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## Further considerations on the identity and distribution of *Pandinus imperator* (C. L. Koch, 1841) and description of a new species from Cameroon (Scorpiones: Scorpionidae)

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(with 19 figures)

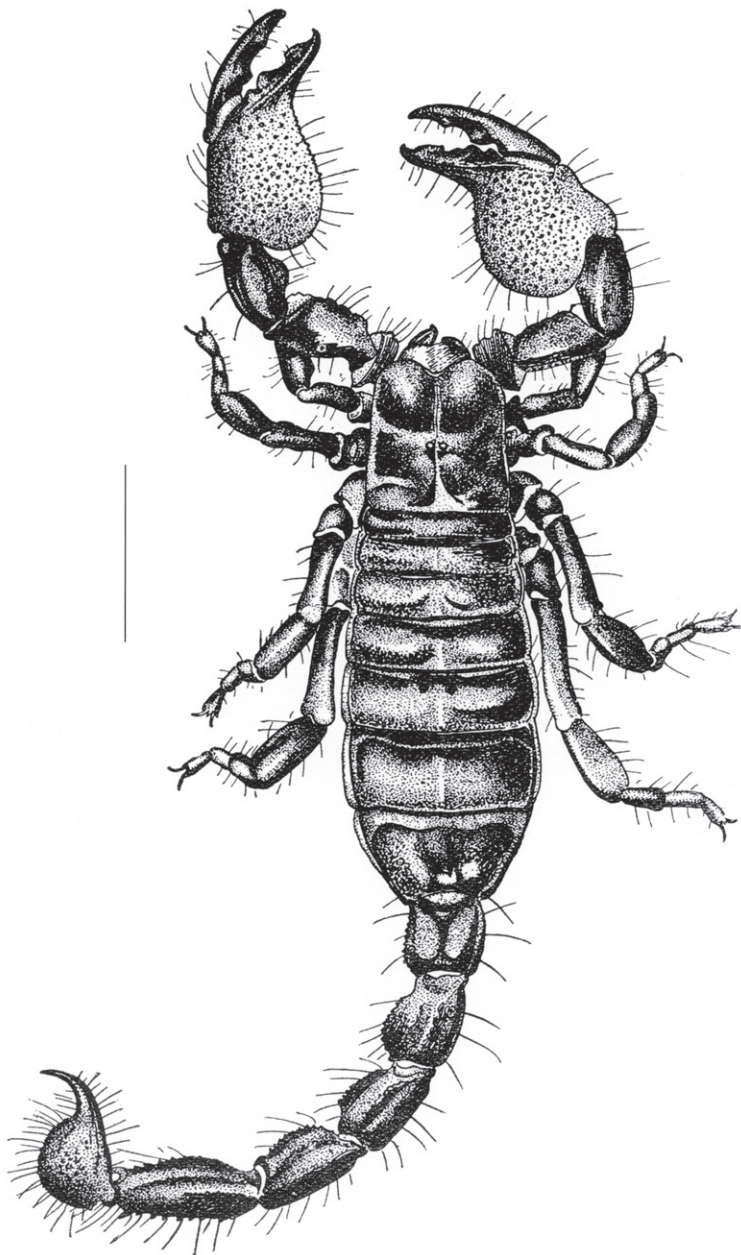
### Abstract

Among the 'giant species' of scorpions which belong to the genus *Pandinus* Thorell, 1876, three are protected by the Washington Convention. These are *Pandinus imperator* (Koch, 1841), *Pandinus dictator* (Pocock, 1888) and *Pandinus gambiensis* Pocock, 1899. In theory, these species can be easily recognised by scorpion experts and even non-experts. However, at least one, *P. imperator*, remains dubious and unclearly characterized. Herein, the argument pleading for the status of *P. imperator* is discussed. It is hypothesized that across the known distribution of *P. imperator* at least three or four distinct populations may be recognized. *Pandinus roeseli* (Simon, 1872) is reestablished as a valid species and a new species, *Pandinus camerounensis* sp. n. is described from the North of Cameroon.

**Key words:** Scorpiones, *Pandinus*, new status, new species, Occidental Africa, Cameroon.

### Introduction

'Giant species' of scorpions which belong to the genus *Pandinus* Thorell, 1876 are well known among scorpion experts. However, it is also well known among amateurs through commercial trade. For this reason, during the 9th



**Fig. 1.** *Pandinus imperator* (Koch), female from Guinea (according to Vachon 1956). In fact, *Pandinus roeseli* (Simon), according to this study (scale bar = 30 mm).

