ARACHNIDES

BULLETIN DE BIBLIOGRAPHIE ET DE RECHERCHES

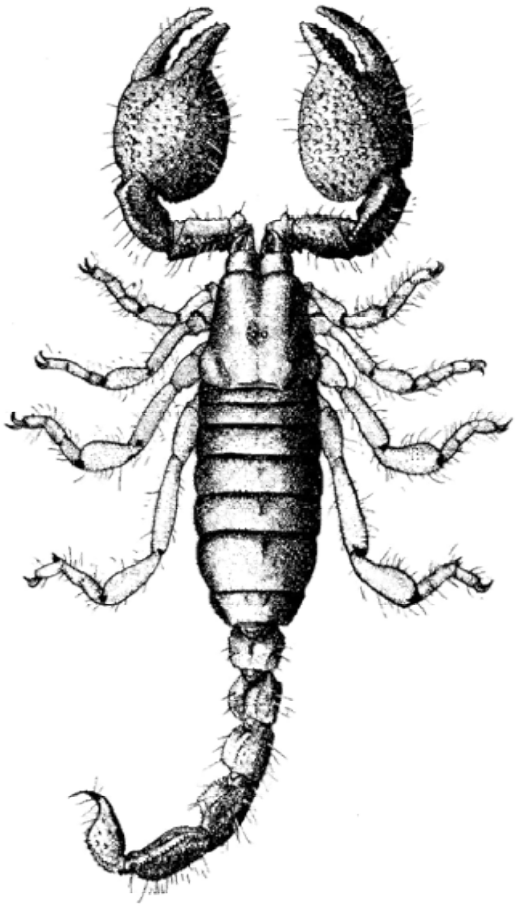

Fig. 477. — *Scorpio maurus* L., ♀ adulte des environs de Mogador ; longueur totale du corps : 7,5 cm.

113 **2024**

A NEW SPECIES OF *SCORPIO* LINNAEUS, 1758 FROM ALGERIA (SCORPIONES: SCORPIONIDAE) AND A NEW CASE OF VICARIANCE.

Eric Ythier (1), Salah Eddine Sadine (2), Yacine Bengaid (3) & Wilson R. Lourenço (4)

(1) BYG Taxa, 382 rue des Guillates, F-71570 Romanèche-Thorins, France. contact@bygtaxa.com – ZooBank: http://zoobank.org/06FD0852-A88E-49E5-B8E6-E1494B86C4E1 – Orcid: https://orcid.org/0000-0002-3194-5184

(2) Laboratoire Valorisation et Conservation des Ecosystèmes Arides (LVCEA), Faculté des Sciences de la Nature et de la Vie et Sciences de la Terre, Université de Ghardaïa, 47000 Ghardaïa, Algeria. sse.scorpion@yahoo.fr – ZooBank: http://zoobank.org/45564AC0-B7ED-4C1E-95DD-9EAB3CED9336 – Orcid: https://orcid.org/0000-0002-0026-8280

(3) Laboratoire Biologie, Eau et Environnement (LBEE), Faculté SNV-STU, Université 8 Mai 1945 Guelma, 401, 24000 Guelma, Algeria. bengaidyacine@yahoo.com

(4) 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. wilson.lourenco@mnhn.fr – ZooBank: http://zoobank.org/58448BD6-79D7-46CE-AFDD-91EFF2B7D4EF – Orcid: https://orcid.org/0000-0002-2386-363X

Abstract

A new species of *Scorpio* Linnaeus, 1758 is described from the Atakor volcanic field in the Hoggar massif, located in the South of Algeria. *Scorpio atakor* **sp. nov.** most certainly represents a vicariant element of *Scorpio tassili* Lourenço & Rossi, 2016, species equally described from a massif formation, the Tassili N'Ajjer, in the South of Algeria. Both species are distributed in high altitudes in these massifs. *Scorpio trarasensis* Bouisset & Larrouy, 1962 **stat. rev., stat. nov.** is also restored from its synonymy with *Scorpio maurus maurus* Linnaeus, 1758 and raised to species level. The number of confirmed species of *Scorpio* in Algeria is raised to six.

