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## A reappraisal of the geographical distribution of *Grosphus grandidieri* Kraepelin, 1900 (Scorpiones: Buthidae)

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(with 16 Figures)

### Abstract

The distributional patterns of the Malagasy scorpion *Grosphus grandidieri* Kraepelin, 1900 (of the family Buthidae), restricted to dry forests in the southern and western parts of the island, are reconsidered. A redescription of this species' diagnostic characters is also presented. The geographic range of *G. grandidieri* is complex and it occurs in several different types of dry forest.

**Key words:** Scorpiones, Buthidae, *Grosphus grandidieri*, Madagascar, distributional patterns, adaptation.

### Introduction

The type series of *Grosphus grandidieri* was collected by G. Grandidier at 'Ankotofotsy' (an imprecise locality) on 22 and 23 May 1898 and this taxon was described by Kraepelin (1900). It is noted on two original labels found in the jar with the type specimen, 'Ankotofotsy – Vallée du St. Augustin' which, according to Viette (1991), corresponds to Anantsono situated about 35 km south of Toliara. This species is distributed across the parts of southwestern Madagascar (Lourenço 1996). It is one of the most conspicuous species of *Grosphus*, with its large adult size, ranging from 85 to 90 mm in total length, and an intense blackish coloration, almost unique among species of this genus.

Over the past 15 years, considerable biological exploration of a wide range of habitats on Madagascar, using different survey techniques (large pit-fall buckets and large scale leaf litter sampling) that were not previously employed, has resulted in substantial new collections of Malagasy scorpions. On the basis of specimens collected with these techniques, *G. grandidieri* does not appear to be particularly common in southwestern Madagascar, as compared to some other members of this genus.

In the present note, we summarize known localities where *G. grandidieri* has been collected or reported. These data are summarized from all the specimens studied in the last 15 years and now deposited in the collections of museums in Paris, Chicago, San Francisco, and Hamburg.

A redescription of this species based on morphological characters is also presented.

### Methods

Illustrations and measurements were produced 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 Vachon (1952) and Hjelle (1990). Photos (Figs 1-4) are taken from specimens collected 2 km NE of Ifaty.

### List of localities where *Grosphus grandidieri* has been collected (arranged from north to south)

Madagascar, Province de Toliara:

Région Menabe, District of Manja, Commune rurale d'Ankiliabo, Fokontany de Rangainomby, Beronto Forest, 11.3 km SE Ankiliabo, 110-130 m (21°46.754'S-043°58.662'E): 3 ♂, 5 ♀.

Ifaty, 2 km NE: baobab forest, sand soil, under bark: ♂, ♀.

Fiherenana (23°14'07"S- 43°52'15"E), 50 m, degraded gallery forest: 4 ♂, 6 ♀.

Vallée de Fiherenana: 2 ♂, 5 ♀.

Benenitra: ♀. [Inferred coordinates 23°27'S, 45°05'E]

Tongobory (23°31'27"S- 44°7'17"E), 20.7 km 29° WNW. Forêt de Mite, 75 m, gallery forest: 5 ♀.

Toliara, Arboretum d'Antsokay: ♀.

Sarodrano, 23°30'30" 43°44'E: ♀.

Mahaleotse, Côte Riv. Onilahy, 68 m (23°31.600'S- 44°05.366'E), gallery forest, (under bark): 2 ♀.

Region of Ampotaka, calcareous cliff: ♀.

Efoetse, 6 km NE. Parc National de Tsimanampetsotsa, Mitoho Cave (24°3.0'S-43°45.0'E): 2 ♂.

Parc National de Tsimanampetsotsa, Forêt de Bemanateza, 20.7 km 81° E Efoetse, 23 km 191° SE Beheloka (23°59'32"S- 43°52'50"E), 90 m, spiny forest thicket: 3 ♂, 2 ♀.

Mahafaly Plateau, 6.2 km 74° ENE Itampolo (24°39'13"S- 43°59'40"E), 80 m, spiny forest thicket: ♂.

Commune Rurale d'Itampolo, 10.5 km SE of Itampolo village (24°44.2'S- 44°01.8'E), 120 m, spiny forest thicket: ♂.

