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Reanalysis of the genus *Scorpio* Linnaeus 1758 in sub-Saharan Africa and description of one new species from Cameroon (Scorpiones, Scorpionidae)

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(with 32 figures)

Abstract

For almost a century, *Scorpio maurus* L., 1758 (Scorpiones, Scorpionidae) has been considered to be no more than a widespread and presumably highly polymorphic species. Past classifications by Birula and Vachon have restricted the status of different populations to subspecific level. In the present paper, and in the light of new evidence, several African populations are now raised to the rank of species. One of these, *Scorpio occidentalis* Werner, 1936, is redescribed and a neotype proposed to stabilise the taxonomy of the group. A new species is also described from the savannah areas of Cameroon. This is the second to be recorded from regions outside the Sahara desert zone.

K e y w o r d s: Scorpiones, Scorpionidae, *Scorpio*, new rank, new species, Africa, Cameroon.

Introduction

The genus *Scorpio* was created by Linnaeus in 1758 (in part), and has *Scorpio maurus* Linnaeus, 1758 as its type species, defined by subsequent designation (Karsch 1879; see also Fet 2000). For several decades, only one widespread and presumably highly polymorphic species was currently recognized: *Scorpio maurus* L., 1758.

In fact, until the end of the 19th century, the presence of more than a single species was accepted by several authors including Simon (1872), Kraepelin (1899) and Pocock (1900). The taxonomic situation of the group remained, however, very confused with some species being placed in different genera such as *Heterometrus* Ehrenberg, 1828 (e.g. Simon 1872, Pocock 1900, Pallary 1928).

Birula (1910) was the first author to publish a detailed revision of the 'forms' associated with *Scorpio maurus*, which he interpreted as subspecies. He arranged these forms in two groups, the 'sectio *maurus*' and the 'sectio *propinquus*' (for details on the composition of these 'sectios' refer to the Catalog of the Scorpions of the World (Fet 2000).

Vachon (1950) - and subsequently (1952) - revised the North African forms of *S. maurus* and confirmed the separation and status of several

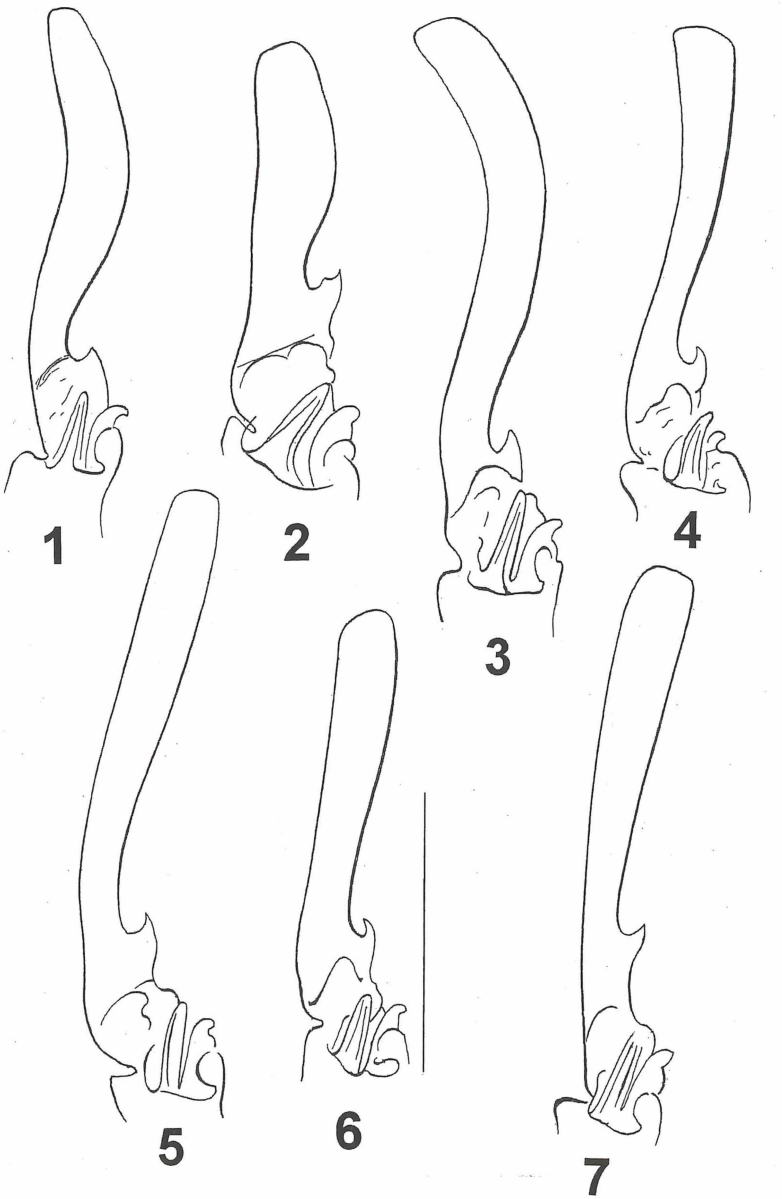
subspecies. Previously Vachon (1940) had shown some criticism of the 'subspecific pulverisation' adopted by Birula (1910) in respect to the species of other genera, such as *Compsobuthus* Vachon, 1949 and *Mesobuthus* Vachon, 1950 (previously placed in the genus *Buthus* Leach, 1815). Nevertheless, he preferred to maintain Birula's subspecific classification in what concerned African forms of *Scorpio*. The most strange aspect about Vachon's conservative position is the fact that in his monograph on North African scorpions (Vachon 1952) he supplied the necessary characters and justifications to raise most, if not all, the subspecific identities to the rank of species.

