

ARTÍCULO:

**Three new species of *Grosphus* Simon from Madagascar (Scorpiones, Buthidae)**

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## THREE NEW SPECIES OF *GROSPHUS* SIMON FROM MADAGASCAR (SCORPIONES, BUTHIDAE)

Wilson R. Lourenço, Steven M. Goodman  
& Olga Ramilijaona

**Abstract:**

Three new species belonging to the genus *Grosphus* Simon (Scorpiones, Buthidae) are described from Madagascar. *Grosphus mahafaliensis* sp. n., from Toliara province, Parc National de Tsimanampetsotsa; *Grosphus darainensis* sp. n., from Antsiranana province, Forêt de Bobankora, E SE of Daraina, and *Grosphus simoni* sp. n., from Toamasina province, Forêt de Plateau de Makira and Mahajanga province, Station Forestière d'Ampijoroa. With these descriptions the total number of species in this endemic genus is raised to 14. Some details are presented on the ecological settings of the sites where the new species were collected. A revised key to the species of *Grosphus* is given.

**Key words:** Scorpiones, Buthidae, *Grosphus*, new species, Madagascar.

**Taxonomy:**

*Grosphus mahafaliensis* sp. n.

*Grosphus darainensis* sp. n.

*Grosphus simoni* sp. n.

### Tres nuevas especies de *Grosphus* Simon de Madagascar (Scorpiones, Buthidae)

**Resumen:**

Se describen tres nuevas especies pertenecientes al género *Grosphus* Simon (Scorpiones, Buthidae) de Madagascar. *Grosphus mahafaliensis* sp. n., de la provincia de Toliara, Parque Nacional de Tsimanampetsotsa; *Grosphus darainensis* sp. n., de la provincia de Antsiranana, bosque de Bobankora, E SE de Daraina; y *Grosphus simoni* sp. n., de la provincia de Toamasina, bosque de Plateau de Makira y de la provincia de Mahajanga, Estación Forestal de Ampijoroa. Con las nuevas descripciones el número total de especies conocidas de este género endémico asciende a 14. Se comentan algunos detalles de tipo ecológico de los lugares de captura de los ejemplares. Se propone una clave de identificación revisada para todas las especies del género *Grosphus*.

**Palabras clave:** Scorpiones, Buthidae, *Grosphus*, nueva especie, Madagascar.

**Taxonomy:**

*Grosphus mahafaliensis* sp. n.

*Grosphus darainensis* sp. n.

*Grosphus simoni* sp. n.

**Introduction**

As discussed in recent papers (Lourenço, 1999, 2001, 2003; Lourenço & Goodman, 2003a), the first *Grosphus* species to be described was *Scorpio (Androctonus) madagascariensis* Gervais (1843) [= *G. madagascariensis*] (Gervais, 1843). Kraepelin (1900) contributed to the study of this genus and described several new species. In his monograph on the scorpions of Madagascar, Fage (1929) described a new variety of *G. limbatus*, which he named *annulata* and was subsequently raised to specific rank as *G. annulatus* (Lourenço, 1996). After Fage's (1929) monograph six new species of *Grosphus* were described (Lourenço, 1996, 1999, 2001, 2003, 2004; Lourenço & Goodman, 2003a). Even given the rather significant increase in the number of recognized taxa in this genus, this lags behind the rate of new species descriptions of other Malagasy scorpion genera such as *Tityobuthus* (Lourenço & Goodman, 2003b).

The taxonomy of *Grosphus* is based mainly on two principal characters: the pattern of coloration and the morphology of the basal middle lamellae of the female pectines. This last character has been considered by scorpion taxonomists to show species specific aspects with little intraspecific variation. However, more detailed investigations have showed that in some cases closely related species have similar basal middle lamellae morphology (Lourenço, 2003; Lourenço & Goodman, 2003a). On the basis of this character some populations closely associated to broadly distributed species such as *G. madagascariensis*, *G. limbatus* or *G. bistratus* remained until recently undescribed (see Lourenço, 2003). For the present study,

more freshly collected material was examined, and three species new to science are described. These new species are closely associated with species complexes formed by *G. madagascariensis*/*G. hirtus* and *G. limbatus*/*G. bistratus*.

### Description of new species

Family **BUTHIDAE** C.L. Koch, 1837

Genus **GROSPHUS** Simon, 1880

#### *Grosphus mahafaliensis* sp. n.

Fig. 1-4, 18.

**MATERIAL EXAMINED:** Madagascar, Province de Toliara, Parc National de Tsimanampetsotsa, N of Efoetse, in coastal *Euphorbia* scrub (N. Lutzmann & J. Kohler), X/2001 (under rock). 1 male holotype. Deposited in the Muséum national d'Histoire naturelle, Paris.

**ETYMOLOGY:** The specific name *mahafaliensis* is an adjective and makes reference to the Plateau de Mahafaly and to the locally occurring cultural group.

