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A new species of *Buthus* Leach, 1815 from the Atlantic coast of Morocco (Scorpiones: Buthidae)

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 Morocco.

Abstract. – The status of the *Buthus* population occurring on the Atlantic coast of Morocco, from Kenitra to El Jadida, originally reported to belong to *Buthus occitanus occitanus* (Amoreux, 1789) then remaining unnamed since studies demonstrated that *B. occitanus* range does not extend beyond Western Europe, is clarified and this population is described as a new species, *B. maamora* **sp. n.** The new species shows affinities with *B. atlantis* Pocock, 1889 and *B. parroti* Vachon, 1949 but can be easily distinguished from these two species by a combination of several key characters. The new taxon described here represents the 19th known *Buthus* species reported from Morocco and raises the number of currently recognized species for the genus *Buthus* to 79.

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Introduction

In his monographic work on scorpions of North Africa, Vachon (1952) reported the *Buthus* population occurring on the Atlantic coast of Morocco, from Kenitra to El Jadida, to belong to *B. occitanus* (Amoreux, 1789) (*B. o. occitanus* according to Vachon, 1952). It is now well known and admitted that the distribution of *B. occitanus* is restricted to Southwest France and Northeast Spain (Gantenbein & Largiadèr, 2003; Lourenço & Vachon, 2004; Lourenço *et al.*, 2012; Sousa *et al.*, 2012; Rossi, 2012; Pedrosa *et al.*, 2013; Teruel & Turiel, 2020; Ythier, 2021, 2022) and so this Moroccan population is not conspecific. The study of the scorpion collection from the late Dr. André Prost (1944-2023), recently bequeathed to the Museum of Lyon, France, including a *Buthus* specimen collected in the Maâmora forest between Kenitra and Rabat, led to re-open the question of the clarification of the status of this Moroccan population that remained unnamed since studies demonstrated that *B. occitanus* range does not extend beyond Western Europe (Sousa *et al.*, 2017), and to the description of a new species, *B. maamora* **sp. n.** The new taxon described here represents the 19th known *Buthus* species reported from Morocco (Dupré, 2017; Touloun, 2019) and raises the number of currently recognized species for the genus *Buthus* to 79.

Methods

Illustrations and measurements were made with the aid of a Motic SMZ-1713 stereo-microscope with an ocular micrometer, together with a digital camera Tucsen HD Lite, a Canon EOS 7D camera and a Wacom Intuos drawing tablet. Maps were made using Google Maps and Adobe Photoshop.

Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Vachon (1952) and Hjelle (1990). Specimens studied herein are deposited in the MHNL (Musée d'Histoire Naturelle de Lyon (Musée des Confluences), CCEC, Lyon, France) and EYCP (Eric Ythier Private Collection, Romanèche-Thorins, France).

Composition of the genus *Buthus* in Morocco (in order of description)

- *Buthus tunetatus* (Herbst, 1800)
- *Buthus paris* (C. L. Koch, 1839)
- *Buthus mardochei* Simon, 1878
- *Buthus atlantis* Pocock, 1889
- *Buthus maroccanus* Birula, 1903
- *Buthus nigrovesiculosus* Hirst, 1925
- *Buthus malhommei* Vachon, 1949
- *Buthus parroti* Vachon, 1949
- *Buthus albengai* Lourenço, 2003
- *Buthus lienhardi* Lourenço, 2003
- *Buthus mariefranceae* Lourenço, 2003
- *Buthus rochati* Lourenço, 2003
- *Buthus draa* Lourenço & Slimani, 2004
- *Buthus bonito* Lourenço & Geniez, 2005
- *Buthus elmoutaouakili* Lourenço & Qi, 2006
- *Buthus boumalenii* Touloun & Boumezzough, 2011
- *Buthus confluens* Lourenço, Touloun & Boumezzough, 2012
- *Buthus oudjani* Lourenço, 2017
- *Buthus maamora* **sp. n.**

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Taxonomic treatment

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

Genus *Buthus* Leach, 1815

Buthus maamora sp. n.