Réserve naturelle Intégrale [now Parc National] d'Andohahela, parcel 2, camp 6, 7.5 km ENE Hazofotsy, 120 m (24°49.0'S- 46°36.6'E): 2 ♂.

Réserve Privé de Berenty, Anjapolo forest, 21.4 km 32.5° NW Amboasary, 65 m (24°55'47"S- 46°12'36"E). Spiny forest thicket: ♂.

**Table 1.** Morphometric values (in mm) of ♂ and ♀ of *Grosphus grandidieri* Kraepelin and holotype ♂ and paratype ♀ of *G. ankarana* Lourenço & Goodman.

	<i>G. grandidieri</i>		<i>G. ankarana</i>	
	♂	♀	holotype ♂	paratype ♀
Total length	96.2	86.1	114.5	105.2
Carapace:				
- length	10.3	10.4	10.9	11.4
- anterior width	7.4	7.8	8.1	8.7
- posterior width	11.3	12.3	11.8	12.9
Metasomal segment I:				
- length	8.4	7.3	11.2	9.8
- width	6.1	6.4	5.8	6.8
Metasomal segment V:				
- length	13.1	12.1	15.3	13.2
- width	5.3	5.6	5.2	5.5
- depth	5.4	5.6	5.1	5.2
Vesicle:				
- width	5.3	5.6	5.1	5.6
- depth	5.7	6.0	5.1	5.6
Pedipalp:				
- Femur length	10.1	9.4	12.2	11.3
- Femur width	2.8	3.2	2.8	3.3
- Patella length	11.2	10.5	12.9	12.7
- Patella width	4.1	4.3	3.7	4.5
- Chela length	19.2	18.4	20.7	20.9
- Chela width	5.2	4.4	4.6	5.4
- Chela depth	4.7	4.2	4.5	5.2
Movable finger:				
- length	11.7	11.4	11.2	12.1

### Taxonomic treatment

Family Buthidae C. L. Koch, 1837

Genus *Grosphus* Simon, 1880

*Grosphus grandidieri* Kraepelin, 1900  
(Figs 1-16)

*Grosphus grandidieri* Kraepelin, 1900: 13.

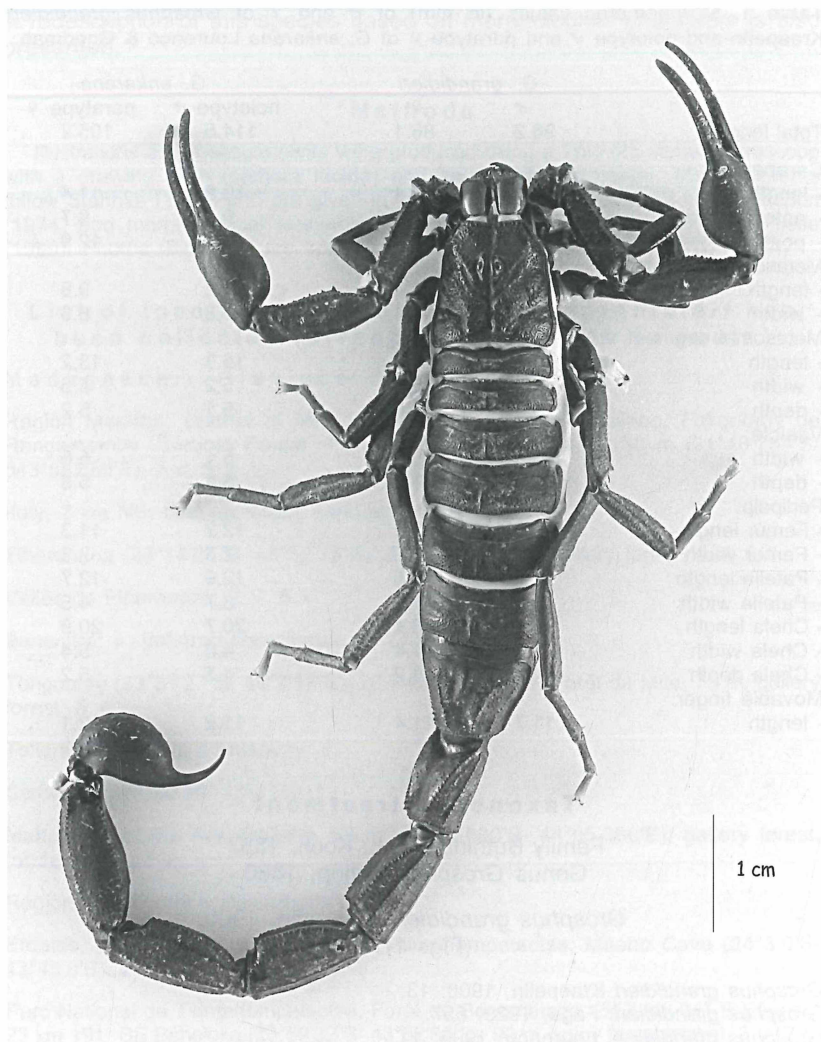
*Grosphus grandidieri*: Fage, 1929: 657.