Conference of the Commission of the Washington Convention which took place from 7 to 18 November 1994 at Fort Lauderdale, Florida, USA, a proposal emanated from Ghana was tabled in order to protect three species of the genus *Pandinus*. The proposal was accepted and the application took effect on 16 February 1995. Three species of the family Scorpionidae (*P. imperator*, *P. dictator* and *P. gambiensis*) were inserted in the Annexe II of the Convention. The proposed reason for the protection of these 'Giant species' came from the fact that they have been the object of commercial transactions in several European countries as well as in the USA.

The currently protected species of *Pandinus* live in tropical regions of Africa and are among the largest scorpions known. Some specimens can reach up to 18-20 cm in total length. On account of their large size, they attract the attention of collectors, who are always ready to buy living specimens which they can maintain in terraria. Because of the intense traffic of scorpions, the decision to include the three *Pandinus* spp. in Annexe II appeared necessary in order to protect their populations.

Following this decision of protection, one problem arose. How can the people responsible for controlling the traffic of these animals be able to correctly identify the protected species on the list, if they are not scorpion experts? Attempting to bring some assistance to these people, Lourenço & Cloudsley-Thompson (1996) produced a short note about the subject which could be used as a simple guide by non-experts. The characters used to define the protected *Pandinus* species were mainly based on the previous works by Vachon (1952, 1967, 1974). Subsequent studies, however (Lourenço & Cloudsley-Thompson 1999, Lourenço: unpublished) attested to the fact that the classical diagnosis presently used for these species are not totally satisfactory, in particular for *P. imperator*.

## Methods

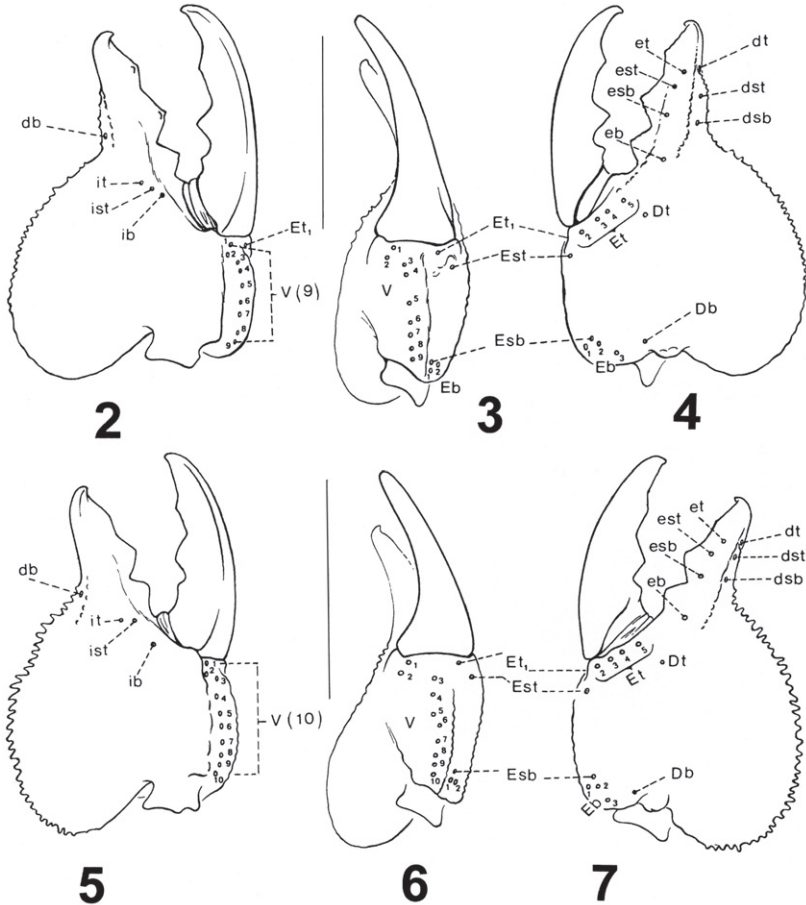
Illustrations and measurements were made with the aid of a Wild M5 stereo-microscope with an attached drawing tube (camera lucida) and an ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows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

## The classification of the *Pandinus* species

Although these 'Giant scorpions' are well known by professional arachnologists and by amateur people, little serious research has been carried out on *Pandinus* spp. The specialised literature on the genus remains poor when compared with that pertaining to other groups of scorpions (Vachon, 1952, 1967, 1974).