(Fig. 1-7, Tab. I-II)

ZooBank: <https://zoobank.org/8E3CB9AD-CC2E-4862-BCEB-5AAD73B665CD>

Buthus occitanus occitanus

Vachon, 1952: 264-270,

Le Corroller, 1967: 63,

Gantenbein & Lariadèr, 2003: 120, 122,

Lambert & Dupré, 1993: 8;

Buthus occitanus

Fet *et al.*, 2000: 94,

Lourenço, 2003: 884,

Stockmann & Ythier, 2010: 338,

El Hidan *et al.*, 2017: 675-677;

Buthus sp.

Sousa *et al.*, 2017: 54-55.

Holotype, ♀, Morocco, Kenitra, Mamora (Maâmora) forest, 10/IV/1967 (A. Prost), deposited in the MHNL.

Etymology. – The specific epithet is placed in apposition to the generic name and refers to the Maâmora forest, between Kenitra and Rabat, where the holotype of the new species was collected. The Maâmora forest is the largest forest in Morocco and is considered to be the largest cork oak (*Quercus suber* L., 1753) forest of the world.

Diagnosis. – Scorpion of moderately large size for the genus, with a total length of 69-71 mm. General coloration yellowish orange to brownish orange; tergites with confluent dark brownish spots. Carinae and granulations moderately to strongly marked on carapace and tergites. Pectines with 24-30 teeth in female, 29-35 teeth in male. Metasomal segment I wider than long in female (length/width ratio 0.92-0.98) and male (length/width ratio 0.92); intermediate carinae complete on segment I, present on distal two thirds of II, on distal half on III, absent on IV-V; telson vesicle bulky, aculeus curved and shorter than the vesicle (aculeus/vesicle ratio 0.68-0.73); anal arch with two lateral lobes. Pedipalp chela manus wider than patella in female (manus/patella width ratio 1.14), as wide as patella in male (manus/patella width ratio 1.00); chela fingers with lobe/notch combination absent; fixed finger with 12-13 rows of granules, movable finger with 13 rows of granules. Metasomal segments with a weak setation, 'oligotrichous' as defined by Vachon (1952). Leg IV retrolateral pedal spur with 1-2 setae.

Description (based on female holotype)

Coloration. – Basically yellowish orange to brownish orange. Prosoma: carapace yellowish orange with median and lateral ocular tubercles marked with dark pigments; carinae infusate. Mesosoma: tergites yellowish orange with confluent dark brownish spots. Metasomal segments yellowish orange with some carinae slightly infusate; telson vesicle yellowish orange, aculeus reddish at its base and blackish at its extremity. Venter yellowish orange to reddish; genital operculum and pectines paler than the other zones. Chelicerae yellowish; fingers yellowish with dark red teeth. Pedipalps yellowish orange without spots; fingers with the oblique rows of granules dark red. Legs yellowish orange.

Morphology. – Carapace moderately to strongly granular; anterior margin with a weak concavity. Carinae strongly marked; anterior median, central median and posterior median carinae strongly granular, with 'lyre' configuration. Furrows deep. 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: three longitudinal carinae moderately to strongly crenulate in all tergites; lateral carinae reduced in tergites I and II; tergite VII pentacarinat. Tergites I-VI moderately to strongly granular on lateral sides; the central area between lateral carinae minutely granular; tergite VII entirely minutely granular. Venter: genital operculum divided longitudinally, each plate with a semi-oval shape. Pectines: pectinal tooth count 25-26; middle basal lamella of the pectines not dilated. Sternites without granules, smooth with elongated spiracles; four moderate carinae on sternite VII; four weak carinae on VI; other sternites acarinat and with two vestigial furrows. Metasomal segments with a weak setation, 'oligotrichous' as defined by Vachon (1952); segment I with ten complete