*Grosphus grandidieri*: Lourenço, 1996: 11.

*Grosphus grandidieri*: Lourenço, Soarimalala & Goodman, 2007: 370.

TYPE MATERIAL. Female (herewith designated *lectotype*), juvenile male (designated *paralectotype*), Madagascar, Ankotofotsy (Vallée du St. Augustin) 22-23 May 1898 (G. Grandidier) (MNHN-RS-1324). Examined.

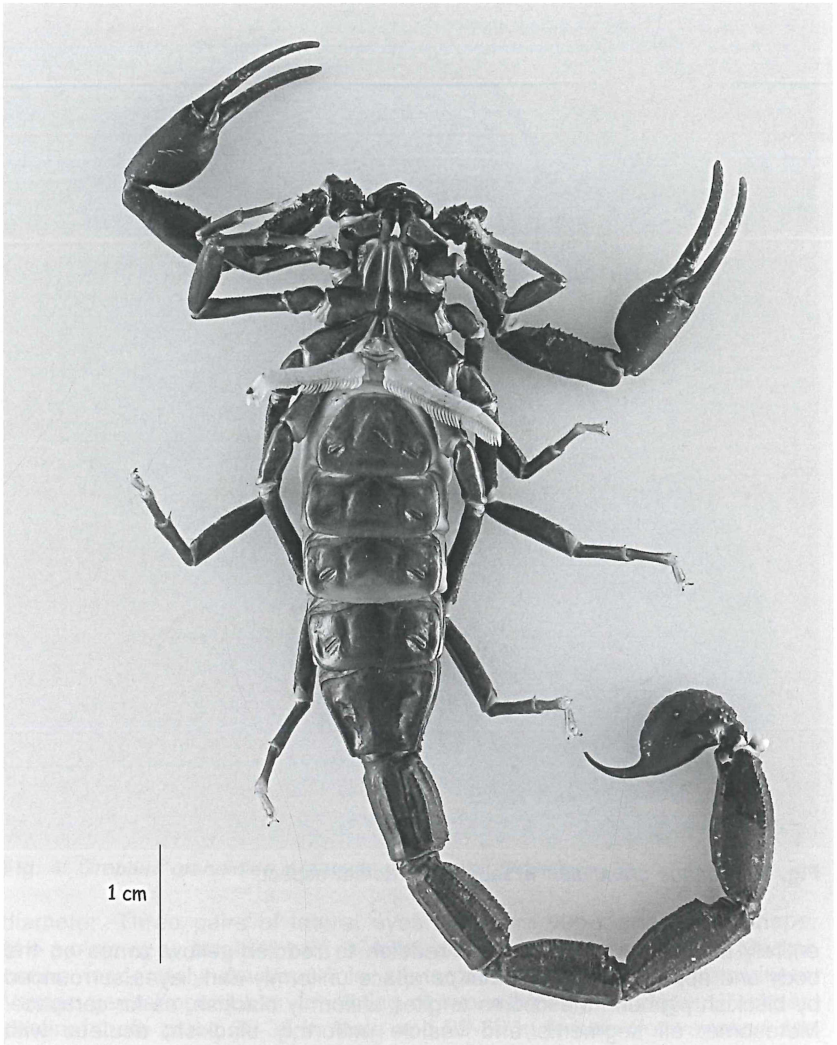
OTHER MATERIAL. Madagascar, Province de Toliara, 2 km NE of Ifaty (23°10'80"S – 43°37'00"E), "dry spiny bush forest, dominated by baobabs (*Adansonia za*) resting on red sand soil," 25 m, 10 November 2004, coll. W.R. Lourenço: ♂, ♀. Commune Rurale d'Itampolo, 10.5 km SE of Itampolo village (24°44.2'S- 44°01.8'E), 120 m, spiny forest thicket, 24 February 2005, coll. V. Soarimalala & S. M. Goodman: ♂. Région Menabe, District of Manja, Commune Rurale d'Ankiliabo. Fokontany de



