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THE GENUS *BUTHUS* LEACH, 1815 IN ALGERIA (SCORPIONES: BUTHIDAE) AND A POSSIBLE NEW CASE OF VICARIANT SPECIES

Haroun Abidi[1], Salah Eddine Sadine[2], Moussa Houhamdi[1],
Amar Madoui[3] & Wilson R. Lourenço[4]

[1] Laboratoire Biologie, Eau et Environnement (LBEE), Faculté SNV-STU, Université 8 Mai 1945 Guelma. BP. 401 24000 Guelma, Algeria. abidiharoun824@gmail.com
[2] Faculté des Sciences de la Nature et de la Vie et Sciences de la terre, Université de Ghardaïa, BP 455 Ghardaïa 47000, Algeria. sse.scorpion@yahoo.fr
[3] Chercheur indépendant, Cité Ziadna Ali, Ain Arnat, Sétif 19017, Algérie. madoui.amar@courrier.uqam.ca
[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

Abstract: One more new species of *Buthus* is described from the coastal region of El-Tarf, in the north-eastern range of Algeria. This new species may represent a possible vicariant element of *Buthus paris* (C. L. Koch, 1839), a species equally known from the north of Algeria, but inhabiting much higher altitudes in the coastal massifs. The number of confirmed species of *Buthus* in Algeria is raised to nine.
Key words: Scorpiones, Buthidae, *Buthus*, new species, vicariant, Algeria, north-eastern range.

El género *Buthus* Leach, 1815 en Argelia (Scorpiones: Buthidae) y un posible nuevo caso de especies vicarias
Resumen: Se describe otra especie nueva de *Buthus* de la región costera de El-Tarf, en la cordiller nororiental de Argelia. Esta especie nueva puede ser vicaria de *Buthus paris* (C. L. Koch, 1839), especie conocida igualmente del norte de Argelia pero propia de altitudes mucho mayores, en las sierras costeras. El número de especies confirmadas de *Buthus* de Argelia se eleva a nueve.
Palabras clave: Scorpiones, Buthidae, *Buthus*, especie nueva, vicaria, Argelia, cordillera nororiental.

Taxonomy / Taxonomía: *Buthus goyffoni* **sp. n.** Abidi, Sadine & Lourenço

Introduction

In several previous publications, the remarkable progress in the number of species for the genus *Buthus* Leach, 1815 was exhaustively discussed. For a precise synopsis one can refers to Lourenço *et al*. (2020). Recent field work performed by one of the authors (H. A.) in the Region of El-Tarf, NE range of Algeria (Fig. 1 Map), habitat located in the coastal ecosystems of the country, leads to the collection of some distinct *Buthus* specimens. Precise analysis of these specimens confirmed that these were different from *Buthus paris* (C. L. Koch, 1839) and *Buthus pusillus* Lourenço, 2013, two species also currently distributed in the coastal zones of North of Algeria. The population from El-Tarf apparently show more affinities with *Buthus paris*, but a number of differences, mainly their global sizes, details in the pectines and trichobothrial patterns could however be outlined. Consequently, a new species of *Buthus* is described at present. The populations of the two species most probably correspond to one more case of vicariance between elements inhabiting quite distinct habitats in Algeria.

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. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Vachon (1952) and Hjelle (1990).