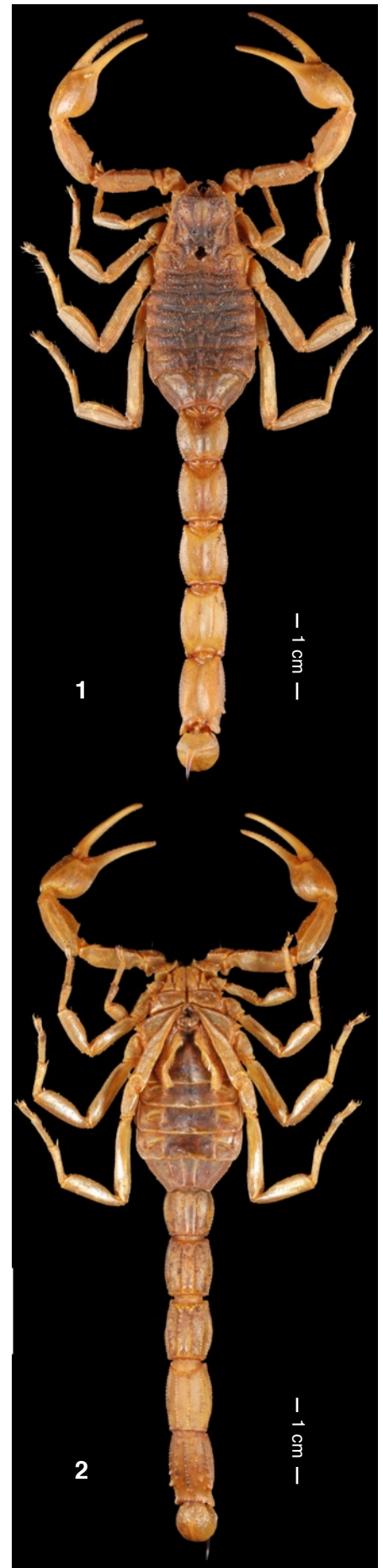


Fig. 1-2. *Buthus maamora* sp. n., ♀ holotype, habitus (dried specimen). 1. Dorsal aspect. 2. Ventral aspect.