**DIAGNOSIS:** A scorpion of medium size with a total length of 44 mm. General coloration reddish yellow. The morphology of the new species shows that it is close to the *Grosphus limbatus*/*G. bistratus* group, but it can be readily distinguished from the other species of this group by the following characters: (i) carapace yellowish without an inverted triangular blackish spot; (ii) dark confluent spots on lateral sides of tergites, and absence of blackish longitudinal bands; (iii) pedipalps, legs, and chelicerae without any spots; (iv) carapace with moderate to strong carinae; (v) telson globular, with aculeus shorter than the vesicle.

#### **DESCRIPTION based on male holotype.**

**Measurements** in Table I.

**Coloration.** Basically yellowish to reddish yellow with some dark zones on the body. Prosoma: carapace yellowish with some discrete blackish spots behind the median eyes, on the posterior margin; eyes surrounded by black pigment. Mesosoma: dark yellow with confluent dark zones. Metasoma: segments I to III yellowish; IV-V reddish yellow, without any dark pigmentation. Telson reddish yellow without spots; aculeus with yellowish base and dark reddish tip. Venter: coxapophysis, sternum, genital operculum and pectines yellowish; sternites greenish yellow. Chelicerae yellowish without any variegated pigmentation; fingers yellowish with the teeth reddish. Pedipalps and legs yellowish without any dark zones.

**Morphology.** Carapace moderately granular; anterior margin almost straight with a very discrete median concavity. All carinae moderate to strong; furrows moderately to strongly developed. Median ocular tubercle anterior to the center of carapace; median eyes separated by a little more than one ocular diameter.

Three pairs of lateral eyes. Sternum between subtriangular and sub-pentagonal in shape. Mesosoma: tergites with thin but moderately intense granulation. Median carina moderately developed in all tergites. Tergite VII pentacarinat. Venter: genital operculum consisting of two semi-oval plates. Pectines: pectinal teeth count 35-37; basal middle lamella of each pecten not dilated in males. Sternites smooth, with elongated stigmata. Metasoma: all segments rounded with carinae weakly marked; segments I to III with 10 carinae, moderately to weakly crenulate. Segment IV with eight carinae, weakly crenulate. Segment V with five carinae, the dorsal one being only vestigial. Dorsal carinae on segments I-IV without any posterior spinoid granules. Intercarinal spaces weakly granular, almost smooth. Telson with granules scattered over latero-ventral and ventral surfaces; its dorsal surface smooth; aculeus moderately curved and shorter than the vesicle; subaculear tooth absent. Cheliceral dentition characteristic of the family Buthidae (Vachon, 1963); two distinct small basal teeth present on the movable finger; ventral aspect of both fingers and of manus with dense, long setae. Pedipalps: femur pentacarinat; patella with dorsointernal and ventrointernal carinae and with several spinoid granules on the internal face; chela smooth, without carinae, only the internal face weakly granular. Fixed and movable fingers with 11/13 oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A- $\alpha$  (Vachon, 1974, 1975). Legs: tarsus with numerous short thin setae ventrally. Tibial spurs present on legs III and IV; pedal spurs present on legs I to IV; all spurs strong.

**FEMALE** unknown.

#### **ECOLOGY**

The region where the holotype of *Grosphus mahafaliensis* was found is in the sub-arid thorn scrub portion of southwestern Madagascar, in a zone known as the Mahafaly Plateau composed of Eocene (54-38 million years ago) limestone (Besaire & Collignon, 1972). This zone receives on average less than 400 mm of rain per year and has an extensive dry season. The natural vegetation of the Mahafaly Plateau is dominated by a relatively dense scrubby understory and a low-canopy forest often with plants adapted to withstand the long dry season (Gautier & Goodman, 2003). Further, the coastal zone, probably where the holotype of *Grosphus mahafaliensis* was collected, is composed of a narrow band of a low scrubby *Euphorbia* habitat.

Other species of scorpions known to occur specifically in the Tsimanampetsotsa area or elsewhere on the Mahafaly Plateau include: *Grosphus annulatus* Fage from the region of Sarodrano close to sea-level; *G. olgae* Lourenço from near Mitoho Cave within the Parc National de Tsimanampetsotsa; *Pseudouroplectes betschi* Lourenço from the Mahafaly Plateau to the north of Itampolo (Lourenço, 2004); and *Palaeochelotonus pauliani* Lourenço from Efoetse (Lourenço, unpublished).