**Fig. 1.** *Grophus grandidieri* Kraepelin, ♂: dorsal aspect.

Rangainomby, Beronto Forest, 11.3 km SE Ankiliabo, 110-130 m (21°46.754'S-043°58.662'E), 19 January 2007, coll. H. A. Rakotondravony: ♀. All four specimens deposited now in the Zoologisches Museum Hamburg (ZMH Acc. No. A1/09).

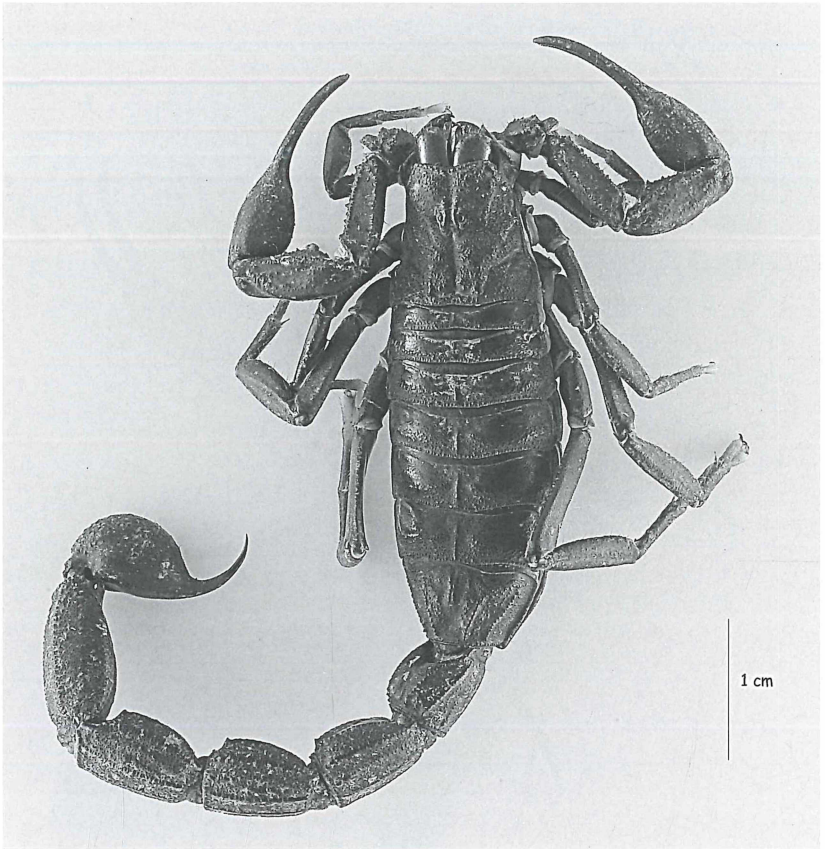
**REVISED DIAGNOSIS.** Scorpions of large size, when compared with most species of the genus, and adults ranging from 85 to 90 mm in total length (see Table 1). The species is smaller than *G. ankarana* Lourenço & Goodman, 2003. General coloration almost entirely blackish over the body and appendages, with paler areas on the ventral surface.



**Fig. 2.** *Grospus grandidieri* Kraepelin, ♂: ventral aspect.

Disposition of granulations on the dentate margins of the pedipalp chela fixed and movable fingers, arranged in 13-14 rows of granules. Pectinal teeth count 29 to 40; 34 to 40 in males and 29 to 34 in females; basal middle lamellae of each pecten not dilated in males; very elongated and curved in females; just after the base, to the apex, covering 8 to 9 most proximal teeth. Trichobothriotaxy type A with a  $\acute{\alpha}$  (Alpha) disposition for the dorsal trichobothria of femur (Vachon 1974, 1975).