After this major monograph by Vachon (1952), some more isolated contributions referred to the forms of *Scorpio*, but always as subspecies (e.g. Vachon 1979, Levy & Amitai 1980, Sissom 1994, Hendrixson 2006). More recently (in Cloudsley-Thompson & Lourenço 1994), I suggested that the globality of *Scorpio maurus* populations may represent a very large polymorphic species complex. Again (Lourenço 2003), this matter came up for discussion and I suggested that more detailed studies of the different forms – including the use of molecular techniques – should attest to the fact that several populations, at present recognized only as subspecies, are in fact true species.

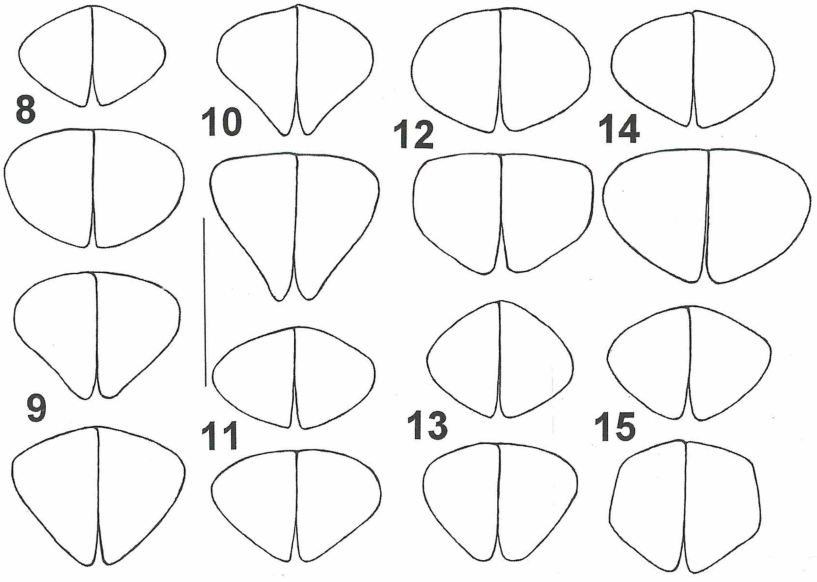
In the Catalog of the Scorpions of the World (Fet 2000) 19 subspecies of *S. maurus* are listed. Twelve of these are correctly stated to be distributed in Africa. At the beginning of the present study I attempted to use Vachon's (1952) monograph to identify some new material from sub-Saharan Africa. My analysis led me to the subspecies *Scorpio maurus occidentalis* Werner, 1936, described from Senegal. I then realized that most of the characters proposed by Vachon (1952), namely the shape of the genital operculum, the structure of the hemispermatophore and also global size, pectinal tooth count and even coloration patterns were adequate for the precise definition of true species.

In view of this preliminary conclusion, I decided to raise all eight forms previously studied by Vachon (1952) to the rank of species, although I accept that subsequent adjustments may be necessary. This decision to rupture the present 'status quo' of the composition of the genus *Scorpio* is similar to my previous decision concerning the genus *Buthus* Leach (Lourenço 2003), in particular with the complex of species including in *Buthus occitanus* (Amoreux, 1789). It seems clear that once a 'drastic' decision has been taken, it is usually followed by subsequent authors.