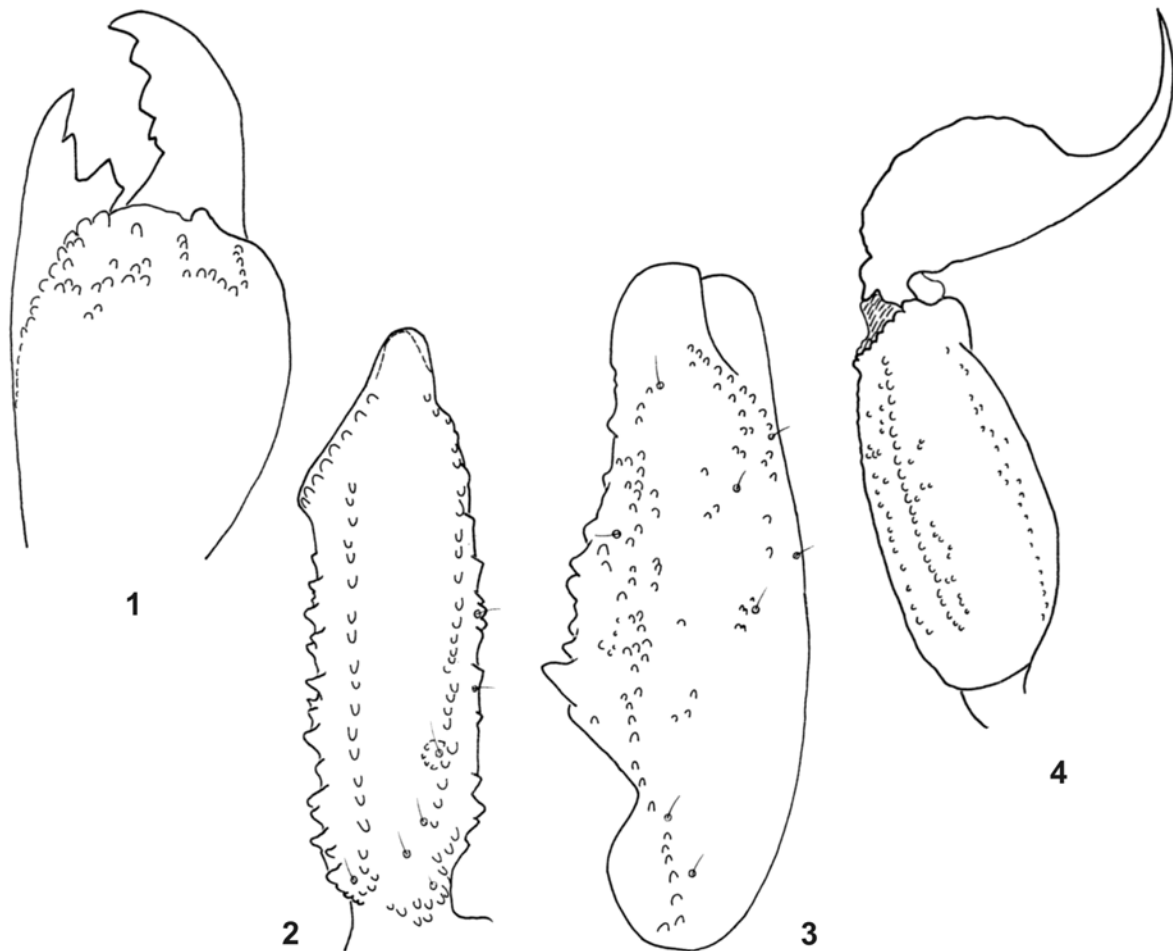


Fig. 1-4. *Grosphus mahafaliensis* sp. n. Male holotype. 1. Chelicera. 2-3. Femur and patella, dorsal aspect, showing trichobothria. 4. Metasomal segment V and telson, lateral aspect.

Table I. Comparative morphometric values (in mm) of the male holotypes of the new species of *Grosphus* described.

	<i>G. mahafaliensis</i> sp. n.	<i>G. darainensis</i> sp. n.	<i>G. simoni</i> sp. n.
<b>Total length</b>	43.9	49.5	54.2
<b>Carapace:</b>			
- length	5.2	6.4	6.4
- anterior width	3.8	4.7	4.8
- posterior width	5.3	6.9	6.9
<b>Metasomal segment I:</b>			
- length	4.0	3.9	4.5
- width	3.3	3.6	3.4
<b>Metasomal segment V:</b>			
- length	6.4	6.8	7.7
- width	3.2	3.1	3.2
- depth	2.9	3.2	3.3
<b>Vesicle:</b>			
- width	2.4	2.8	2.8
- depth	2.2	2.9	2.9
<b>Pedipalp:</b>			
- Femur length	4.8	5.7	6.2
- Femur width	1.4	2.0	1.9
- Patella length	5.2	6.6	7.1
- Patella width	1.9	2.9	2.7
- Chela length	9.0	11.2	11.9
- Chela width	2.6	3.0	3.1
- Chela depth	2.5	2.6	2.8
<b>Movable finger:</b>			
- length	4.9	6.4	6.8

***Grosphus darainensis* sp. n.**

Fig. 5-8, 18.

**MATERIAL EXAMINED:** Madagascar, Province d'Antsiranana, Forêt de Bobankora, east side, 12 km E SE of Daraina (13° 12.7' S – 49° 46.3' E), 100-350 m (M. Raheriarisena & H. A. Rakotondravony), X/2002-III/2003. 1 male holotype. Deposited in the collections of the Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo

**ETYMOLOGY:** The specific name is an adjective and makes reference to the region of Daraina where the new species was collected.

**DIAGNOSIS:** A scorpion of medium size with a total length of 50 mm. General coloration yellowish. The morphology of the new species shows it to be close to the *Grosphus madagascariensis*/*G. hirtus* group, but it can be readily distinguished from the other species of this group by the following characters: (i) coloration of the body and appendages completely yellowish to reddish yellow; (ii) granulations and carinae moderately to weakly marked; (iii) metasomal segment I as long as wide.