Results

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

Genus ***Buthus*** Leach, 1815

Check-list of the *Buthus* species present in Algeria

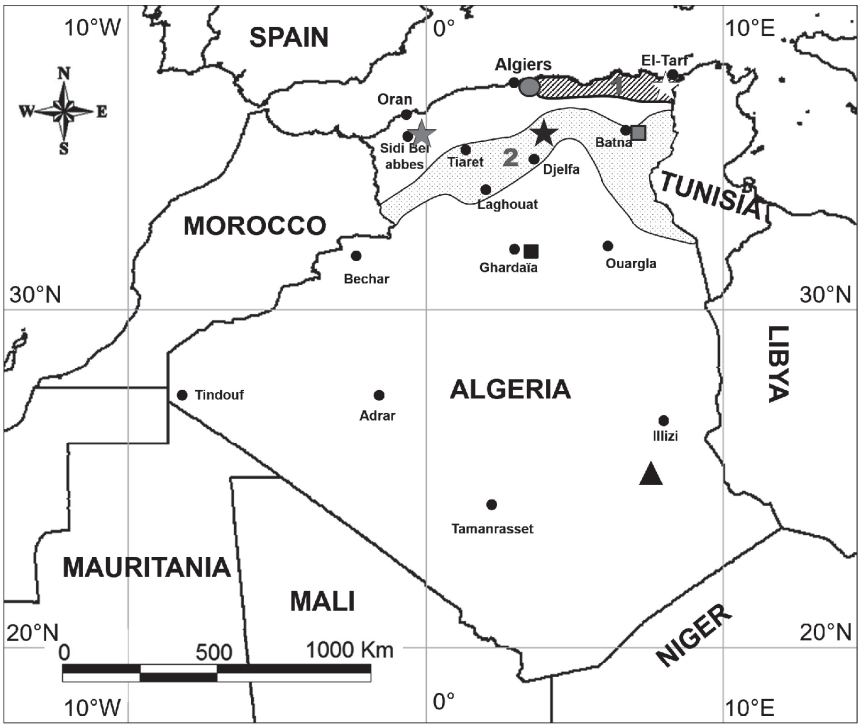
Buthus tunetanus (Herbst, 1800)
Buthus paris (C. L. Koch, 1839)
Buthus tassili Lourenço, 2002
Buthus pusillus Lourenço, 2013
Buthus saharicus Sadine, Bissati & Lourenço, 2016
Buthus aures Lourenço & Sadine, 2016
Buthus boussaadi Lourenço, Chichi & Sadine, 2018
Buthus apiatus Lourenço, El Bouhissi, Sadine, 2020
Buthus goyffoni sp. n. Abidi, Sadine & Lourenço

Buthus paris (C. L. Koch, 1839) - Revised diagnosis

Androctonus paris C. L. Koch, 1839: 25-28, pl. CLI, fig. 352.

For this diagnosis we only take in account the populations ranging from the Tunisian Coastal Massifs to the region of Alger, defined by Vachon (1952) as the group I and which corresponds to the typical form of *Buthus paris*. The other two groups defined by Vachon (1952) from W Algeria and Morocco most certainly correspond to different species (Lourenço, 2017). New illustrations are proposed based on specimens collected in Babor- Sétif, located in the mountainous system of North of Algeria (Figs. 2-8).

Scorpion of moderate to large size, with a total length ranging from 60 to 75 mm in both females and males. General coloration yellow to pale yellow carapace densely spotted; tergites with conspicuous confluent spots; metasomal