Keywords. Scorpion, *Scorpio*, new species, Algeria, Hoggar, Atakor, vicariance.

Résumé

Une nouvelle espèce appartenant au genre *Scorpio* Linnaeus, 1758 est décrite du plateau volcanique de l'Atakor dans le massif du Hoggar, dans le sud de l'Algérie. *Scorpio atakor* **sp. nov.** représente très probablement un vicariant géographique de *Scorpio tassili* Lourenço & Rossi, 2016, espèce également décrite d'un massif du sud de l'Algérie, le Tassili N'Ajjer. Les deux espèces sont présentes à haute altitude dans ces massifs. *Scorpio trarasensis* Bouisset & Larrouy, 1962 **stat. rev., stat. nov.** est également restaurée de sa synonymie avec *Scorpio maurus maurus* Linnaeus, 1758 et élevée au rang d'espèce. Le nombre connu d'espèces de *Scorpio* en Algérie est porté à six.

Mots clés. Scorpion, *Scorpio*, nouvelle espèce, Algérie, Hoggar, Atakor, vicariance.

Introduction

Since the initial decision taken by Lourenço (2009) to raise several forms or subspecies of *Scorpio* to the rank of species, a number of new *Scorpio* species were described: *Scorpio savanicola* Lourenço, 2009 from Cameroon, *Scorpio sudanensis* Lourenço & Cloudsley-Thompson, 2009 from Sudan, *Scorpio niger* Lourenço & Cloudsley-Thompson, 2012 from Niger, *Scorpio ennedi* Lourenço, Duhem & Cloudsley-Thompson, 2012 from Chad, *Scorpio tassili* Lourenço & Rossi, 2016 and *Scorpio atlasensis* Khammassi, Harris & Sadine, 2023 from Algeria, *Scorpio iznassen* Ythier & François, 2023, *Scorpio moulouya* Ythier & François, 2023 and *Scorpio touili* Ythier & François, 2023 from Morocco, and *Scorpio granulomanus* Al-Saraireh, Yağmur, Afifeh & Amr, 2023 from Jordan.

In their analysis about some *Scorpio* species characterized by their light coloration, namely *Scorpio punicus* Fet, 2000, *Scorpio occidentalis* Werner, 1936, *Scorpio savanicola* Lourenço, 2009 and *Scorpio niger* Lourenço & Cloudsley-Thompson, 2012, Lourenço & Cloudsley-Thompson (2012) suggested that these species were possible members of a single group which originated from a common ancestor, but presently occupy distinct regions of distribution. The range of distribution of *S. punicus* appears to be limited to the high plateaus of Tunisia and Northern Algeria (Vachon, 1952, 1958; Fig. 12), whereas the other three species are distributed much further to the South, in the Sahel region. Among the species of light coloration described more recently, two species are distributed in the high plateaus of Northern Algeria (*S. atlasensis*) and Morocco (*S. touili*) and have affinities with *S. punicus*, while two other species are described from Chad (*S. ennedi*) and Southern Algeria (*S. tassili*).

The recent discovery of a *Scorpio* specimen found in the Atakor volcanic field in the Hoggar massif, in the South of Algeria, led to a comparative study with *S. tassili* described from another close massif in Southern Algeria, the Tassili N'Ajjer, showing that the species of the Hoggar and Tassili N'Ajjer present a number of affinities, but some morphological differences can be outlined. Consequently, a new species of *Scorpio* is described at present. The populations of the two species certainly correspond to a new case of vicariance between elements inhabiting habitats previously in contact during past climatic periods, but now isolated by the expansion of aridity (Lourenço et al., 2018).

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, Habitus photographs were made with a Canon EOS 7D and Adobe Photoshop software. Map was made using Adobe Photoshop software. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Vachon (1952) and Hjelle (1990). Type material studied herein is deposited in the Muséum national d'Histoire naturelle, Paris, France.