The genus *Pandinus* was proposed by Thorell (1876), but in previous publications the classification of species formerly associated to this genus was unclear. *Pandinus imperator* was described by C. L. Koch (1841) based on a dry preserved specimen, without any indication about its possible original locality. This specimen supposedly deposited in the collections of the Berlin Museum, was subsequently lost. The characters used by C. L. Koch (1841) in his description, are extremely general and can be attributed to almost any large species of *Pandinus*. Simon (1872) in an early study about

scorpions, described a new species *Pandinus roeseli* (under *Heterometrus*), based mainly on a 'giant scorpion' illustrated by Roesel de Rosenhof (see Lourenço, 1988). It is doubtful however, that he designated a type for this species. He indicated the type locality as the Coastal region of Guinea, as previously done by Roesel de Rosenhof. Simon (1872) also indicated several characters distinguishing his new species from the C. L. Koch species, *P. imperator*. Pocock (1888) in an early study about the African species of the genus *Scorpio* Linnaeus, called attention to the confusing classification of this group of scorpions, but maintained the validity of both *P. imperator* and *P. roeseli* and described a new species *Pandinus dictator* (under *Scorpio*) from the island of Fernando Po in Equatorial Guinea. In a later publication, Pocock (1899) also described a subspecies for *P. imperator* as *P. imperator gambiensis* from Gambia and Senegal.



**Figs 2-7.** Trichobothrial patterns of *Pandinus imperator* (Koch) (2-4) and *P. gambiensis* Pocock (5-7) (after Vachon 1967) (scale bars = 20 mm).

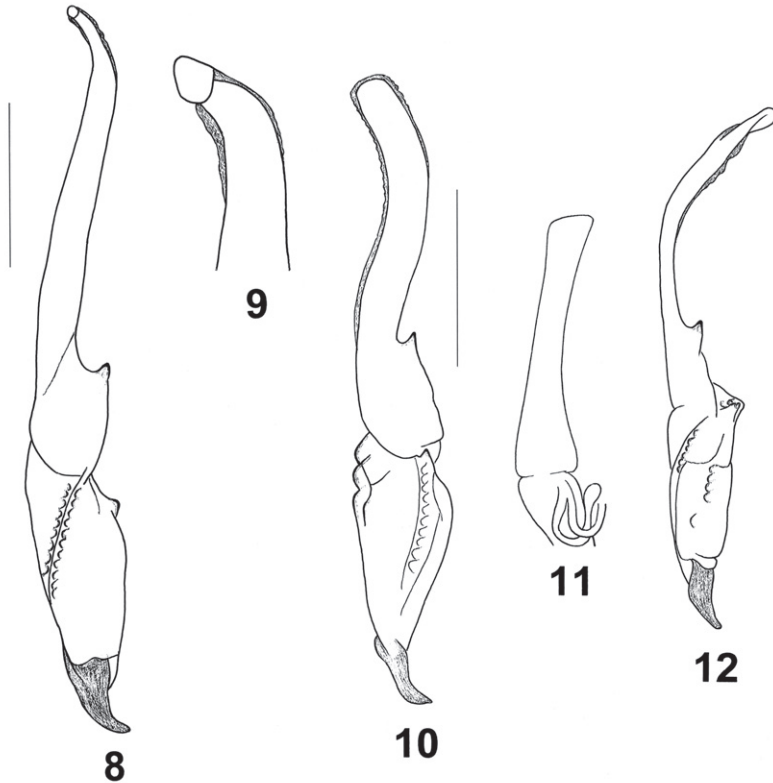
Thorell (1893) synonymised *P. roeseli* with *P. imperator*. His justifications were scholar, but based on characters which now appear to have a certain degree of variation among individuals of a same population. This synonymy was, however, maintained by subsequent authors and *P. imperator* was defined 'a priori' as the most common species of *Pandinus* in Western Africa. The trichobothrial patterns defined by Vachon (1967, 1974) for the species *P. imperator*, *P. dictator* and *P. gambiensis* apparently confirmed the status of these three species. Nevertheless, the true status of *P. imperator* remains dubious since its description was based on very general characters, an unknown collection locality, and the type specimen is lost.