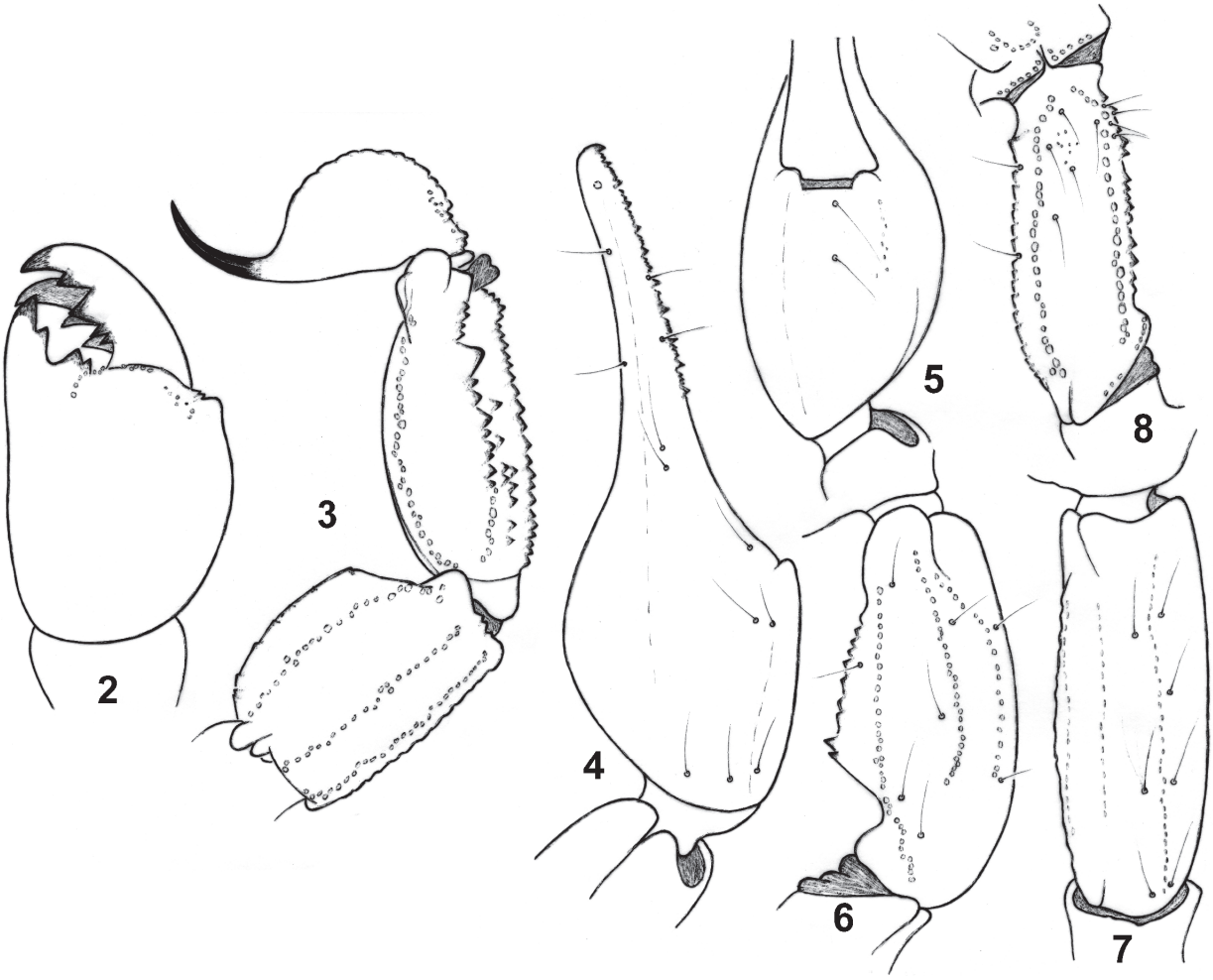


Fig. 1. Map of Algeria, showing the distribution of the known *Buthus* species. *Buthus paris* (dashed area 1). *Buthus tunetanus* (dashed area 2). *Buthus tassili* (▲ black triangle). *Buthus pusillus* (● gris circle). *Buthus saharicus* (■ black square). *Buthus aures* (■ gris square). *Buthus boussaadi* (★ black star). *Buthus apiatus* (★gris star). *Buthus goyffoni* sp. n. (★ white star). **Figs. 2-3.** *Buthus paris*, male from Sétif. **2**. Chelicera, dorsal aspect. **3**. Metasomal segments IV-V and telson, lateral aspect. **Figs. 4-8.** *Buthus paris*, male from Sétif. Trichobothrial pattern. **4-5**. Chela, dorso-external and ventral aspects. **6-7**. Patella, dorsal and external aspects. **8**. Femur, dorsal aspect.

segments without spots, excepted by the ventral carinae which are slightly brownish; pedipalps and legs without spots; chelicerae yellow, without variegated spots. Carinae and granulations strongly marked on carapace, tergites and metasomal segments. Fixed and movable fingers with 12-13 rows of granules. Pectines with respectively 20 to 25 and 27 to 30 teeth in females and males. Tibial spurs moderately to strongly develop. Trichobothrial pattern as illustrated in figures 4-8.

Buthus goyffoni sp. n. Abidi, Sadine & Lourenço

Figs. 9-21.

MATERIAL: Algeria, NE, region of El-Tarf, 16/XI/2019 (H. Abidi), male holotype; 3 males and 3 female paratypes. Holotype and 2 male paratypes deposited in Muséum national d'Histoire naturelle, Paris; 1 male and 3 female paratypes deposited in the University of Ghardaïa, Algeria.

PATRONYM: Name honours the late Dr Max Goyffon, MNHN, Paris.

DIAGNOSIS: Scorpion of moderate to large size, with a total length ranging from 45 to 49 mm for males and 31 to 36 mm for females. General coloration blackish-yellow; carapace and tergites densely spotted; tergites with conspicuous confluent spots; metasomal segments yellow with blackish spots over the carinae legs and pedipalps yellow without spots; chelicerae yellow with variegated spots on the anterior and external lateral zones. Carinae strongly marked on carapace, tergites and metasomal segments; granulations from moderate to weak. Fixed and movable fingers with 11-11 or 11-12 rows of granules. Pectines with respectively 25 teeth in females and 27 to 29 teeth in males. Tibial spurs strongly developed.