Composition of the genus *Scorpio* in Algeria (in order of description)

- *Scorpio maurus* Linnaeus, 1758
- *Scorpio trarasensis* Bouisset & Larrouy, 1962 **stat. rev., stat. nov.**
- *Scorpio punicus* Fet, 2000
- *Scorpio tassili* Lourenço & Rossi, 2016
- *Scorpio atlasensis* Khammassi, Harris & Sadine, 2023
- *Scorpio atakor* **sp. nov.**

Taxonomic treatment

Family Scorpionidae Latreille, 1802

Genus *Scorpio* Linnaeus, 1758

Scorpio trarasensis Bouisset & Larrouy, 1962 **stat. rev., stat. nov.**
ZooBank: https://zoobank.org/NomenclaturalActs/d5033ea4-f9a5-4ecb-8349-7b9cd2b6b41c

This dark species was originally described by Bouisset & Larrouy (1962) as a subspecies of *S. maurus* Linnaeus, 1758, on the basis of 15 male and female specimens collected in the hills (400-600 ma.s.l.) around M'Sirda Fouaga, Tlemcen Wilaya, in the Tellian Atlas of North-Western Algeria, close to the border with Morocco (Fig. 12). In its original description, it was compared notably with two other dark subspecies, *S. m. maurus* distributed on the northern flanks of the Tellian Atlas in Tunisia and eastern Algeria up to Algiers (Vachon, 1952; Fig. 12) and *S. m. hesperus* Birula, 1910 described from the surroundings of Tanger in Morocco, but showed morphological differences notably in the shape of the hemispermatophore, pectine teeth and chelicera setation.

In a book (non-peer reviewed) on Scorpionidae, Kovařík (2009) placed *S. m. trarasensis* in synonymy with *S. m. maurus*, as often, without any explanation and without examining any specimen of *S. m. trarasensis*. This arbitrary decision was not considered in Khammassi *et al*. (2023), while it was questioned in Ythier & François (2023) and considered invalid in Dupré et al. (2023). On the basis of the total absence of justification for the synonymization of *S. m. trarasensis*, and the increase in the number of *Scorpio* species discovered in Northern Africa, notably in the Tellian Atlas where this subspecies was collected (*S. atlasensis*, *S. iznassen*), it appears important to revalidate *S. trarasensis* **stat. rev., stat. nov.** until material can be examined. This subspecies is revalidated at the specific level considering the now well accepted evidence that most morphological characters used for the determination of *Scorpio* populations (e.g. shape of the hemispermatophore, genital operculum, pectine teeth, etc.) are adequate for the definition of true species (Lourenço, 2009); evidence which is also supported by molecular analyses (e.g. Talal et al., 2015; Khammassi et al., 2023).

Scorpio atakor **sp. nov.** (Figs. 1-10)
ZooBank: https://zoobank.org/NomenclaturalActs/16d59dfb-1657-4671-972e-1bd1d02fe37c

Algeria, Hoggar massif, Atakor, 23°17'N, 05°43'E, between 2150-2250 m a.s.l., 28/VIII/2022 (Y. Bengaid). 1 pre-adult ♂holotype deposited in the Muséum national d'Histoire naturelle, Paris, France.

Etymology. The specific name is placed in apposition to the generic name and refers to the Atakor volcanic field in the Hoggar massif, where the new species was found.

Diagnosis. Probably moderate size for the genus; the pre-adult male has a total length of 36.14 mm. Coloration, basically light yellow to reddish-yellow with some darker pigmentation on the centre of carapace; chelicerae without variegated spots. Carapace acarinate without any granulations and smooth; four pairs of lateral eyes. Mesosoma almost smooth and lustrous, with sparse granulations on lateral sides of tergites. Genital operculum suboval, formed by two plates having a semi-triangular shape. Pectinal plate weakly divided in two parts, the posterior part slightly wider than the anterior part. Pectines with 12-12 teeth. Telson globular and strongly granulated, with spinoid granules ventrally. Pedipalps with weak to moderate carinae; chela manus with moderately marked granules on dorso-external aspect. Dentate margin on fixed and movable fingers with 6-6 series of granules divided by 5 strong accessory granules. Trichobothriotaxy of type C, orthobothriotaxic.

Fig. 1-2. *Scorpio atakor* sp. nov. male holotype. Habitus, dorsal (1) and ventral (2) aspects. Scale bar = 1 cm.