One species in particular, *Scorpio occidentalis* Werner, 1936, originally described from Senegal, is unique in that it inhabits a non-desert environment. Since this species remains extremely poorly characterized, and in view of the fact that the type specimen formerly deposited in Zoologischen Museum Hamburg was destroyed in 1943 during the World War II (Dr. H. Dastych, *in litt.*), I decided to describe and designate one specimen as neotype, in order to give a complete account of, and stabilise, the characters of the species. This decision is caused by a real taxonomic necessity. Furthermore, a new species from Cameroon associated with *S. occidentalis*, is described here. This is the second *Scorpio* species to be reported from beyond the Saharan region.



Figs 1-7. Hemispermatophores, external aspect: **1**. *Scorpio maurus*; **2**. *S. hesperus*; **3**. *S. birulai*; **4**. *S. punicus*; **5**. *S. mogadorensis*; **6**. *S. fuliginosus*. **7**. *S. weidholzi* (modified after Vachon, 1952). (Scale bar = 3 mm).



Figs 8-15. Genital operculum, male and female: **8**. *Scorpio maurus*; **9**. *S. birulai*; **10**. *S. hesperus*; **11**. *S. punicus*; **12**. *S. mogadorensis*; **13**. *S. weidholzi*; **14**. *S. fuliginosus*; **15**. *S. occidentalis* (modified after Vachon, 1952). (Scale bar = 3 mm).

Methods

Illustrations and measurements were made with the aid of a Wild M5 stereomicroscope 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 Vachon (1952) and Hjelle (1990).

Abbrevations:
MHNG - Muséum d'Histoire naturelle, Geneva;
MNHN - Muséum national d'Histoire naturelle, Paris;
ZMH - Zoologisches Museum Hamburg.

Taxonomic account

Family Scorpionidae Latreille, 1802

Genus *Scorpio* Linnaeus, 1758

Note: For details of the morphological characteristics of the following listed species, the reader should refer to Vachon (1952). [See also Fet (2000) for nomenclatural aspects].

Scorpio maurus Linnaeus, 1758
(Figs 1, 8)

Scorpio maurus Linnaeus, 1758

Original type lost. Most certainly from North Africa. A neotype was described by Fet et al. (2002) from Tunisia and is now deposited in the collections of the Muséum national d'Histoire naturelle, Paris (MNHN-RS-1236).

DISTRIBUTION. Africa. Algeria, Morocco (?), Tunisia.

Scorpio birulai Fet, 1997. **New rank**
(Figs 4, 9)

Scorpio maurus subtypicus Birula, 1910

DISTRIBUTION. Morocco.
Note: See Fet (2000) for nomenclatural changes.

Scorpio fuliginosus (Pallary, 1928). **New rank**
(Figs 6, 14)

Heterometrus fuliginosus Pallary, 1928

DISTRIBUTION. Morocco.

Scorpio hesperus Birula, 1910. **New rank**
(Figs 2, 10)

Scorpio maurus hesperus Birula, 1910

DISTRIBUTION. Morocco.

Scorpio mogadorensis Birula, 1910. **New rank**
(Figs 5, 12)

Scorpio maurus magadorensis Birula, 1910 *

DISTRIBUTION. Morocco.

Note: * incorrect original spelling: see Fet 2000.

Scorpio punicus Fet, 2000. **New rank**
(Figs 4, 11)

Scorpio maurus tunetanus Birula, 1910

DISTRIBUTION. Algeria, Libya, Morocco, Tunisia.

Note: See Fet (2000) for nomenclatural changes.

Scorpio weidholzi Werner, 1929. **New rank**
(Figs 7, 13)

Scorpio maurus weidholzi Werner, 1929

DISTRIBUTION. Morocco.

Scorpio occidentalis Werner, 1936. **New rank**
(Figs 15-20)