DESCRIPTION based on male holotype and paratypes. Measurements on Table I.

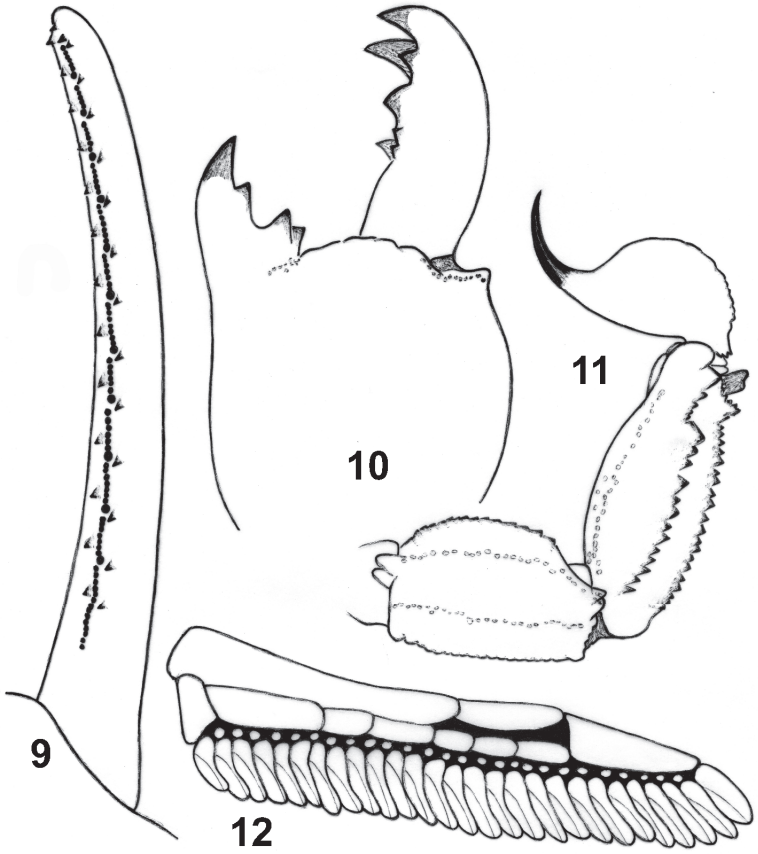
Table I. Morphometric values (in mm) of the *Buthus* species treated in this study

	B. paris Male from Sétif	*B goyffoni* sp. n. Male holotype
Total length*	55.0	45.7
Carapace:		
Length	6.7	5.2
Anterior width	4.5	3.8
Posterior width	7.5	6.2
Mesosoma length	13.2	12.1
Metasomal segment I:		
Length	4.5	3.4
Width	4.8	3.7
Metasomal segment II:		
Length	5.0	4.0
Width	4.6	3.6
Metasomal segment III:		
Length	5.4	4.3
Width	4.6	3.4
Metasomal segment IV:		
Length	6.3	5.1
Width	4.3	3.3
Metasomal segment V:		
Length	7.5	6.3
Width	4.0	3.0
Depth	3.4	2.6
Telson length	6.4	5.3
Width	3.3	2.6
Depth	2.7	2.3
Femur:		
Length	5.6	4.5
Width	2.0	1.6
Patella:		
Length	6.4	5.3
Width	2.8	2.2
Chela:		
Length	11.3	9.2
Width	3.2	2.1
Septh	3.5	2.2
Movable finger:		
Length	7.3	6.2