**DESCRIPTION based on male holotype.**

**Measurements** in Table I.

**Coloration.** Basically yellowish to reddish yellow with some discrete dark zones on the body. Prosoma: carapace yellowish with an inverted slightly dark triangular zone between median and lateral eyes; eyes surrounded by black pigment. Mesosoma: yellowish, without any dark zone. Metasoma: segments I to III yellowish; IV reddish yellow; V reddish; IV and V with some vestigial dark pigmentation on the ventral carinae. Telson reddish without spots; aculeus with reddish yellow base and dark reddish tip. Venter: coxapophysis, sternum, genital operculum and pectines yellowish; sternites pale yellow, with the exception of VII which is dark yellow. Chelicerae yellowish with dark variegated pigmentation particularly on the anterior third; fingers yellow with reddish teeth. Pedipalps: yellowish with chela fingers reddish. Legs yellowish without spots.

**Morphology.** Carapace moderately granular; anterior margin almost straight, with a weak median concavity. All carinae weak; furrows moderately developed. Median ocular tubercle anterior to the center of carapace; median eyes separated by one ocular diameter. Three pairs of lateral eyes. Sternum sub-triangular in shape. Mesosoma: tergites with thin but intense granulation. Median carina moderately developed in all tergites. Tergite VII pentacarinata. Venter: genital operculum consisting of two subtriangular plates. Pectines: pectinal

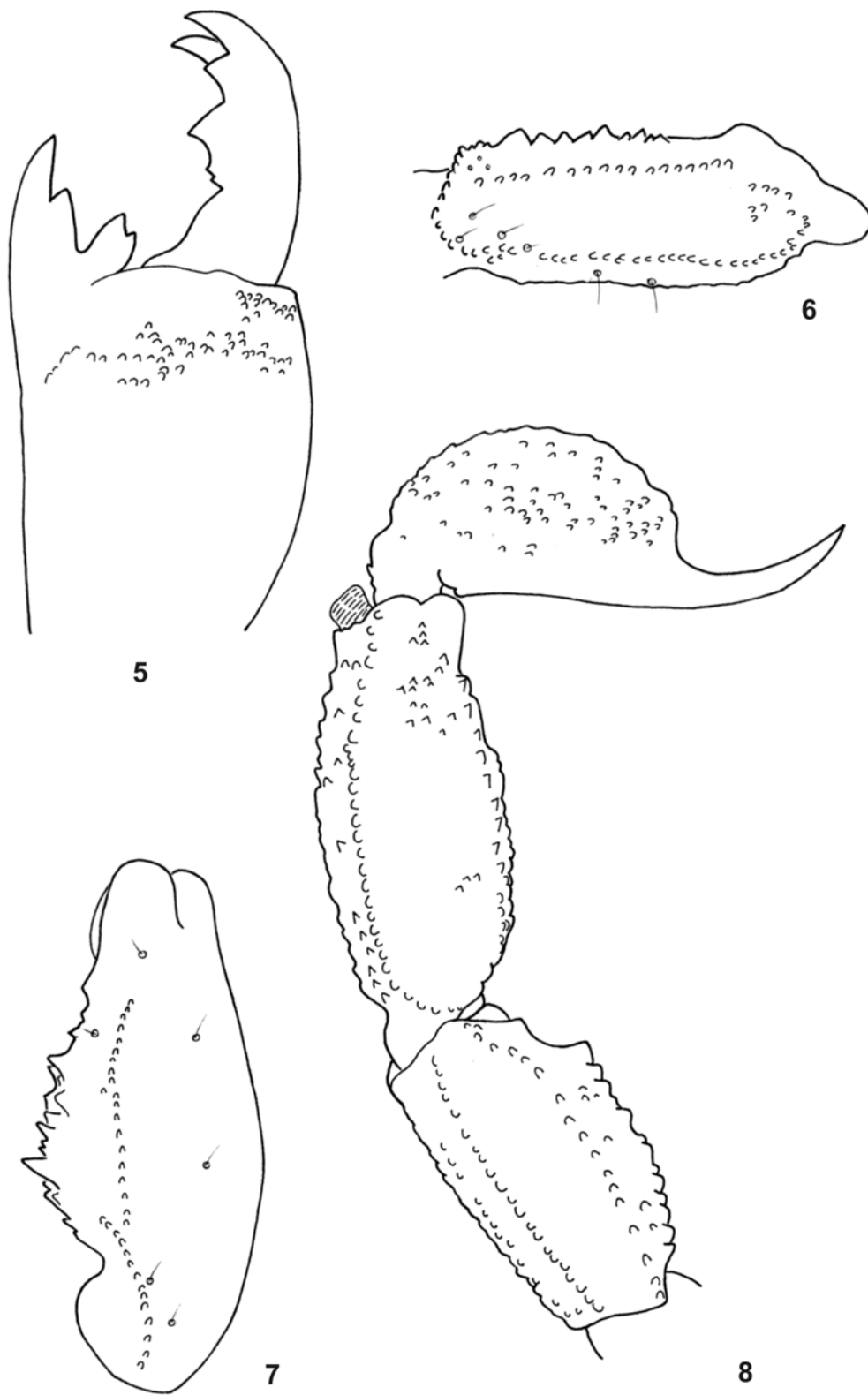
teeth count 18-17; basal middle lamellae of each pecten not dilated in males. Sternites smooth, with elongated stigmata; VII with two vestigial carinae. Metasoma: segments I and II with 10 carinae, moderately crenulate. Segments III and IV with eight carinae, moderately crenulate. Segment V with five carinae. Dorsal carinae on segments II to IV with one small posterior spinoid granule. Intercarinal spaces moderately granular. Telson with a moderate granulation over latero-ventral and ventral surfaces; its dorsal surface smooth; aculeus weakly curved and shorter than the vesicle; subaculear tooth absent. Cheliceral 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. Pedipalps: femur pentacarinata; patella with a dorsointernal carina and with several spinoid granules on the internal face; chela smooth, without carinae, only the internal face weakly granular. Fixed and movable fingers with 12/13 oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A-  $\alpha$  (Vachon, 1974, 1975). Legs: tarsus with numerous short thin setae ventrally. Tibial spurs present on legs III and IV; pedal spurs present on legs I to IV; all spurs moderate to strong.