Description (based on male holotype; measurements after the description).

Coloration. Carapace reddish yellow with diffuse variegated darker spots between lateral eyes and posterior sutures; median and lateral ocular tubercles marked with dark pigments. Tergites yellowish brown; sternites yellowish. Coxapophysis and sternum yellowish; genital operculum and pectines pale yellow. Metasoma yellowish. Telson yellowish; aculeus yellowish at its base and reddish at its extremity. Chelicerae yellow without any variegated spots; fingers yellow with reddish teeth. Pedipalps: femur and patella yellowish; chela yellowish with carinae and fingers reddish yellow; dentate margins of fingers reddish. Legs pale yellow.

Morphology. Carapace acarinate without any granulations, smooth; anterior margin with a moderately pronounced concavity; posterior furrows moderately pronounced; median ocular tubercle distinct in the centre of the carapace; four pairs of lateral eyes; the first and last ones slightly reduced, the two others of equal size. Mesosoma: tergites acarinate and smooth (lustrous) with sparse granulation only on lateral sides. Sternum pentagonal, slightly higher than wide. Venter: genital operculum suboval, formed by two plates having a semi-triangular shape, convex anteriorly and posteriorly. Pectinal plate weakly divided in two parts, the posterior part slightly wider than the anterior part. Pectines longer than length of third coxa and slightly exceeding the distal end of fourth coxa; pectinal tooth count 12-12; fulcra strongly developed. Sternites smooth and shiny; VII with four well marked carinae; spiracles linear and conspicuous. Metasoma with moderately to strongly marked carinae on segments I to IV; granulation becomes spiniform on segment V; ventral and latero-ventral carinae intensely spinoid on V; all intercarinal surfaces weakly granular. Telson globular and strongly granular with four ventral carinae formed by strong spinoid granules; aculeus shorter than vesicle and moderately curved. Cheliceral dentition characteristic of the Scorpionidae (Vachon, 1963); movable finger with one subdistal tooth, and conspicuous basal teeth. Pedipalps: femur with four incomplete carinae, intercarinal surfaces smooth to weakly granulated; patella with dorsal

carina almost complete, intercarinal surfaces smooth to weakly granulated; chela with weakly marked ventral carinae; dorsal carinae moderately marked; dorsoexternal aspect of the manus moderately granular. Dentate margin on fixed and movable fingers with 6-6 series of granules divided by 5 strong accessory granules. Trichobothriotaxy of type C; orthobothriotaxic (Vachon, 1974); femur with 3 trichobothria, patella with 19, and chela with 26. Legs: tarsi of legs I to IV with 7/5, 8/5, 8/6, 8/7 internal and external spines arranged in series.