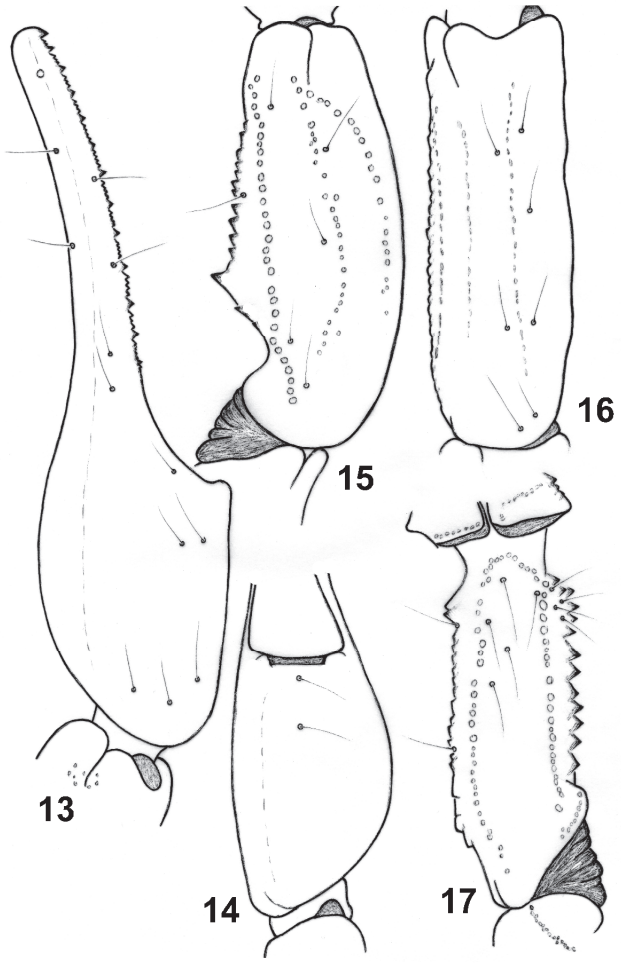
* including telson

Coloration basically yellow to blackish-yellow. Prosoma: Carapace yellow densely spotted with blackish pigments on carinae and ocular tubercle. Mesosoma yellow with conspicuous blackish confluent spots. Metasomal segments yellow with conspicuous blackish spots on carinae; vesicle yellow; aculeus yellowish at its base and dark red at its extremity. Venter yellow; pectines pale yellow. Chelicerae yellow with variegated spots covering the anterior 1/3 of the total surface and the external lateral zones; fingers yellow with almost blackish teeth. Pedipalps yellow without spots; fingers with the oblique rows of granules dark red. Legs yellow without spots.