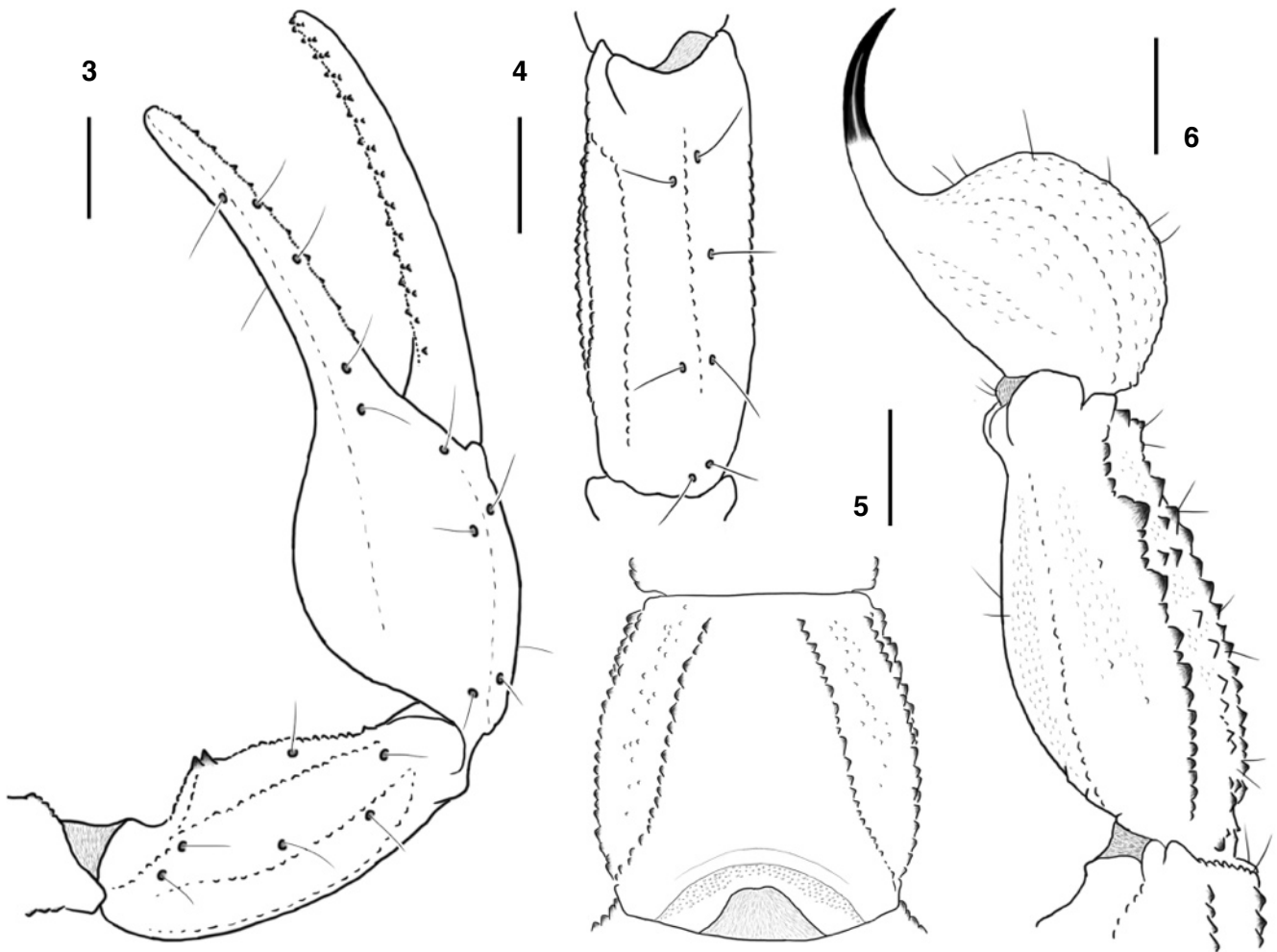


Fig. 3-6. *Buthus maamora* sp. n., ♀ holotype. **3-4.** Trichobotrial pattern. **3.** Right pedipalp patella and chela, dorsal aspect. **4.** Right pedipalp patella, external aspect. **5-6.** Metasoma. **5.** Segment I, dorsal aspect. **6.** Segment V and telson, lateral aspect. (Scale bars = 2 mm).

carinae, II-III with eight complete carinae, IV and V with eight and five carinae, respectively; intermediate carinae complete on segment I, present on distal two thirds of II, on distal half on III, absent on IV-V; dorsal and dorsolateral carinae vestigially to weakly subcrenulate; ventral carinae strongly marked and raised distally on II-III; segment V with ventrolateral carinae crenulate with 2-3 lobate denticles posteriorly; ventral median carina divided posteriorly, over 1/3 of the total length; anal arc composed of 9 ventral teeth and two lateral lobes. Intercarinal spaces minutely granular on segment V, especially dorsally; other segments almost smooth; metasomal segment I wider than long (length/width ratio 0.92-0.98). Telson with some granulations ventrally; aculeus curved and shorter than the vesicle (aculeus/vesicle ratio 0.68-0.73), 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 and not fused; ventral aspect of both fingers and manus covered with long dense setae. Pedipalps with a weak setation, 'oligotrichous' as defined by Vachon (1952); femur pentacarinat; patella with 8 carinae moderately to strongly marked, internal with 9-10 spinoid granules, all faces weakly granular; chela with vestigial carinae, almost smooth; chela manus wider than patella (manus/patella width ratio 1.07), as wide as patella in male (manus/patella width ratio 1.00); fingers with lobe/notch combination absent; fixed and movable fingers with 13-13 rows of granules; internal and external accessory granules present, stronger than principal granules; three accessory granules on the distal end of the movable finger next to the terminal denticle. Legs: tibial spurs strong on legs III and IV; pedal spurs strong on legs I to IV, leg IV retrolateral pedal spur with 1-2 setae. Trichobothriotaxy: trichobothrial pattern of Type A, orthobothriotaxic as defined by Vachon (1974). Dorsal trichobothria of femur arranged in β (beta) configuration (Vachon, 1975).

Morphometric values (mm) of the female holotype (morphometric ratios in Tab. I-II).