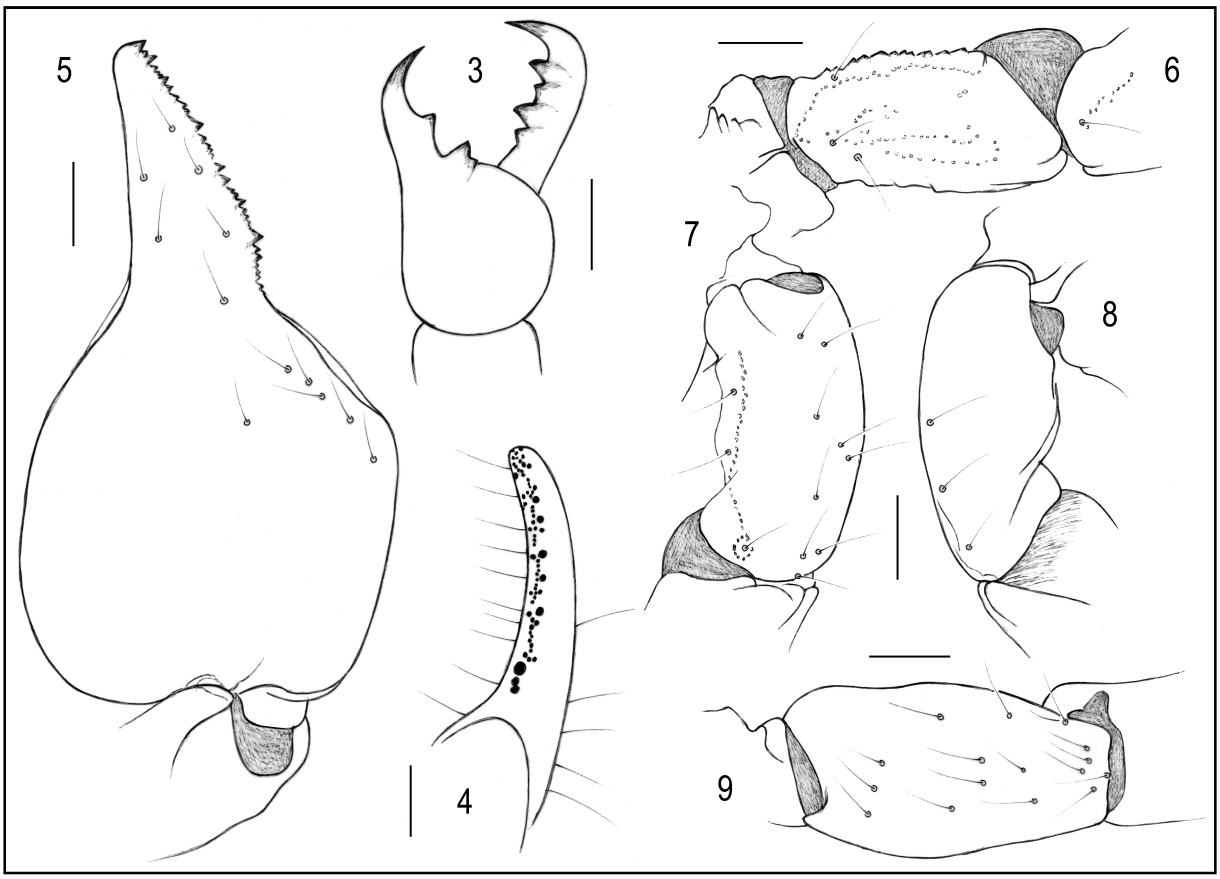

Fig. 3-9. *Scorpio atakor* **sp. nov.** male holotype. 3. Chelicera, dorsal aspect.4. Dentate margin of movable finger with rows of granules. 5-9. Trichobothrial pattern. 5. Chela dorso-external aspect. 6. Femur, dorsal aspect. 7-9. Patella, dorsal (7), ventral (8) and external (9) aspects. Scale bars = 1 mm.

Relationships. *Scorpio atakor* **sp. nov.** shows similarities with *Scorpio tassili* Lourenço & Rossi, 2016 in respect to several characters but also by a common zone of distribution in the South of Algeria. Both species can however be distinguished notably by the following main features: (i) four pairs of lateral eyes (three in *S. tassili*), (ii) dentate margin on chela fixed and movable fingers with series of granules divided by 5 strong accessory granules (3 or 4 in *S. tassili*), (iii) chela fixed finger trichobothrium **eb** more distal than in *S. tassili*, situated just distal to junction of movable finger, closer to **esb** than **Dt** (in *S. tassili*, **eb** is slightly displaced on manus, closer to **Dt** than **esb**), (iv) patella with external trichobothria $\mathbf{em_1}$ and $\mathbf{em_2}$ situated on the same level ($\mathbf{em_1}$ distal to $\mathbf{em_2}$ in *S. tassili*). More important however seems to be the disjointed pattern of geographical distribution presented by the two species, suggesting the existence of vicariant populations (Fig. 12).

Morphometric values (in mm) of the male holotype. Total length (including telson), 36.14. Carapace: length, 6.00; anterior width, 4.00; posterior width, 5.75. Mesosoma length, 12.13. Metasomal segments. I: length, 2.13; width, 2.88; II: length, 2.38; width, 2.63; III: length, 2.50; width, 2.44; IV: length, 3.00; width, 2.25; V: length, 4.00; width, 1.88; depth, 1.63. Telson length, 4.00. Vesicle: width,

1.88; depth, 1.50. Pedipalp: femur length, 3.50, width, 1.88; patella length, 3.88, width, 1.88; chela length, 8.25, width, 2.50, depth, 4.25; movable finger length, 5.38.