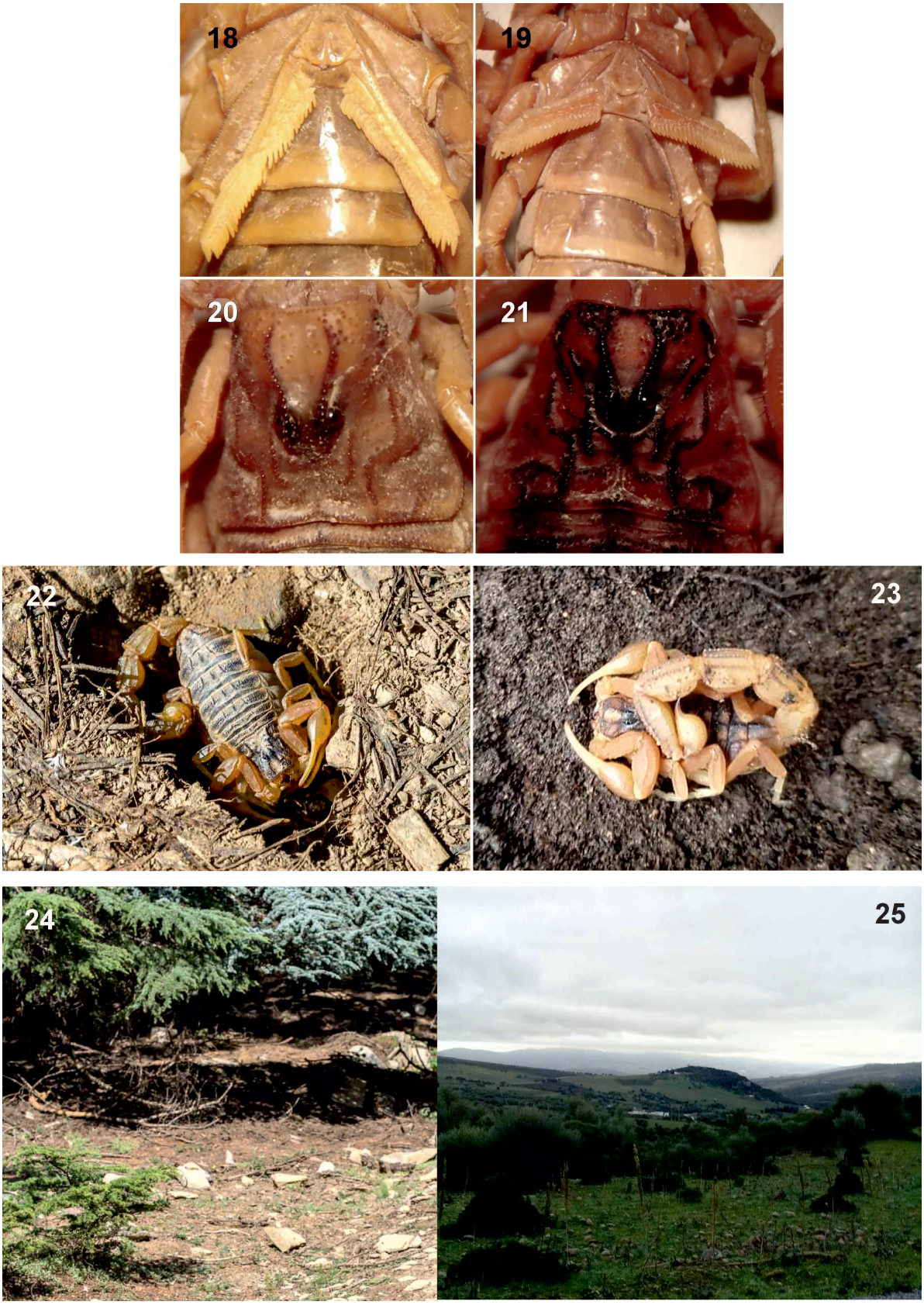
Morphology. Carapace moderately granular; anterior margin with a weak concavity. Carinae strongly marked; anterior median, central median and posterior median carinae strongly granular, with 'lyre' configuration. All furrows moderate. Median ocular tubercle located in the centre of the carapace. Eyes separated by about two ocular diameters. Three pairs of lateral eyes of moderate size in relation to median eyes. Sternum triangular, weakly narrowed; slightly wider than long. Mesosoma: tergites strongly granular. Three longitudinal carinae moderately to strongly crenulate in all tergites; lateral carinae reduced in tergites I and II. Tergite VII pentacarinate. Venter: genital operculum divided longitudinally, which plate with a semi-oval shape. Pectines: pectinal tooth count 29-28 in male holotype (see diagnosis for variation); middle basal lamella of the pectines not dilated. Sternites without granules, smooth with elongated spiracles; four moderate carinae on sternite VII; two on VI; other sternites almost acarinated and with two vestigial furrows. Metasomal segments with a weak to moderate setation; segments I to III with ten crenulated carinae; intermediate incomplete on III; ventral slightly better marked on II-III but without lobate granules; segment IV with eight carinae, crenulated; the first four segments with an almost smooth dorsal depression; segment V with five carinae; the latero-ventral carinae crenulate with 3-4 lobate denticles posteriorly; ventral median carina not divided posteriorly; anal arc composed of 9-10 ventral teeth, and two lateral lobes. Intercarinal spaces weakly granular. Telson with some granulations ventrally and laterally; aculeus curved and slightly shorter than the vesicle, without a subaculear tubercle. Cheliceral dentition as defined by Vachon (1963) for the family Buthidae; external distal and internal distal teeth approximately the same length; basal teeth on movable finger small but not fused; ventral aspect of both fingers and manus covered with long dense setae. Pedipalps with a weak setation; femur pentacarinate; patella with 8-9 carinae, moderately to strongly marked; all faces weakly granular; chela smooth, with vestigial carinae. Fixed and movable fingers with 11-11 or 11-12 oblique rows of granules. Internal and external accessory granules present, moderately strong; three accessory granules on the distal end of the movable finger next to the terminal denticle. Legs: tarsus with two longitudinal rows of moderately long setae ventrally; tibial spurs



Figs. 9-12. *Buthus goyffoni* sp. n. Male holotype (9-11); male paratype (12). **9**. Cutting edge of chela movable finger with rows of granules. **10**. Chelicera, dorsal aspect. **11**. Metasomal segments IV-V and telson, lateral aspect. **12**. Pecten.



Figs. 13-17. *Buthus goyffoni* sp. n. Male holotype. Trichobothrial pattern. **13-14**. Chela, dorso-external and ventral aspects. **15-16**. Patella, dorsal and external aspects. **17**. Femur, dorsal aspect.