If the trichobothrial patterns for both *P. dictator* and *P. gambiensis* are clearly diagnostic, a number of semi-distinct populations from Western Africa can be associated to *P. imperator* (Lourenço & Cloudsley-Thompson 1999). The study of some *Pandinus* recently collected in the north of Cameroon (in a zone of transition between the Sahel and Savannas) showed a similar trichobothrial pattern but exhibited other distinctive characters to that of '*P. imperator*' collected from areas of rain forests. For this reason, I decided to explore the morphology of the hemispermatophores. This character has been largely used in many similar groups with great success (e.g. Lamoral, 1979, Lourenço 1987, 2009), but was largely neglected in the study of *Pandinus*. I also extended this analysis to male specimens of the Coastal region of Guinea (cf. *P. roeseli*) and to specimens from south of Togo/Ghana, 'a priori' cospecific with *P. imperator*.

The results are presented in the key below (see also Figures 8-12). Since the hemispermatophore structure is quite distinct for these three populations, *P. roeseli* is reestablished here as a valid species, and a new species is described from the North of Cameroon. Further studies will be necessary to clarify the status of all West-African populations and future molecular investigation would contribute greatly to this subject.

**Taxonomic key for *P. imperator* and associated species**

- 1. Species of large size, reaching 150 to 180 mm in total length . . . . . 2
- (1) Species of moderate size, reaching 95 to 110 mm in total length . . . . . 3
- 2. Distal lamina of hemispermatophore weakly curved with basal portion larger than the distal one; presence of a tubercular structure in the apex . . . . . *P. imperator*
- (2) Distal lamina of hemispermatophore not curved; globally large over its entire surface; absence of a tubercular structure in the apex . . . . . *P. roeseli*
- 3. Distal lamina strongly curved with the basal portion narrowed; absence of a tubercular structure on its apex . . . . . *P. camerounensis* sp. n.



**Figs 8-12.** Hemispermatophores. **8.** *Pandinus imperator* (Koch). **9.** Idem, detail of the apex showing the tubercular structure. **10.** *P. roeseli* (Simon). **11.** Idem, drawing from Vachon (1952). **12.** *P. camerounensis* sp. n., holotype (scale bars = 5 mm).

### Taxonomic treatment

Family Scorpionidae Latreille, 1802

Genus *Pandinus* Thorell, 1876

*Pandinus camerounensis* sp. n.  
(Figs 12-18)

**TYPE MATERIAL:** Cameroon, Regions of Sanguéré-Djoi/Kismatari/Djalingo (Average coordinates, 9°23,229' – 13°500,68'), 1 male holotype, 3 males and 2 female paratypes, (P. Prudent leg.), August/2011-November/2012. Cotton and tomato fields (some scorpions collected in termite mounds). Holotype and 3 paratypes deposited in the Zoologisches Museum, Hamburg; 2 paratypes deposited in the Muséum national d'Histoire naturelle, Paris, France.

**COMPARATIVE MATERIAL** of *P. imperator* now deposited in the Zoologisches Museum, Hamburg:

*Pandinus imperator*, 1 adult male, SE Notsé, South of Togo, 21 April 2009 (J.-M. Betsch leg.);

*Pandinus imperator*, 2 adult females, North of Gabon, Eboname, 14 April 2010 (J.-M. Betsch leg.).

ETYMOLOGY: The specific name refers to the country in which the new species was collected.