Scorpio maurus occidentalis Werner, 1936

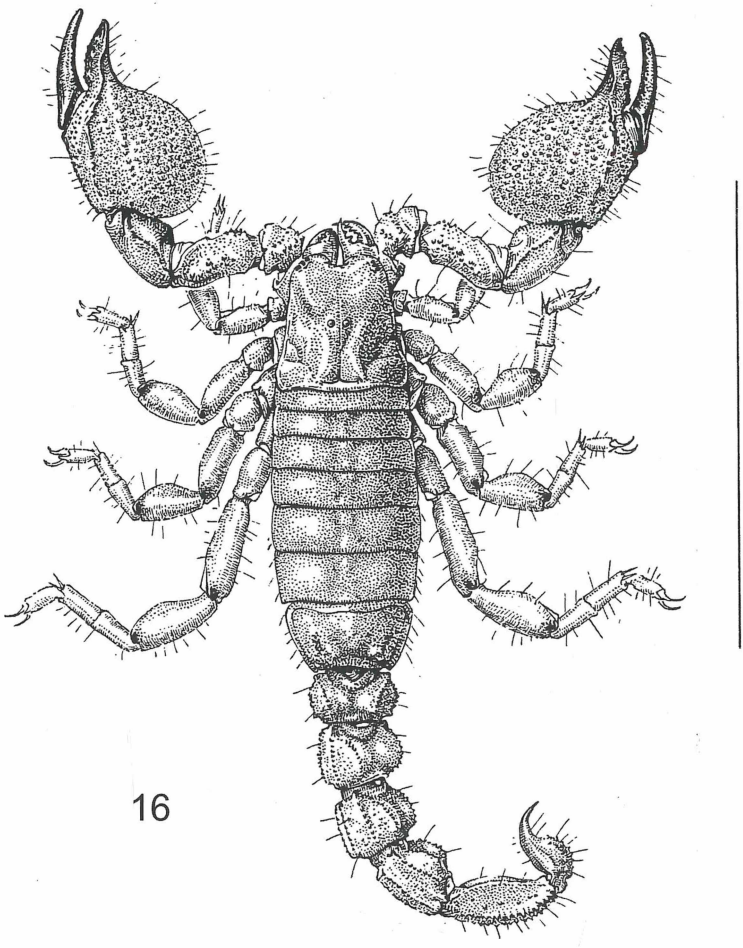


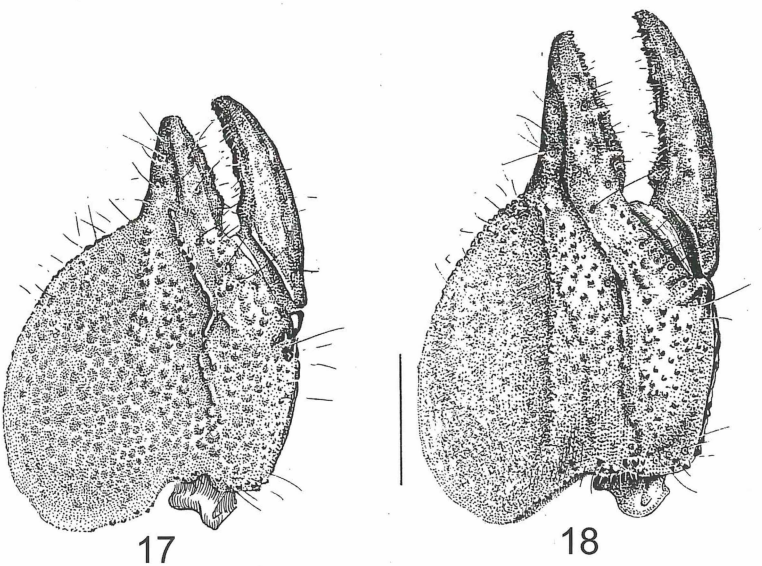
Fig. 16. *Scorpio occidentalis* Werner: habitus, female from Mauritania. (Scale bar = 30 mm).

TYPE MATERIAL. H o l o t y p e, a male formerly in ZMH, was destroyed in 1943.

TYPE LOCALITY. The desert North from Upper Gambia (river), Senegal.

MATERIAL EXAMINED. Senegal, Parc national du Niokolo-Kola, November 1979, coll. P. M. Brignoli: male, here desinated as n e o t y p e. Deposited in the Zoologisches Museum, Hamburg (ZMH Acc. No. A8/09).

OTHER MATERIAL EXAMINED. Senegal, Fété-Olé, Ferlo, ♂, 24 July 1971 (G. Gillon), MNHN-RS-6282. No exact locality data, no date, no collector named: 3♂, MNHN-RS-



Figs 17-18. *Scorpio occidentalis*. Male and female chela, dorso-external aspect (from Vachon 1952, 1953). (Scale bar = 4 mm).

1227. Mali, Toukoto (13°27'N - 9°53'W), near River Bakoye, Oktober 1979, coll. P.M. Brignoli : 4♂.

Note: This material, previously listed by Lourenço (2003) as *Scorpio maurus* from Toukoto, Riv. Bakey in Sudan, actually referred to "French Soudan", today Mali. MHNG.