**FEMALE** unknown.

**ECOLOGY**

The site the holotype of *Grosphus darainensis* sp. n. was collected is in a forested area forming a zone of exceptional ecotonal transition in the central portion of northern Madagascar known as the Daraina Forest, after the largest local village. This area is biotically very complex and the remaining forests are extensively reduced in size and fragmented. In a distance of a few kilometers there are shifts between forest formations typical of the dry deciduous forests of the west and humid forests of the east. Elevation, aspect, soil type, and distance to the sea are important parameters associated with these shifts. The specific site the holotype of *G. darainensis* sp. n. was collected is composed of lowland dry deciduous forest that is relatively intact, with little ground litter, relatively open understory, and resting on reddish lateritic soils.

Other species of scorpions known to occur in the forests of the Daraina area include *Heteroscorpion magnus* Lourenço & Goodman and *Tityobuthus darainensis* Lourenço & Goodman (Lourenço & Goodman, 2002).



**Fig. 5-8.** *Grosphus darainensis* sp. n. Male holotype. **5.** Chelicera. **6-7.** Femur and patella, dorsal aspect, showing trichobothria. **8.** Metasomal segments IV-V and telson, lateral aspect.

***Grosphus simoni* sp. n.**

Fig. 9-12, 18.

**MATERIAL EXAMINED:** Madagascar, Province de Toamasina, Forêt de Plateau de Makira, Forêt de Sahantaha, 7.7 km SW Soanafindra (5° 13.6' S – 49° 31.8' E), 300–1000 m (V. Andrianjakarivelo), 22/I/2003 (SMG-13646). 1 male holotype, deposited in the Field Museum of Natural History. Province de Mahajanga, Station Forestière (SF) d'Ampijoroa (16° 19.4' S – 46° 48.4' E), 160 m, in dry deciduous forest on white sand (S. M. Goodman), 18/IV/2003 (SMG 13617). 1 male paratype, deposited in the Muséum national d'Histoire naturelle, Paris.

**ETYMOLOGY:** Patronym is in honor of French arachnologist Eugene Simon, who described the genus *Grosphus*.

**DIAGNOSIS:** Scorpions of medium size with a total length of 54 to 60 mm. General coloration reddish yellow. Certain morphological characters indicate that *G. simoni* sp. n. is close to the *G. madagascariensis* / *G. hirtus* group, but it can be readily distinguished from the other species of this group by the following characters: (i) a much paler global coloration, with the appendages reddish yellow to yellowish; (ii) metasomal granulation and carinae strongly marked; (iii) dorsal carinae of metasomal segments II to IV with 2 to 6 strong posterior spinoid granules.

**DESCRIPTION based on male holotype and male paratype.**

**Measurements** in Table I.

**Coloration.** Basically reddish yellow to yellowish. Prosoma: carapace reddish with the posterior and lateral margins dark; eyes surrounded by black pigment. Mesosoma: reddish yellow with dark strips on the posterior margins of tergites. Metasoma: all segments reddish with some vestigial dark pigmentation on the ventral carinae. Telson reddish yellow without spots; aculeus with reddish yellow base and dark reddish tip. Venter: coxapophysis, sternum, genital operculum and pectines yellowish; sternites pale yellow with greenish zones; VII dark. Chelicerae yellowish with dark variegated pigmentation over the entire surface; fingers and teeth reddish. Pedipalps: reddish yellow. Legs yellowish without spots.