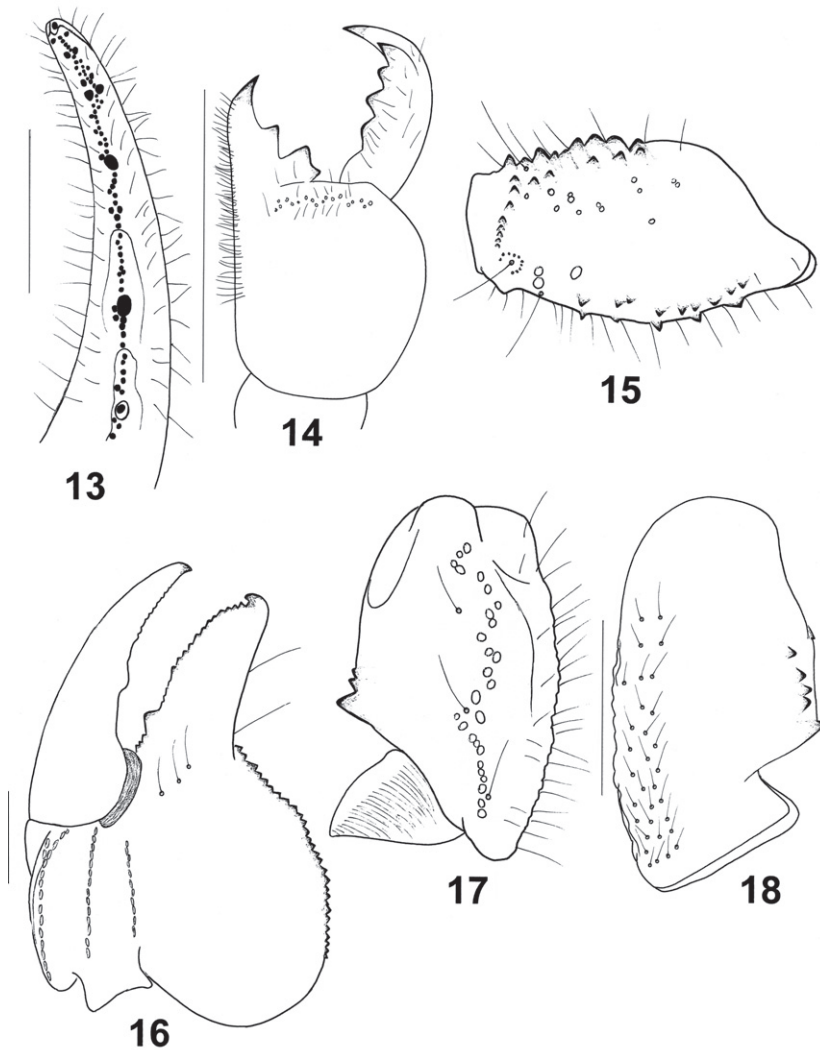
DIAGNOSIS: Scorpions of moderate size with respect to the genus. Male and female reaching 99.5 and 105.4 mm in total length, respectively. Coloration, generally reddish to reddish-brown, without any dusty markings and with legs, chelicerae and telson paler than the body. Pedipalps, especially the chela, with moderately marked carinae. Chela manus with strongly marked granules on dorso-external aspect. Telson bulked and moderately granular. Pectines enlarged with 14 to 16 teeth in males and females. Trichobothriotaxy of type C, neobothriotaxic 'majorante'. Genital operculum with two semi-oval plates in the male and one oval plate in the female with a small incision at the base. Hemispermaphore: As in Fig. 12; distal lamina strongly curved and with the basal portion narrowed; absence of a tubercular structure on its apex.

DESCRIPTION: Based on male holotype and paratypes. Measurements in Table 1.

**C o l o r a t i o n.** Body generally reddish to reddish-brown. **P r o s o m a:** Carapace reddish-brown with some black near the eyes. **M e s o s o m a:** Tergites reddish-brown with the posterior edge slightly paler; sternites yellowish-brown. Coxapophysis and sternum reddish-yellow; genital operculum and pectines dark yellow. **M e t a s o m a:** all segments reddish-brown with some dark pigments over carinae. Telson reddish; aculeus reddish at the base and blackish at the extremity. **C h e l i c e r a e** reddish-brown with inconspicuous variegated brownish spots; fingers blackish with dark reddish teeth. **P e d i p a l p s:** femur, patella and chela reddish-brown; fingers blackish. **L e g s** reddish-yellow to reddish-brown.

**MORPHOLOGY.** **C a r a p a c e** acarinate with a few granulations especially on median and posterior zones; anterior margin with a strongly pronounced concavity; posterior furrows strongly pronounced; median ocular tubercle slightly posterior to the centre of the carapace; three pairs of lateral eyes of almost equal size. **M e s o s o m a:** Tergites almost acarinate and smooth with some sparse, thin granulation. Sternum pentagonal, slightly higher than wide. **V e n t e r:** genital operculum formed by two semi-oval plates in male and one oval plate in female, with a small incision at the base. Pectines enlarged; pectinal tooth count 14-16 in male holotype and 14-13 in female paratype (see also diagnosis); fulcra strongly developed. Sternites smooth and shiny, with two longitudinal parallel furrows on III to VI; VII with punctations; spiracles linear and conspicuous. **M e t a s o m a** with moderately to strongly marked carinae on segments I to IV; granulation becomes spiniform on dorsal carinae of segments II to V; ventral and latero-ventral carinae intensely spinoid on V; all intercarinal surfaces moderately granular. Telson bulked and

moderately granular with four ventral carinae formed by spinoid granules; aculeus slightly shorter than vesicle and moderately curved. Chelicera l dentition characteristic of the Scorpionidae (Vachon, 1963); movable finger with one subdistal tooth, and weakly marked basal teeth. P e d i p a l p s with moderate granulation; femur with four carinae, almost complete; patella