- **Total length** (including telson) 68.65
- **Carapace**
length 8.88;
posterior width 9.88.
- **Mesosoma**: length 15.13.
- **Metasomal segments**
I, length 5.63; width 5.75; depth 5.00;
II, length 6.50; width 5.50; depth 4.88;
III, length 6.75; width 5.38; depth 4.88;
IV, length 7.88; width 5.13; depth 4.63;
V, length 9.00; width 4.75; depth 4.13.
- **Telson**: length 8.88.
- **Vesicle**: length 5.25; width 4.50; depth 4.13.
- **Pedipalp**
femur, length 7.38; width 2.38;
patella, length 8.25; width 3.50;
chela, length 15.13;
chela manus, length 5.63; width 4.00; depth 4.25;
movable finger length 9.50.

Comparisons. – As previously mentioned, the *Buthus* population occurring on the Atlantic coast of Morocco from Kenitra to El Jajida, described here as *Buthus maamora* sp. n., was originally considered as *B. occitanus* (*B. o. occitanus* according to Vachon, 1952). It is now well admitted that the distribution of *B. occitanus* is restricted to Southwest France and Northeast Spain, and so this Moroccan population is not conspecific.

However, both species can be easily distinguished notably by the main features indicated below.

In Morocco, *Buthus maamora* **sp. n.** show some morphological affinities with two other species also occurring on the Atlantic coast: *B. atlantis*, occurring south of the distribution of the new species, in sandy dune habitats from Essaouira up to the south of Agadir, and *B. parroti* (originally described as *B. atlantis parroti*), from forest habitat in the Souss Valley, between the southwest of Agadir and Taroudant). Both species can also be easily distinguished notably by the main features indicated below.

- *B. occitanus*

(i) general coloration slightly paler, notably on tergites (darker in *B. maamora* **sp. n.**);

(ii) male slightly smaller with 54-64 mm total length (69 mm in *B. maamora* **sp. n.**);

(iii) pedipalp chela manus slenderer with length/width ratio 1.44-1.66 in female (1.25-1.41 in *B. maamora* **sp. n.**) and 1.68-1.87 in male (1.50 in *B. maamora* **sp. n.**);

(iv) male pedipalp chela manus narrower than patella, with manus/patella width ratio 0.87-0.99 (same width as patella in *B. maamora* **sp. n.** with manus/patella width ratio 1.00);

(v) metasomal segment I longer than wide with length/width ratio 1.02-1.07 in female and 1.03-1.13 in male (wider than long in *B. maamora* **sp. n.** with length/width ratio 0.92-0.98 in female and 0.92 in male);

(vi) metasomal segments IV and V narrower in both sexes with length/width ratio lower than in *B. maamora* **sp. n.** (see Tab. I-II);

(vii) male telson vesicle less bulky with telson length/width ratio 2.30-2.41 (2.23 in *B. maamora* **sp. n.**) and vesicle length/width ratio 1.27-1.39 (1.25 in *B. maamora* **sp. n.**);

(viii) several other distinct morphometric values (see Tab. I-II);

(ix) a totally allopatric geographic distribution (southwest France and northeast Spain).

- *B. atlantis*

(i) general coloration slightly paler, notably on tergites (darker in *B. maamora* **sp. n.**);

(ii) female slightly larger with 79-90 mm total length (69-71 mm in *B. maamora* **sp. n.**);

(iii) male pedipalp chela manus narrower than patella, with manus/patella width ratio 0.85-0.88 (same width as patella in *B. maamora* **sp. n.** with manus/patella width ratio 1.00);

(iv) metasomal segment I longer than wide with length/width ratio 1.09-1.24 in female and 1.08-1.22 in male (wider than long in *B. maamora* **sp. n.** with length/width ratio 0.92-0.98 in female and 0.92 in male);

(v) metasomal segments IV and V narrower in both sexes with length/width ratio lower than in *B. maamora* **sp. n.** (see Tab. I-II);

(vi) aculeus as long as or longer than vesicle, i.e. aculeus/vesicle ratio ≥ 1 (shorter than vesicle in *B. maamora* **sp. n.** with aculeus/vesicle ratio 0.68-0.73);

(vii) male telson vesicle less bulky with telson length/width ratio 2.58-2.86 (2.23 in *B. maamora* **sp. n.**) and vesicle length/width ratio 1.42-1.48 (1.25 in *B. maamora* **sp. n.**);

(viii) several other distinct morphometric values (see Tab. I-II);

(ix) anal arch with three lateral lobes (two in *B. maamora* **sp. n.**).