Figs. 18-21. *Buthus goyffoni* sp. n. Male and female paratypes. **18-19**. Ventral aspect showing male and female genital operculum and pectines; to notice that pectines do not overlap. **20-21**. Male and female carapaces showing pigmentation. **Figs. 22-23.** Male of *B. paris* and male paratype of *B. goyffoni* sp. n. in their natural habitat. **Figs. 24-25**. Natural biotopes in the regions of Sétif and El-Tarf.

strong on legs III and IV; pedal spurs strong on legs I to IV. Trichobothriotaxy: trichobothrial pattern of Type A, orthobothriotaxic as defined by Vachon (1974). Dorsal trichobothria of femur arranged in β (beta) configuration (Vachon, 1975).

RELATIONSHIPS: *Buthus goyffoni* sp. n. shows similarities with *Buthus pusillus* by its small size, with values always inferior to 50 mm in total length for both species. The two species differ, however, in their coloration pattern with longitudinal strips on the mesosoma for *B. pusillus* and confluent strips for the new species. The pigmentation pattern of *Buthus goyffoni* sp. n. is closer to that of *Buthus paris* but the two species can be distinguished by a number of other characters: (i) a much smaller in size for the new species which ranges from 31 to 49 mm in total length versus 60 to 75 in *B. paris*, (ii) pectines in the new species do not overlap in their proximal zone, including in males, (iii) the new species has a smaller number of rows of granules on the chela fingers; 11-11 or 11-12 versus 12-13 for *B. paris*, (iv) fixed finger trichobothrium **est** is distal to **db** in *B. paris* while it is proximal in the new species. More important, both species inhabit quite different biotopes. See ecological section. This pattern of geographical distribution may suggest the existence of vicariant populations.

TAXONOMIC COMMENTS. Vachon (1952) defined the *Buthus* populations of the Coastal zones ranging from Tunisia to Morocco in two subspecies, *Buthus occitanus tunetanus* (Herbst, 1800) and *Buthus occitanus paris* (C. L. Koch, 1839). He indicated, however the possible existence of local groups or varieties. In fact, the most recent studies lead, in most cases, to the conclusion that those varieties are in fact distinct species (Lourenço, 2013, 2017; Lourenço *et al*., 2020). This particular biogeographical pattern suggests the existence of micro-endemic vicariant populations in distinct biotopes of the Coastal region of North Africa (Lourenço, 2013, 2017; Lourenço *et al*., 2018, 2020). For Tunisia, Kovařík (2006) proposed two new species equally associated to *B. tunetanus* and *B. paris*. Although we cannot have a final opinion about the validity of these two species, they apparently are valid and in all cases totally distinct from the species defined for the Coastal region of Algeria. This supports once more the existence of micro-endemic populations of *Buthus*, what was recently suggested by Teruel & Turiel (2020) for Spain.

Comparative ecological characteristics between the regions of El-Tarf and Sétif

Buthus paris was already defined by Vachon (1952) as a typical species of the high massifs of the coastal zones of Tunisia, Algeria and Morocco. We take here as example the population of *B. paris* observed in the region of Babor - Sétif. This region is located close to the Mediterranean Sea, but at altitudes of 1900 to 1960 m. The bioclimatic conditions are of the Semi-Arid type (Barkat, 2014) with rather cold winters and temperatures can range from 5.9°C in January to 26°C in August. Snow is present during at least 160 days per year (Seltzer, 1946) with important quantities reaching 4 meters in certain locations (Madoui, 2019). Annual precipitation reaches 450 mm per year and the typical vegetation is mostly represented by *Cedrus atlantica*, *Abies numidica* and *Quercus canariensis* (see Madoui, 2019).

In contrast the region of El Tarf, where the new species was collected is also located close to the Mediterranean Sea, but at altitudes ranging only from 220 to 250 m. The bioclimatic conditions are those of the sub-wet type with moderately cold to warm winters (Sobhi, 2009) with temperatures which can range from 12°C in January to 27.5°C in August. Annual precipitation reaches 800 to 1000 mm per year and the typical vegetation is mostly represented by *Pinus halepensis*, *Quercus suber*, *Quercus canariensis* and *Fraximus* sp. (see Sobhi, 2009).

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