REDESCRIPTION. Measurements in Table 1. Coloration. Almost



**Fig. 3.** *Grophus grandidieri* Kraepelin, ♀: dorsal aspect.

entirely blackish with some dark reddish to reddish-yellow zones on the body and appendages. Prosoma: carapace uniformly dark; eyes surrounded by blackish pigment. Mesosoma tergites uniformly blackish, as for carapace. Metasoma: all segments and vesicle uniformly blackish; aculeus with reddish base and blackish tip. Venter: coxapophysis, sternum and genital operculum reddish with yellowish spots; pectines pale yellow. Chelicerae reddish-yellow with a dark variegated pigmentation along its entire surface; fingers reddish with teeth blackish. Pedipalps: femur and patella blackish; chela with a blackish hand and dark reddish fingers; rows of granules on fingers blackish. Legs uniformly blackish.

**MORPHOLOGY.** P r o s o m a. Carapace moderately to strongly granular; anterior margin with a weak median concavity. All carinae weak; furrows moderately to strongly developed. Median ocular tubercle anterior to the center of carapace; median eyes separated by more than one ocular

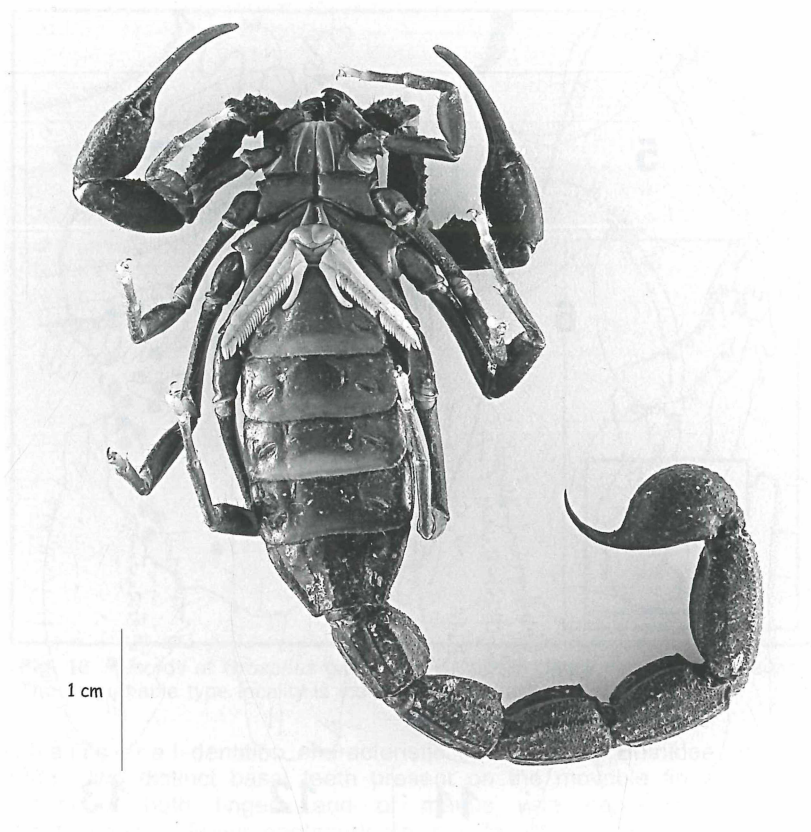
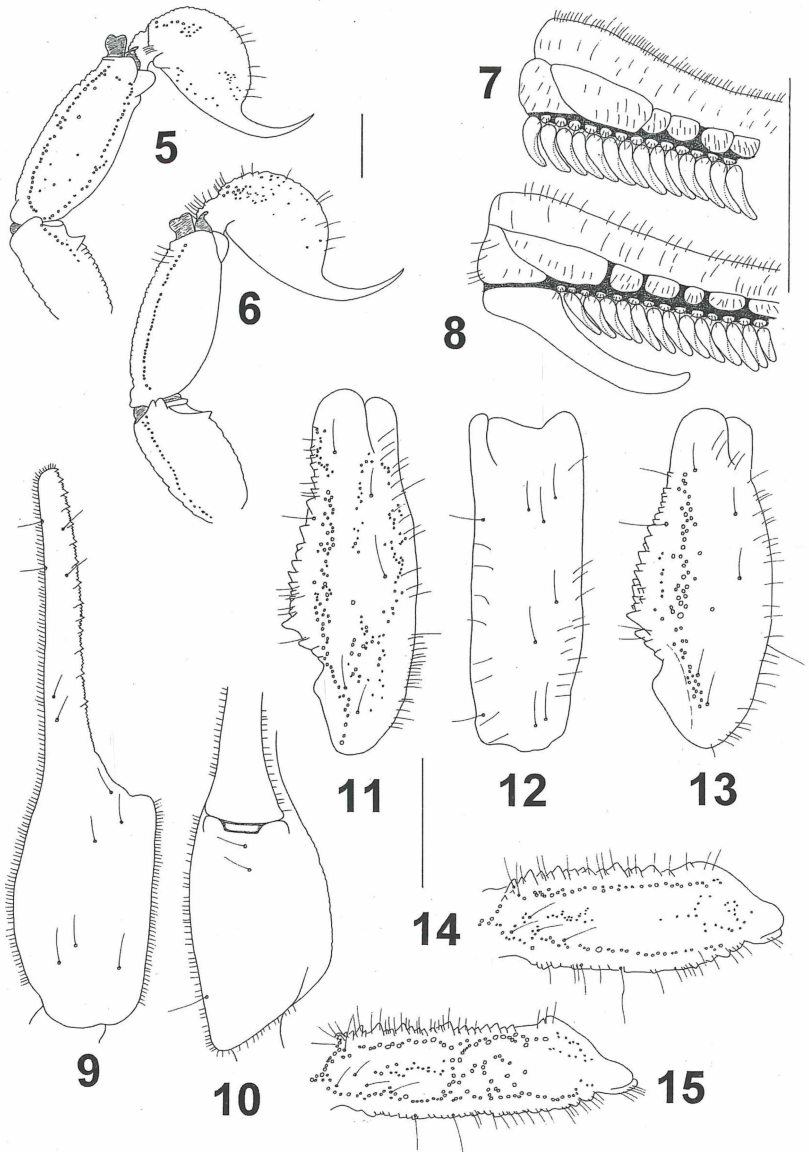