- *B. parroti*

(i) size slightly smaller with total length 60 mm in female (69-71 mm in *B. maamora* **sp. n.**) and 59 mm in male (69 mm in *B. maamora* **sp. n.**);

(ii) pedipalp chela manus slenderer in male with length/width ratio 1.60 (1.50 in *B. maamora* **sp. n.**);

(iii) male pedipalp chela manus narrower than patella, with manus/patella width ratio 0.89 (same width as patella in *B. maamora* **sp. n.** with manus/patella width ratio 1.00);

(iv) metasomal segments IV and V narrower in male with length/width ratio lower than in *B. maamora* **sp. n.** (see Tab. I-II);

(v) male telson vesicle less bulky with telson length/width ratio 2.67 (2.23 in *B. maamora* **sp. n.**) and vesicle length/width ratio 1.40 (1.25 in *B. maamora* **sp. n.**);

(vi) several other distinct morphometric values (see Tab. I-II);

(vii) leg IV retrolateral pedal spurs with 5-6 setae (1-2 in *B. maamora* **sp. n.**);

(viii) an allopatric geographic distribution (Souss Valley, separated by High Atlas mountain range).

Distribution and ecology. – *B. maamora* **sp. n.** is distributed along the Atlantic coast, from Kenitra to El Jadida (Vachon, 1952; El Hidan *et al.*, 2017; Sousa *et al.*, 2017). It does not seem to extend more in the South, where it is replaced by *B. atlantis*, from Safi (Fig. 7). The new species seems to inhabit both forest and sandy habitats, as specimens were found in coastal forests (e.g. Maâmora, Temara, Daït Erroumi) and sand beaches (e.g. Mohammedia, El Jadida).

