagascar and description of eight new species and subspecies. *Proceedings of the California Academy of Sciences*, 4th Ser., **57**: 751-783.

MITCHELL, R. W. & S. B. PECK 1977. *Typhlochactas sylvestris*, a new eyeless scorpion from montane forest litter in Mexico (Scorpionida, Chactidae, Typhlochactinae). *The Journal of Arachnology*, **5**: 159-168.

PECK, S. B. & T. L. FINSTON 1993. Galapagos islands troglobites: the questions of tropical troglobites, parapatric distributions with eyed-sister-species, and their origin by parapatric speciation. *Mémoires de Biospéologie*, **20**: 19-37.

SIMON, E. 1879. 3e Ordre. - Scorpiones. Pp. 79-115, In: *Les Arachnides de France. VII. Contenant les Ordres des Chernetes, Scorpiones et Opiliones.* Roret, Paris: 332 pp.

SISSOM, W. D. 1988. *Typhlochactas mitchelli*, a new species of eyeless, montane forest litter scorpion from northeastern Oaxaca, Mexico (Chactidae, Superstitioninae, Typhlochactini). *The Journal of Arachnology*, **16**: 365-371.

STAHNKE, H. L. 1970. Scorpion nomenclature and mensuration. *Entomological News*, **81**: 297-316.

VACHON, M. 1963. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les scorpions, *Bulletin du Muséum national d'Histoire naturelle*, Paris, 2e sér., **35**: 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. *Bulletin du Muséum national d'Histoire naturelle*, Paris, 3e sér., n° **140**, Zool. 104: 857-958.

VACHON, M. & W. R. LOURENÇO 1985. Scorpions cavernicoles du Sarawak (Borneo). *Chaerilus chapmani* n. sp. (Chaerilidae) et *Lychas hosei* (Pocock, 1890) (Buthidae). *Mémoires de Biospéologie*, **12**: 9-18.

VANDEL, A. 1964. *Biospéologie. La biologie des animaux cavernicoles*. Gauthier-Villars, Paris: 619p.

VOLSCHENK, E. S. & L. PRENDINI 2008. *Aops oncodactylus*, gen. et sp. nov., the first troglobitic urodacid (Urodacidae: Scorpiones), with a re-assessment of cavernicolous, troglobitic and troglomorphic scorpions. *Invertebrate Systematics*, **22**: 235-257.

ZHU, M.-S., G.-X. HAN & W. R. LOURENÇO,2008. The chaerilid scorpions of China (Scorpiones: Chaerilidae). *Zootaxa*, **1943**: 37-52.