Biogeographic considerations

As previously discussed (e.g. Lourenço & Duhem, 2009, Ythier et al., 2021), the present composition of the Saharan fauna is the heritage of ancient faunas present in North Africa since the beginning or, at least, Middle Cenozoic times (Vachon, 1952). North African regions experienced numerous paleoclimatological vicissitudes during the last few million years, some even in more or less recent Quaternary periods. The Sahara has undergone a series of wet periods, the most recent occurring 10,000-5,000 years BP, and it was not until about 3,000 years BP that the Sahara assumed its present arid state (Cloudsley-Thompson, 1984). Even though recent studies suggest that the Sahara Desert may be much older than was previously thought (Schuster et al., 2006), it seems reasonable to postulate that extremely arid areas have always existed as patchy desert enclaves, even when the general climate of North Africa enjoyed more mesic conditions.

Fig. 10. *Scorpio atakor* **sp. nov.** male holotype, alive in its natural habitat.

In these arid and desert regions of North African Sahara, a specialized scorpion fauna would have evolved in response to the aridity. From 'ancient lineages' probably pre-adapted to arid conditions, more recent groups evolved such as genera *Androctonus* Ehrenberg, *Buthacus* Birula, *Buthiscus* Birula, *Leiurus* Ehrenberg and possibly even some particular species of *Buthus* (Sadine et al., 2016); some of these extant elements are in fact typically psammophilic. Most certainly, several of these lineages were already present in North Africa for at least 10 to 15 MY (Gantenbein & Largiadèr, 2003; Lourenço & Vachon, 2004). In contrast, other lineages less well adapted to aridity and, previously, only present in more mesic environments, have regressed markedly in their distribution with the expansion of the desert. Consequently, some elements probably have, in some cases experienced negative selection and have even vanished since. In other cases, populations have been reduced to very limited and patchy zones of distribution, sometimes with important disjunctions in their patterns of distribution (Vachon, 1952).

Fig. 11. Natural habitat of *Scorpio atakor* **sp. nov.** in the Atakor volcanic field, Hoggar massif, Southern Algeria.

The patterns of distribution of North African scorpions observed today can be summarised as follows: a core Saharan region, which was described by Vachon (1952) as the 'central compartment', in which only the groups best adapted to xeric conditions are distributed. The Peri-Saharian zone, surrounding most of the central compartment, in which some remarkable disjunctions occur, e.g. the genus *Microbuthus* Kraepelin, with species in Mauritania and Morocco in the West and other species in Eritrea, Djibouti and Egypt in the East (Lourenço, 2002; Lourenço & Duhem, 2007). Finally, as indicated by Vachon (1952), several groups (sometimes less well adapted to xeric environments) have their populations limited to refugia. These refugia are in particular represented by the Saharan massifs, such as Hoggar and Tassili N'Ajjer in Algeria, but also several other elevated regions in Mauritania, Niger, Chad and Libya. Some examples are provided by endemic genera, such as *Cicileus* Vachon, *Egyptobuthus* Lourenço and *Pseudolissothus* Lourenço (Vachon, 1952; Lourenço, 1999a,b, 2001). The new *Scorpio* species described here, as well as *Scorpio tassili*, probably correspond to this type of endemic and relictual pattern of distribution (Fig. 12).

The dating of the last events preceding the global isolation of the Hoggar and Tassili N'Ajjer populations can be somewhat difficult establish. Nevertheless, according to Swezey (2009), the appearance of persistent and widespread eolian sediments in the Sahara is coincident with the onset of major glaciation in the northern hemisphere at approximately 2.5 million years ago, and then the Sahara has oscillated between arid and semi-arid/temperate conditions since then (with the semi-arid/temperate conditions occurring during interglacial maxima). The most recent semi-arid/temperate interval occurred approximately 11,000-5,000 years ago (Swezey, 2001; Bristow & Armitage, 2016). The onset of glaciation in the northern hemisphere is certainly a major climate perturbation for the planet, and it is always reasonable to explain the onset of aridification in the Sahara as being part of this major climate perturbation.