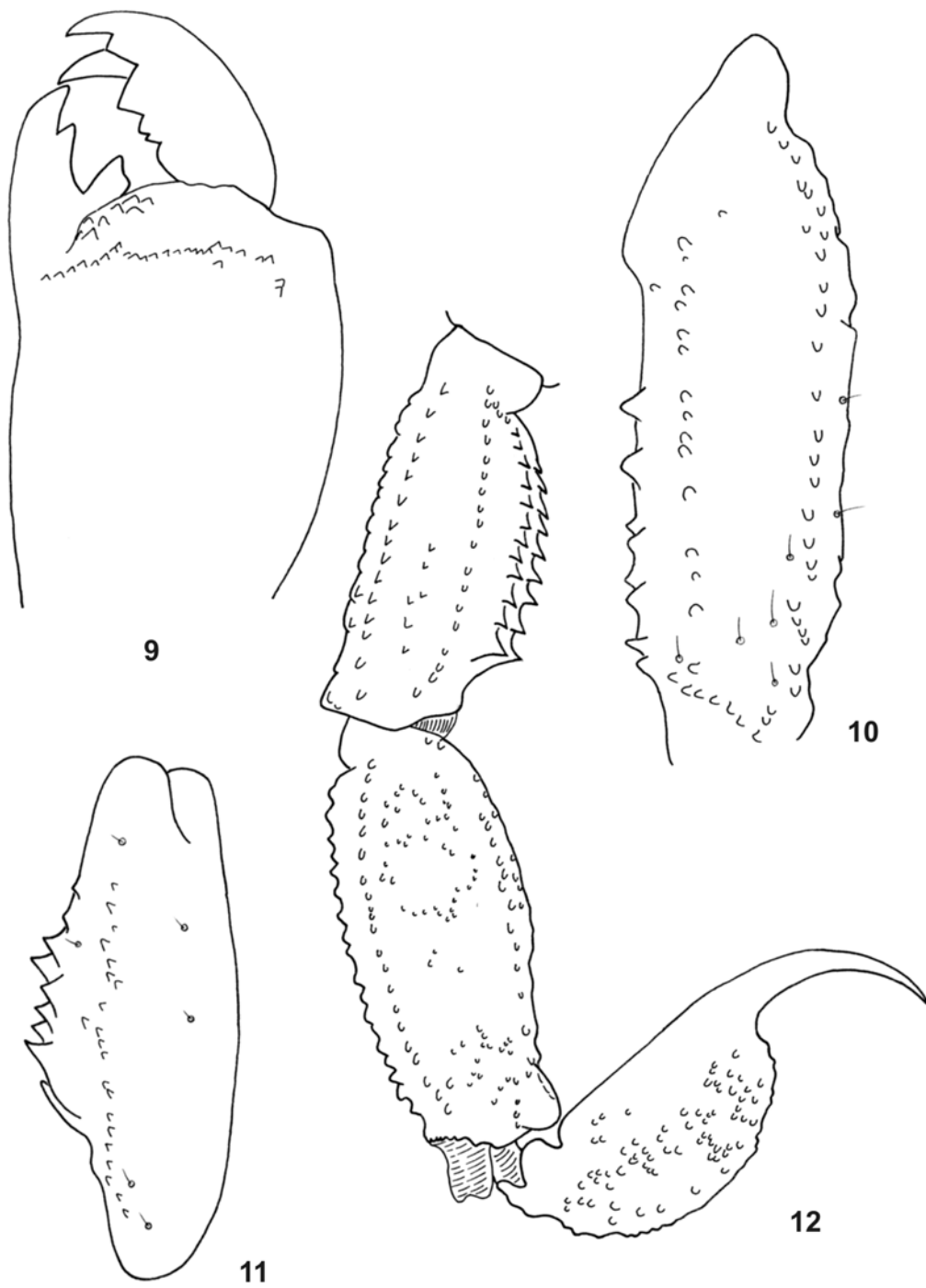
**Morphology.** Carapace moderately granular; anterior margin almost straight, with a weak median concavity.

All carinae weak; furrows moderately developed. Median ocular tubercle anterior to the center of carapace; median eyes separated by a little more than one ocular diameter. Three pairs of lateral eyes. Sternum sub-triangular in shape. Mesosoma: tergites with thin poorly intense granulation. Median carina moderately developed in all tergites. Tergite VII pentacarinata. Venter: genital operculum consisting of two semi-oval plates. Pectines: pectinal tooth count 16-16; basal middle lamellae of each pecten not dilated in males. Sternites smooth, with elongated stigmata; VII with four vestigial carinae. Metasoma: segments I to III with 10 carinae, crenulate; segment IV with eight carinae, crenulate. Segment V with five carinae. Dorsal carinae on segments II to IV with 2-6 strong posterior spinoid granules. Intercarinal spaces strongly granular. Telson strongly granular over latero-ventral and ventral surfaces; its dorsal surface smooth; aculeus moderately curved and shorter than the vesicle; subaculear tooth absent. Cheliceral 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. Pedipalps: femur pentacarinata; patella with a dorsointernal carina and with several strong spinoid granules on the internal face; chela smooth, without carinae, only the internal face weakly granular. Fixed and movable fingers with 12/13 oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A- $\alpha$  (Vachon, 1974, 1975). Legs: tarsus with numerous short thin setae ventrally. Tibial spurs present on legs III and IV; pedal spurs present on legs I to IV; all spurs strong.

**FEMALE** unknown.

**ECOLOGY.**

Within the Makira Forest, the site the holotype was collected, the following species of scorpions were collected by V. Andrianjakarivelo with pit-fall devices during an inventory of small mammals of this region: *Grosphus madagascariensis* (Gervais) and *Tityobuthus baroni* (Pocock). In contrast the scorpion fauna of the SF d'Ampijoroa, part of the Parc National d'Ankarafantsika is notably different and composed of *Grosphus madagascariensis*, *G. ankarafantsika*, *G. hirtus*, *G. garciai*, *Tityobuthus dastychi*, and *Opisthacanthus madagascariensis* (Lourenço, 2003).