DIAGNOSIS. Scorpions of small to moderate size, with respect to the genus. Males reaching 47 (52) mm in total length. Coloration, basically yellowish to reddish-yellow with legs, chelicerae and telson paler than the body. Pedipalps, especially the chela, strongly enlarged with very short fingers. Chela manus with strongly marked granules especially on the dorso-external aspect. Telson markedly elongated; ratio between telson length x vesicle width = 2.52 (see Table 1). Pectines with 12 to 15 teeth. Trichobothriotaxy of type *C*, orthobothriotaxic. Genital operculum with semi-triangular plates. Hemispermatophore: distal lamella elongated but weakly curved.

DESCRIPTION based on male neotype (measurements in Table 1).

C o l o r a t i o n. Body basically yellowish to reddish-yellow. P r o s o m a. Carapace reddish-yellow with some darker zones in the median zone; some blackness near the eyes. M e s o s o m a. Tergites reddish-yellow, with a vestigial median longitudinal dark stripe; sternites III-VII yellowish.

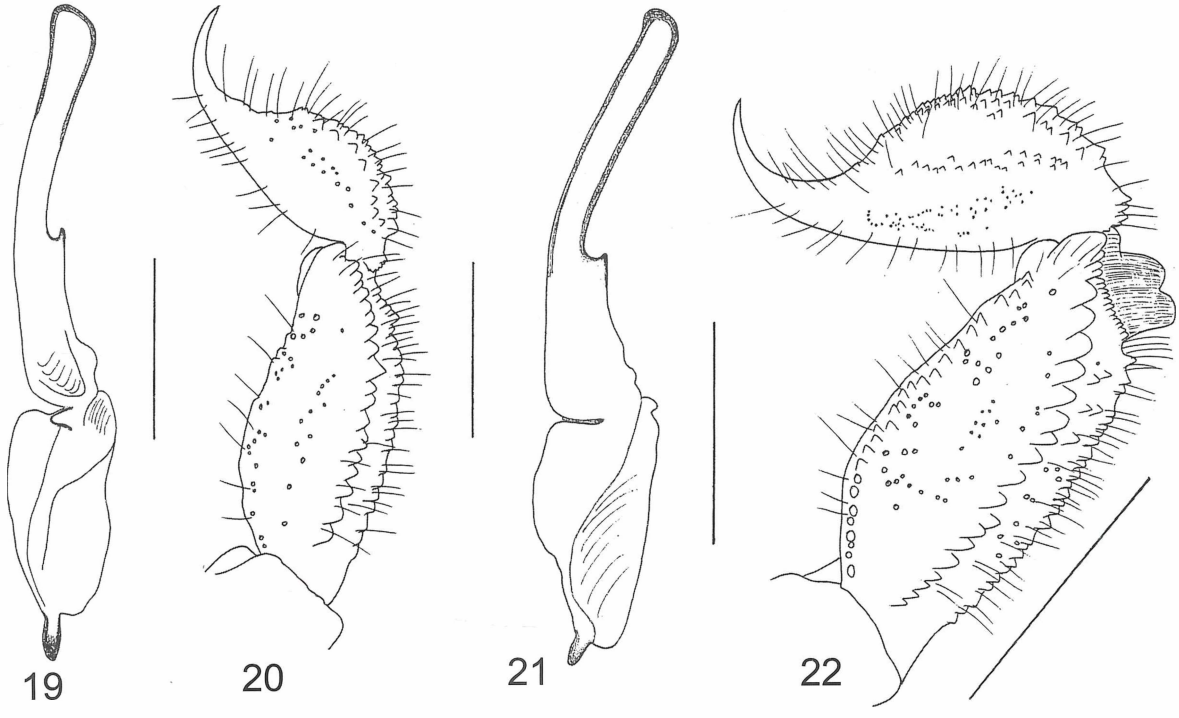
Table 1. Morphometric values (in mm) of the ♂ neotype of *Scorpio occidentalis*, Werner and the ♂ holotype and ♀ paratype of *Scorpio savanicola* **sp. n**.