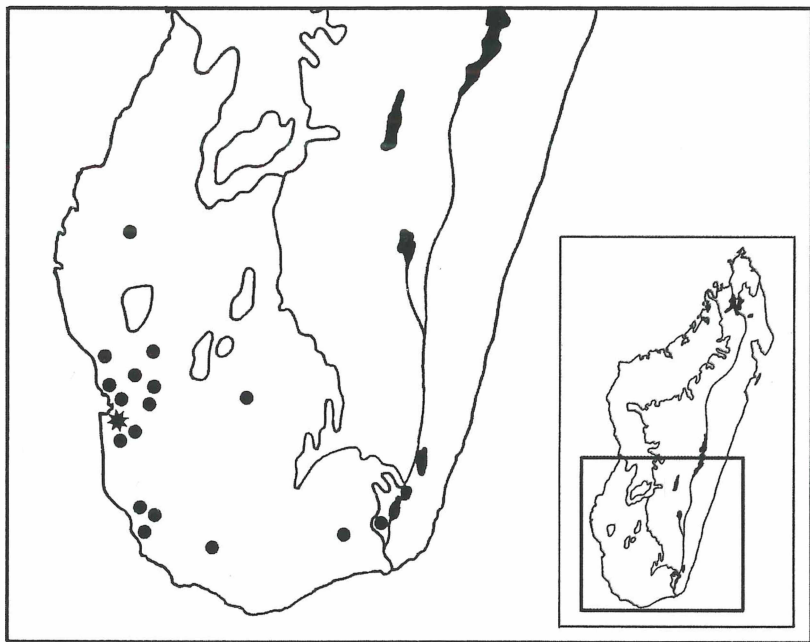
Fig. 4. *Grosphus grandidieri* Kraepelin, ♀: ventral aspect.