**Fig. 9-12.** *Grosphus simoni* sp. n. Male holotype. **9.** Chelicera. **10-11.** Femur and patella, dorsal aspect, showing trichobothria. **12.** Metasomal segments IV-V and telson, lateral aspect.

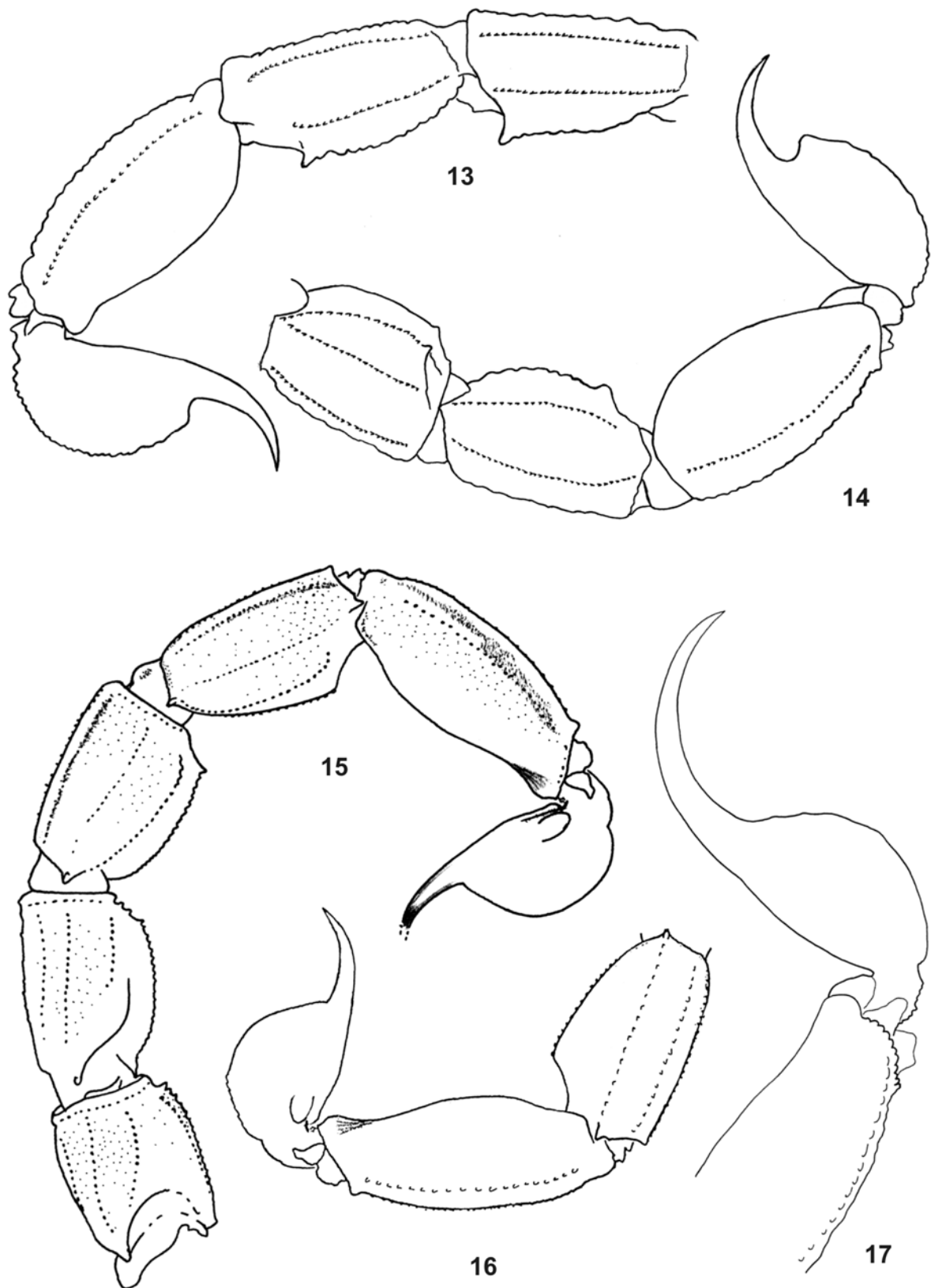
### Key to the species of the genus *Grosphus*