	S. occidentalis Werner	***S. savanicola* sp. n.**	
	♂ neotype	♂ holotype	♀ paratype
Total length	47.1(52.9*)	42.4(47.2*)	51.1(56.5*)
Carapace:			
- length	8.7	7.5	8.7
- anterior width	5.7	5.2	6.0
- posterior width	9.0	8.0	9.2
Mesosoma length	15.1	15.0	21.7
Metasomal segment I:			
- length	3.3	2.8	2.9
- width	5.0	4.5	4.7
Metasomal segment V:			
- length	6.4	5.5	5.8
- width	3.3	2.9	3.0
- depth	2.7	2.4	2.8
Telson:			
- length	5.8	4.8	5.4
- width	2.3	2.5	2.7
- depth	2.2	2.3	2.3
Pedipalp:			
- femur length	4.9	4.4	4.8
- femur width	2.8	2.6	2.9
- patella length	6.3	5.8	5.9
- patella width	3.3	2.7	3.0
- chela length	12.8	10.7	12.4
- chela width	4.4	3.9	4.6
- chela depth	8.0	7.2	7.6
movable finger length	6.3	5.6	7.0

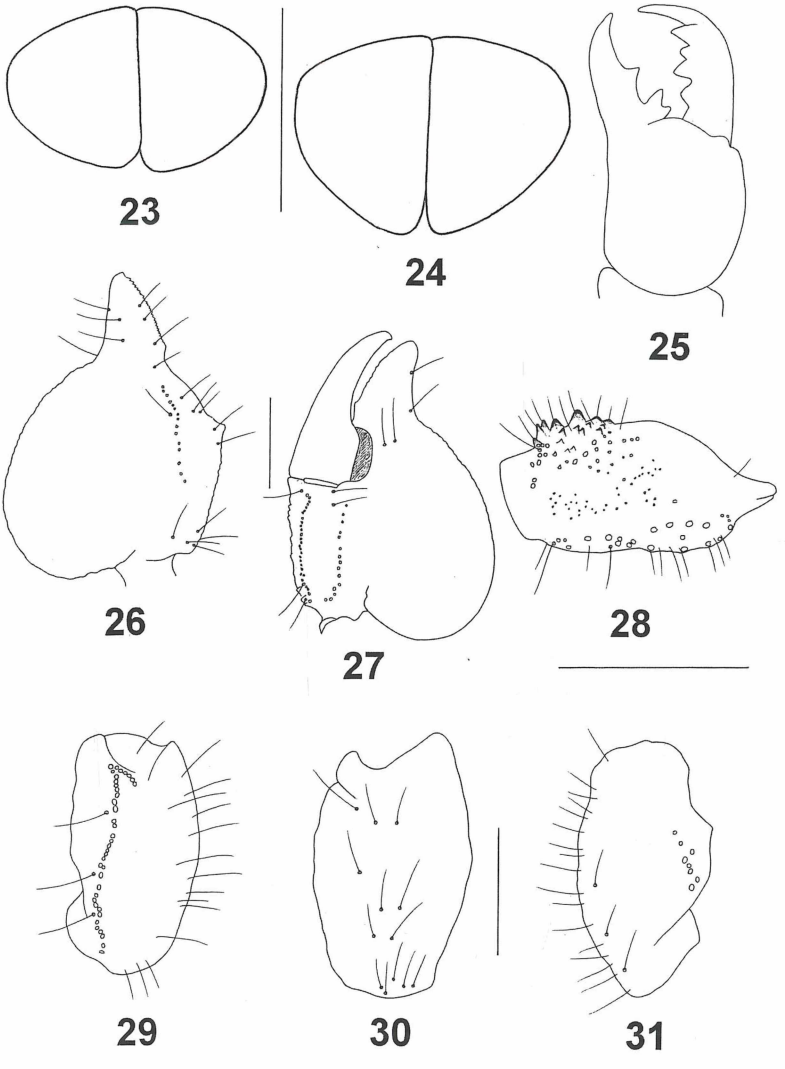
* including telson length.

Coxapophysis and sternum yellowish; genital operculum and pectines pale yellow. M e t a s o m a. All segments reddish-yellow, with some dark pigment over carinae. Telson yellowish; aculeus reddish at the base and blackish at the extremity. C h e l i c e r a e yellowish without any variegated spots; fingers reddish with dark teeth. P e d i p a l p s: Femur yellowish; patella and chela reddish with the presence of blackish pigment over the chela fingers. Legs yellowish.