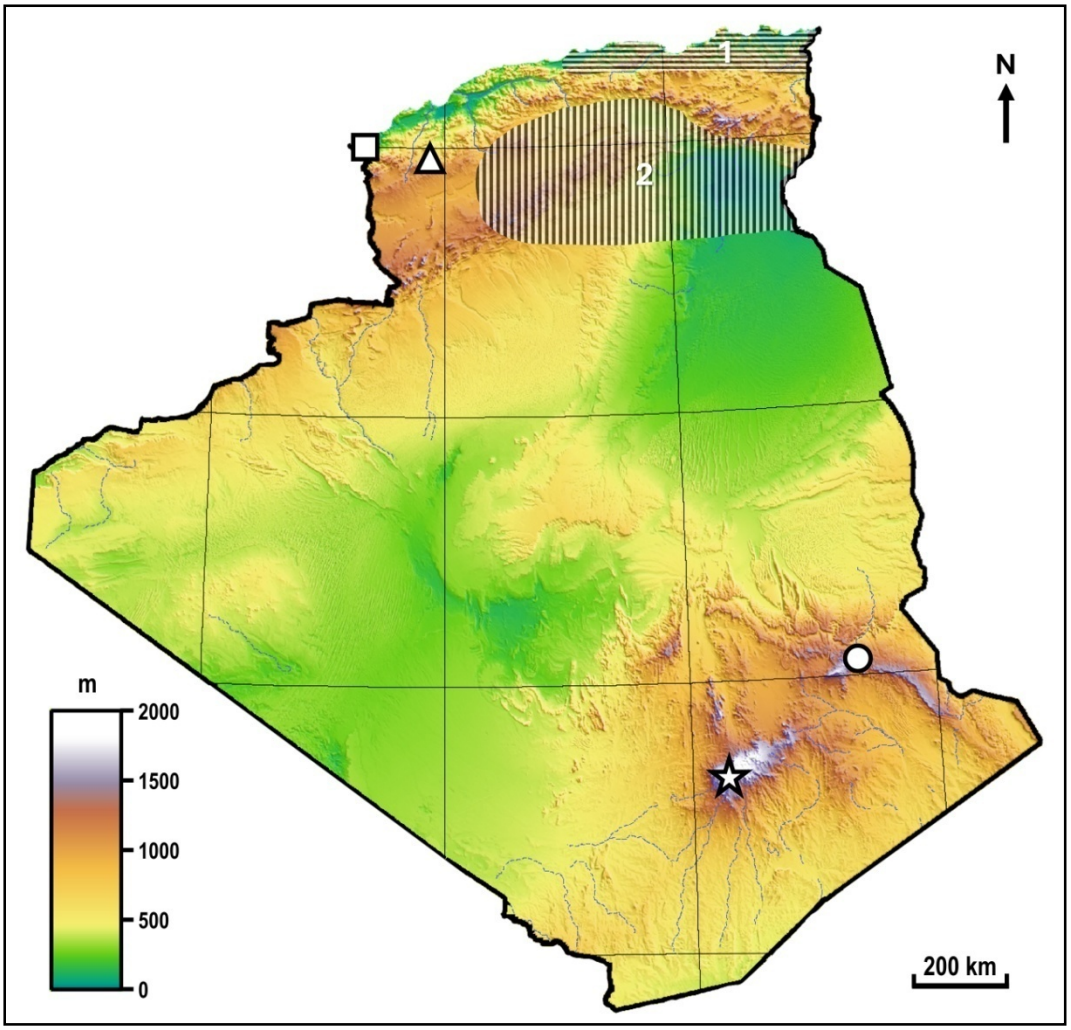

Fig. 12. Map of Algeria, showing the distribution of the genus *Scorpio*: *S. maurus maurus* (dashed area 1), *S. trarasensis* **stat. rev., stat. nov.** (square), *S. punicus* (dashed area 2), *S. atlasensis* (triangle), *S. tassili* (circle) and *S. atakor* **sp. nov.** (star).

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ARACHNIDES N°113. 2024

SOMMAIRE

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