- 1 Pectines with a maximum of 21 teeth ..... 2
- Pectines with more than 22 teeth ..... 6
- 2 Coloration yellowish to reddish brown; variegated brownish pigmentation may be present or not ..... 3
- Coloration dark, from brown to dark brown or blackish ..... 5
- 3 Coloration reddish brown, with variegated brownish pigmentation; body length about 30 mm ... *G. garciai*
- Coloration yellowish to reddish yellow, without variegated pigmentation; body length from 40 to 55 mm ..... 4
- 4 Coloration yellowish; dorsal carinae of metasomal segments II-IV with one small spinoid posterior granule ..... *G. darainensis* sp. n.
- Coloration reddish yellow; dorsal carinae of metasomal segments II-IV with 2-6 strong spinoid posterior granules ..... *G. simoni* sp. n.
- 5 Coloration dark brown to blackish, without light spots; metasomal segment I longer than wide; basal middle lamellae of female pectines oval in shape ..... *G. madagascariensis*
- Coloration brown with lighter spots; metasomal segment I wider than long; basal middle lamellae of female pectines subquadrangular in shape ..... *G. hirtus*
- 6 Coloration blackish or reddish brown to yellowish; pectines with 30 to 40 teeth; body length more than 90 mm ..... 7
- Coloration reddish brown to yellowish, never blackish; body length less than 90 mm ..... 8
- 7 Coloration blackish throughout ..... *G. grandidieri*
- Coloration reddish brown to yellowish ..... *G. ankarana*
- 8 Mesosoma with homogenous coloration, reddish brown or yellowish ..... 9
- Mesosoma with a blackish median longitudinal band, or with two blackish lateral longitudinal bands ..... 14
- 9 Total length more than 65 mm; mesosoma reddish brown ..... *G. flavopiceus*
- Total length less than 60 mm; mesosoma dark yellow; metasomal segment V and telson with or without blackish spots ..... 10
- 10 Metasomal segments and telson without blackish spots ..... 11
- Metasomal segments and telson with blackish spots ..... 12
- 11 Metasomal segments yellowish, with moderate to strong carinae on II to IV ..... *G. intertidalis*
- Metasomal segments reddish yellow; rounded and with vestigial carinae ..... *G. mahafaliensis* sp. n.
- 12 Metasomal segment V and telson with blackish spots ..... *G. annulatus*
- Metasomal segment V and telson blackish ..... 13
- 13 Telson with aculeus of the same length or shorter than the vesicle ..... *G. feti*
- Telson with aculeus longer than the vesicle ..... *G. olgae*
- 14 Mesosoma with a wide blackish median longitudinal band; basal middle lamellae of female pectines three times longer than wide at their base and covering the 4 proximal teeth ..... *G. limbatus*
- Mesosoma with two narrow blackish lateral longitudinal bands ..... 15
- 15 Carapace without a blackish triangular spot; basal middle lamellae of female pectines weakly curved, widening in proximal half and covering the two proximal teeth ..... *G. bistriatus*
- Carapace with a blackish triangular spot; basal middle lamellae of the female pectines curved and constantly narrowing from the base to apex covering the four proximal teeth ..... *G. ankarafantsika*

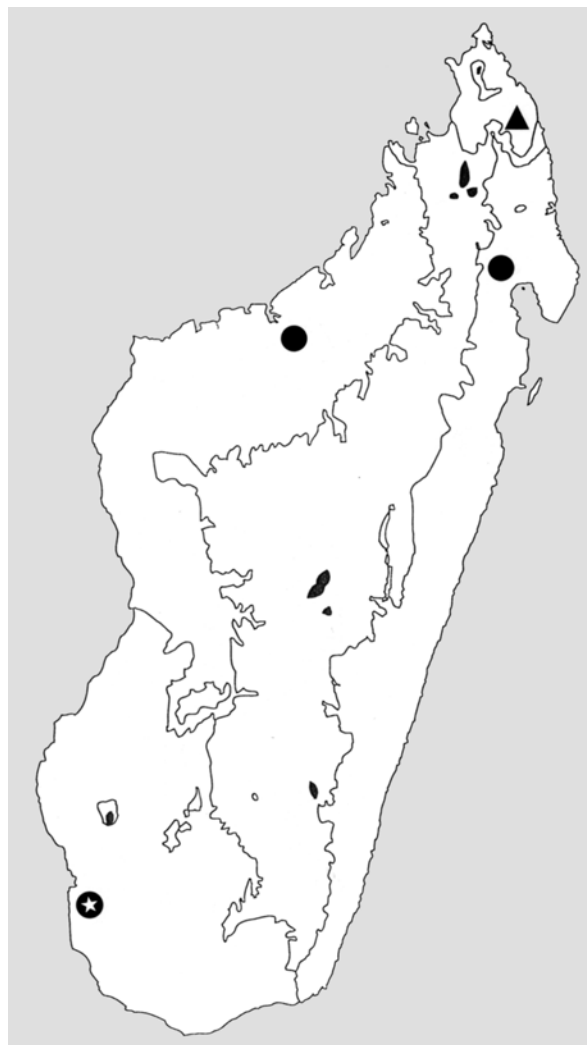
### Acknowledgements

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**Fig. 13-17.** Metasomal segments and telson, lateral aspect. **13.** *Grosphus madagascariensis* (male). **14.** *Grosphus garciai* Lourenço (male). **15.** *Grosphus intertidalis* Lourenço (female). **16.** *Grosphus ankarafantsika* Lourenço (female). **17.** *Grosphus olgae* Lourenço (male).



**Fig. 18.** Map of Madagascar with the type localities of the three new *Grosphus* species. *Grosphus mahafaliensis* sp. n. (▲), *Grosphus darainensis* sp. n. (●), and *Grosphus simoni* sp. n. (★).

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