**Figs 13-18** *Pandinus camerounensis* sp. n. male holotype. **13.** Movable finger of pedipalp chela with rows of granules. **14.** Chelicera dorsal aspect. **15-18.** Trichobothrial pattern. **15.** Femur, dorsal aspect. **16.** Chela internal aspect. **17-18.** Patella, dorsal and ventral aspects.



with dorsal carina almost complete; chela with moderately marked ventral carinae; other carinae inconspicuous; dorso-external aspect of the manus strongly granular. Dentate margin on fixed and movable fingers with a series of granules divided by 5 or 6 strong accessory granules. Trichobothriotaxy of type C, neobothriotaxic 'majorante' (Vachon, 1974); patella with 30-33 ventral trichobothria, and chela with 3 internal trichobothria. Legs: tarsi of legs I to IV with 4 internal and 3 external spines.

**Table 1.** Measurements (in mm) of male holotype and female paratype of *Pandinus camerounensis* sp. n.

	♂ (holotype)	♀ (paratype)
Total length*	99.5	105.4
Carapace:		
- length	15.8	17.2
- anterior width	10.3	11.4
- posterior width	16.5	17.9
Mesosoma length	35.4	37.1
Metasoma, segment I:		
- length	7.7	8.1
- width	7.4	7.5
Metasoma, segment V:		
- length	13.2	14.1
- width	5.2	5.4
- depth	4.8	5.2
Telson length	12.0	12.9
Vesicle:		
- width	5.6	5.9
- depth	4.7	5.1
Pedipalp:		
femur length	10.4	10.7
femur width	5.6	6.2
patella length	10.9	11.5
patella width	6.3	6.8
chela length	26.6	28.8
chela width	6.4	6.7
chela depth	15.2	16.7
Movable finger length	14.9	16.9

\*Excluding telson length.

Comparative values:

Male of *P. imperator* from SE Notsé, South of Togo = 154.8 mm in total length.

Male of *P. roeseli* from Kindia in Guinea = 115.6 mm in total length.

Female of *P. imperator* from Edéa South of Cameroon = 163.3 mm in total length.

REMARKS: *Pandinus camerounensis* sp. n., is here distinguished from *Pandinus imperator* (Koch, 1841) and from *Pandinus roeseli* (Simon, 1872), the two most geographically related species of the genus, mainly by their global size and structure of the hemispermatophores. The first two species are bigger in size, reaching total lengths of 150 to 180 mm. The structure of hemispermatophores are quite distinct in the three species (see Figs 8-12). In



**Fig. 19.** The natural habitat of *Pandinus camerounensis* sp. n. Aerial view of the Sanguéré-Djoi/Kismatari region, showing the typical Savannah/Sahel vegetation (photo by François-Régis Delobal).

*P. imperator* the distal lamina is weakly curved and the basal portion larger than the distal one; a tubercular structure is present on its apex. In *P. roeseli* the distal lamina is shorter than in the other two species and globally large.

### Habitat of the new species

The area in which *Pandinus camerounensis* sp. n. was collected is the transitional zone between the Sahel and savannah formations (Fig. 19). Most of these natural formations have been replaced in recent years by agricultural activities. The new species was collected in cotton and tomato fields, and some specimens were found in termite mounds. In present days, most of the area of the Senguéré-Djoi is used for agriculture, but some parcels are still composed of bushes.

Until now, a number of scorpion species have been collected and described from the region of Northern Cameroon. Naturally, some of these were collected in more ancient times when large parcels of the natural environment was still present. These are: *Leiurus savanicola* Lourenço, Qi & Cloudsley-Thompson, 2006 and *Scorpio savanicola* Lourenço, 2009 (Lourenço *et al.*, 2006; Lourenço, 2009). More recently, three other species were described from this region: *Buthus prudenti* Lourenço & Leguin, 2012, *Babycurus prudenti* Lourenço, 2013 and *Butheoloides savanicola* Lourenço, 2013 (Lourenço 2012, 2013; Lourenço & Leguin, 2012). Among the studied material were a small number of *Hottentotta hottentotta* (Fabricius, 1787), but these require yet further investigation (Lourenço unpublished). It is quite possible, however, that with increasing anthropic action on the environment, most scorpion species will experience a significant regression of their populations. Only more opportunistic species (what seems to be the case of *Buthus prudenti*), will see their populations expand and colonize most of the area (Lourenço 1991).

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