MORPHOLOGY. P r o s o m a. Carapace acarinate with thin granulation on anterior margin and median zone; anterior margin with a strongly pronounced concavity; posterior furrows moderately to strongly pronounced; median ocular tubercle distinct in the centre of the carapace; three pairs lateral eyes; the third eye smaller than the other two. M e s o s o m a: Tergites almost acarinate and smooth with some sparse, thin granulation on tergites IV to VII. Sternum pentagonal, wider than high. Venter: Genital operculum formed by two plates having a semi-triangular shape. Pectines: Pectinal tooth count 15-14; fulcra strongly developed. Sternites



Figs 19-22. Hemispermatophore, external aspect and metasomal segment V and telson, lateral aspect: **19-20**. *Scorpio occidentalis* Werner, male neotype from Senegal; **21-22**. *S. savanicola* sp. n., male holotype. (Scale bars = 3 mm).



Figs 23-31. *Scorpio savanicola* sp. n., 23, 25-31. male holotype, 24. female paratype; **23-24**. genital operculum; **25**. chelicera, dorsal aspect; **26-31**. trichobothrial pattern; **26-27**. chela, dorso-external and ventral internal aspects; **28**. femur, dorsal aspect; **29-31**. patella, dorsal, external and ventral aspects. (Scale bars: 23-25 = 2 mm; 26-31 = 3 mm).

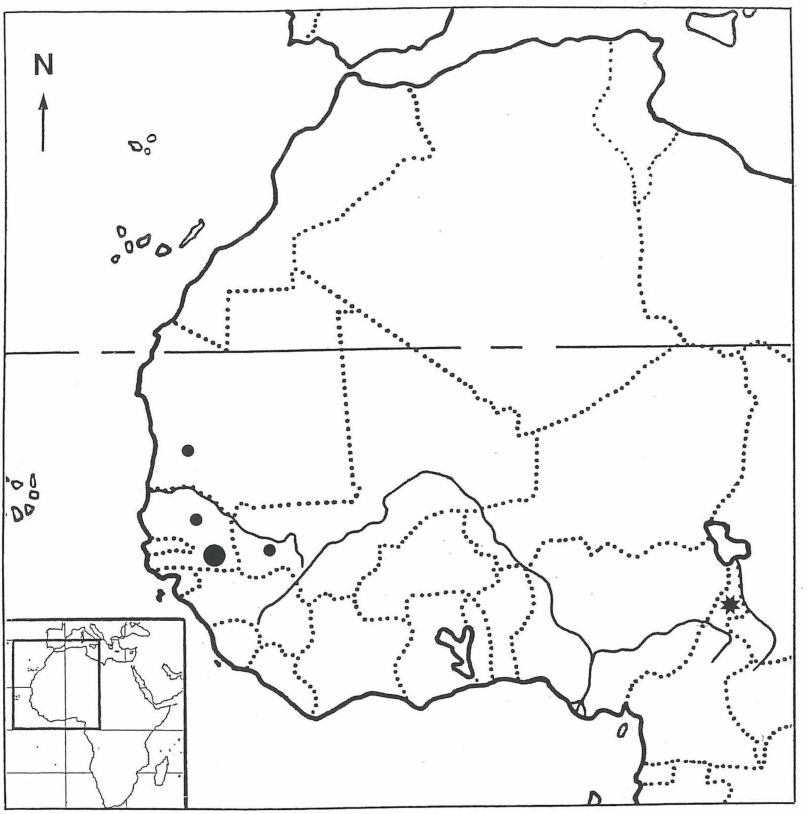


Fig. 32. Records of *Scorpio occidentalis* Werner (black circles: the bigger one indicates the locality of the neotype) and the type locality of *S. savanicola* sp. n. (black star).

smooth and shiny; VII with four strongly marked carinae; spiracles linear and conspicuous. M e t a s o m a with strongly marked carinae on segments I to IV; granulation becoming strongly spiniform on segment V; ventral and latero-ventral carinae intensely spinoid on V; all intercarinal surfaces weakly granular. Telson markedly elongated with two lateral and four ventral carinae formed by spinoid granules; aculeus slightly shorter than vesicle and moderately curved. C h e l i c e r a l dentition characteristic of the Scorpionidae (Vachon 1963); movable finger with one subdistal tooth and conspicuous basal teeth. Pedipalps with moderate to strong granulation; femur with three carinae, almost complete; patella with a dorsal carina complete; chela with vestigial carinae; dorso-external aspect of the manus moderately granular. Dentate margin on fixed and movable fingers with a series of granules divided by four and five strong accessory granules. Trichobothriotaxy of type *C*; orthobothriotaxic (Vachon 1974); femur with 3 trichobothria, patella with 19, and chela with 26. L e g s. Tarsi of legs I to

IV with 6-4/6-5/7-6/7-6 internal and external spines arranged in series. Hemispermatophore. Distal lamella elongated but weakly curved.