diameter. Three pairs of lateral eyes. Sternum sub-triangular in shape. *Mesosoma*. tergites with a weak to moderate granulation. Median carina moderately developed in all tergites. Tergite VII pentacarinat. Venter: genital operculum consisting of two subtriangular plates. Pectines: pectinal tooth count 36-36 in male and 29-30 in female (for variation see diagnosis); basal middle lamellae of each pecten not dilated in males; elongated and curved in females; almost constant in wide from the region just after the base to the apex, covering 8 to 9 most proximal teeth. Sternites smooth, with elongated stigmata; III-VI with two longitudinal furrows; VII with four vestigial carinae. *Metasoma*. Segments I and II with 10 carinae, moderately crenulate; segment III with 10 carinae on males and 8 on females; segment IV with 8 carinae, weakly crenulate. Segment V with 5 carinae. Dorsal carinae on segments I-IV with one posterior spinoid granule. Intercarinal spaces moderately to weakly granular. Telson with granulations on the ventral aspect; aculeus strongly curved and slightly shorter than the vesicle; subaculear tooth absent.



**Figs 5-15.** *Grosphus grandidieri* Kraepelin: **5-6.** metasomal segment V and telson, lateral aspect. (5: ♂; 6: ♀); **7-8.** pectines. (7: ♂. 8: ♀), with strong dilatation of the basal middle lamella; **9-15.** trichobothrial pattern; **9-10.** chela, dorso-external and ventral aspects (♀). **11-13.** Patella, dorsal and external aspects (11: ♂. 12-13: ♀); **14-15.** femur, dorsal aspect (♀ and ♂).





**Fig. 16.** Records of *Grosphus grandidieri* Kraepelin (black circles) in Madagascar. The presumable type locality is indicated by a black star.

**C h e l i c e r a l** dentition characteristic of the family Buthidae (Vachon 1963); two distinct basal teeth present on the movable finger; ventral aspect of both fingers and of manus with dense, long setae. **P e d i p a l p s.** femur pentacarinat; patella with a dorsointernal carina and with several spinoid granules on the internal face; chela almost smooth, without carinae; all segments moderately to weakly granular. Movable and fixed fingers with 13-14 oblique rows of granules in males and females. Trichobothriotaxy; orthobothriotaxy A-á (Alpha) (Vachon 1974, 1975). **L e g s.** tarsus with very numerous, brush-like, setae ventrally. Tibial spurs present on legs III and IV; pedal spurs present on legs I to IV; all spurs strong.

### Ecology

The southwestern and southern portions of Madagascar are the most arid zones on the island and have a very pronounced dry season. Following known distribution of *Grosphus grandidieri* along the west coast in a southern direction and at its southern limit eastwards to Amboasary Sud, there is a pronounced clinale decrease in annual rainfall from 496 mm at Morombe, 390 mm at Toliara, 411 mm at Androka, 483 mm at Tsiombe, and 491 mm at Amboasary Sud (Chaperon et al. 1993). At more inland localities, in the vicinity this species has been collected, annual

rainfall at Manja is 875 mm, at Benenitra is 668 mm, and at Bezaha of 582 mm (l.c. 1993). Following this cline, the shift in rainfall gives rise to changes in vegetational types that range from close to the southern limit of Western Dry Forest (forest type terms follow Moat and Smith 2007) in the Forêt de Beronto and South Western Dry Spiny Forest-Thicket in various states of degradation at most of the other sites.

*G. grandidieri* is known from a variety of edaphic and micro-climate conditions, ranging from gallery forests with seasonally mesic habitat, cliff faces with at least partially less direct solar radiation, and to open areas of South Western Dry Spiny Forest-Thicket. This species is known largely from lowland elevations and within a relatively short distance from the coastal plain, except at the sites of Ankiliabo, Benenitra, Tongobory, Ampotaka, Tongobory, and 'parcel 2' of Andohahela. In short, it appears to be adapted to a wide range of different habitats within its known distribution, all of which are notably dry compared to other portions of Madagascar.

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