DISTRIBUTION. Senegal, Mauritania, Mali.

Scorpio savanicola sp. n.
(Figs 21-31)

TYPE MATERIAL. Holotype ♂; paratypes: ♂ and 3♀. Cameroon, South of Garoua (savannah formation), October 1981, coll. P. M. Brignoli. Holotype (ZMH Acc.No. A9/09) and 2 female paratypes (Acc.No. A10/09) deposited in the Zoologisches Museum, Hamburg; male and female paratype in the Museum national d'Histoire naturelle, Paris.

ETYMOLOGY. The specific name refers to the savannah formations where the new species was collected.

DIAGNOSIS. Scorpions of small size with respect to the genus. Males reaching 42 (47) and females 51 (56) mm in total length. Coloration, basically reddish-yellow to reddish-brown with legs, chelicerae and telson paler than the body. Pedipalps, especially the chela, strongly enlarged, with very short fingers in males. Chela manus with strongly marked granules on dorso-external aspect. Telson bulked and short; ratio between telson length x vesicle width = 1.92 (see Table 1). Pectines with 9-11 teeth in females and 12-14 in males. Trichobothriotaxy of type *C*, orthobothriotaxic. Genital operculum with semi-oval plates. Hemispermatophore: distal lamella elongated, narrow and moderately to strongly curved.

DESCRIPTION. Based on male holotype and female paratype (measurements in Table 1).

Coloration. Body basically reddish-yellow to reddish-brown. Prosoma: Carapace reddish-brown with some blackness near the eyes. Mesosoma. Tergites reddish-brown, darker than carapace, with a median longitudinal brownish stripe; sternites reddish-brown on male, brownish on female; sternite VII darker than the others. Coxapophysis and sternum reddish-yellow on male, reddish-brown on female; genital operculum and pectines yellowish. Metasoma: all segments reddish-yellow to reddish-brown, with some dark pigment over carinae. Telson reddish-yellow; aculeus reddish at the base and blackish at the extremity. Chelicerae reddish-yellow with some variegated brownish spots on the base of fingers; fingers reddish with dark teeth. Pedipalps: femur, patella and chela reddish with the presence of blackish pigment over the chela fingers. Legs yellowish.

MORPHOLOGY. Prosoma. Carapace lustrous and acarinate on female; male with some thin granulations on median zone; anterior margin with a strongly pronounced concavity; carinae absent; posterior furrows moderately to strongly pronounced; median ocular tubercle distinct in the

centre of the carapace; three pairs of lateral eyes; third eye smaller than the other two. Mesosoma. Tergites almost acarinate and smooth (lustrous) with some sparse, thin granulation on male. Sternum pentagonal, wider than high. Venter: genital operculum formed by two plates with a semi-oval shape. Pectines: pectinal tooth count 14-13 on male holotype and 10-9 on female paratype; fulcra strongly developed. Sternites smooth and shiny, with two longitudinal parallel furrows on III to VI; VII with four strong carinae; spiracles linear and conspicuous. Metasoma with strongly marked carinae on segments I to IV; granulation becomes strongly spiniform on segment V; ventral and latero-ventral carinae intensely spinoid on V; all intercarinal surfaces strongly granular. Telson short and bulky with two lateral and four ventral carinae formed by spinoid granules; aculeus shorter than vesicle and strongly curved. Cheliceral dentition characteristic of the Scorpionidae (Vachon 1963), movable finger with one subdistal tooth, and conspicuous basal teeth. Pedipalps with moderate to strong granulation; femur with four carinae, almost complete; patella with dorsal carina complete; chela with weakly marked carinae; dorso-external aspect of the manus strongly granular. Dentate margin on fixed and movable fingers with a series of granules divided by 4 or 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 6-4(6-4)/6-5(6-5)/7-5(8-5)/7-6(7-5) internal and external spines arranged in series. Hemispermatophore. Distal lamella narrowed and moderately to strongly curved.

REMARKS. *Scorpio savanicola* sp. n., can be distinguished from other *Scorpio* species, and in particular from *S. occidentalis*, the most geographically related species of the genus, by the following features: (i) a darker coloration overall, more to reddish-brown, (ii) pedipalp chela more strongly granulated, (iii) telson short and bulky; see ratios between length x width in diagnosis, (iv) genital operculum plates semi-oval, (v) distal lamella of hemispermatophore narrow and more curved.

Acknowledgements

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