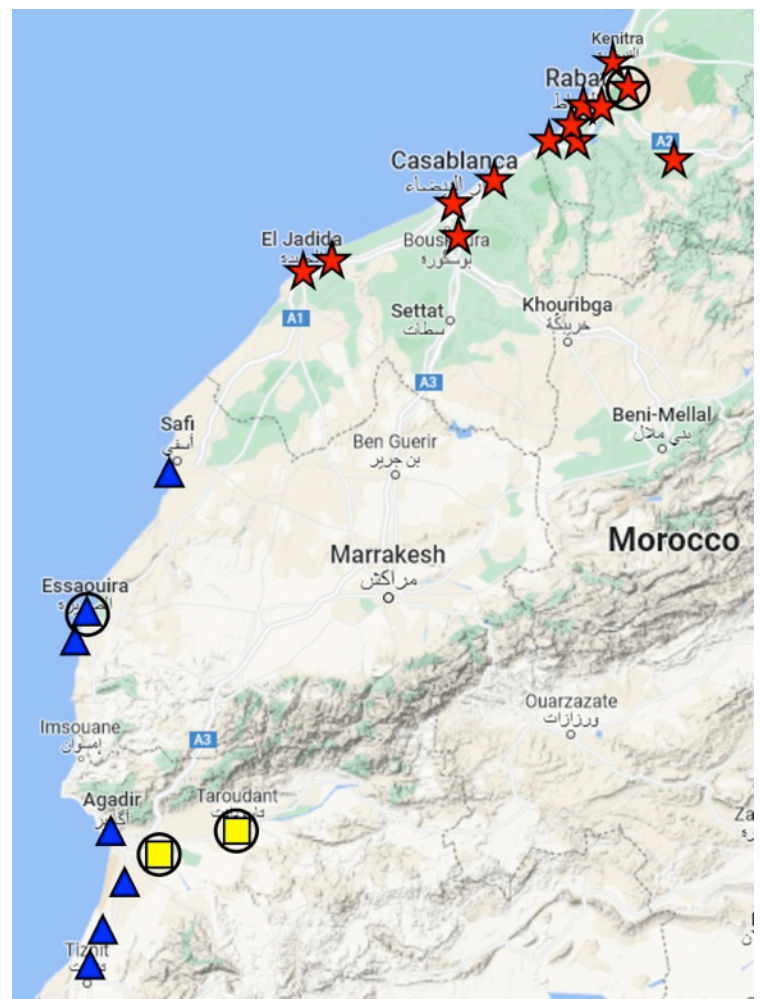


Fig. 7. Relief map of northeast Morocco showing the known distribution of the *Buthus* species discussed in this work: *B. maamora* **sp. n.** (red star), *B. atlantis* (blue triangle) and *B. parroti* (yellow square), with surrounded symbols showing the type localities.

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Résumé

Ythier E., 2023. – Une nouvelle espèce de *Buthus* Leach, 1815 de la côte Atlantique du Maroc (Scorpiones: Buthidae). *Faunitaxys*, 11(69): 1 – 7.

Le statut de la population de *Buthus* présente sur la côte Atlantique du Maroc, de Kénitra à El Jadida, à l'origine identifiée comme appartenant à *Buthus occitanus occitanus* (Amoreux, 1789) puis restée non identifiée depuis les études démontrant que la répartition de *B. occitanus* est restreinte à l'Europe de l'Ouest, est clarifié et cette population est décrite en tant que nouvelle espèce, *B. maamora* sp. n. La nouvelle espèce montre des affinités avec *B. atlantis* Pocock, 1889 et *B. parroti* Vachon, 1949 mais peut être aisément distinguée de ces deux espèces par une combinaison de plusieurs caractères. Ce nouveau taxon représente la 19^{ème} espèce de *Buthus* décrite pour le Maroc et porte à 79 le nombre d'espèces de *Buthus* actuellement reconnues.

Mots-clés. – Scorpion, *Buthus*, *maamora*, systématique, taxonomie, morphologie, nouvelle espèce, description, côte Atlantique, Maroc.

Table I. – Comparative table of total length and selected morphometric ratios of *Buthus* adult females.*Buthus maamora* sp. n. (n=2; Morocco, Kenitra, MHNL; Morocco, Sidi Bouknadel, Vachon, 1952)*Buthus occitanus* (n=21; France and Spain, MHNL, EYCP, Teruel & Turiel, 2020)*Buthus atlantis* (n=4; Morocco, Sidi Kaouki, EYCP; Morocco, Massa, EYCP; Morocco, Essaouira, Vachon, 1952)*Buthus parroti* (n=1; Morocco, Ademine, Vachon, 1952)

Adult females	<i>B. maamora</i> sp. n.	<i>B. occitanus</i>	<i>B. atlantis</i>	<i>B. parroti</i>
Total L	69-71	50-70	<u>78-90</u>	<u>60</u>
Pedipalp L / Carapace L	3.46-3.65	3.49-3.84	3.45-3.69	3.86
Pedipalp chela L/W	3.50-3.78	3.68-4.52	3.40-4.24	3.71
Pedipalp chela manus L/W	1.25-1.41	<u>1.44-1.66</u>	1.20-1.57	1.43
Pedipalp chela manus L/D	1.32	1.22-1.43	1.42-1.45	NA
Pedipalp chela L / Movable finger L	1.56-1.59	1.54-1.64	1.55-1.61	1.63
Pedipalp Movable finger L / Chela manus L	1.69-1.80	1.55-1.87	1.73-1.83	1.60
Pedipalp chela manus W / Patella W	1.14	1.04-1.22	1.00-1.25	1.17
Metasoma L / Carapace L	4.03	4.08-4.48	4.10-4.71	3.81
Metasomal segment I L/W	0.92-0.98	<u>1.02-1.07</u>	<u>1.09-1.24</u>	0.90
Metasomal segment I L/D	1.06-1.13	1.06-1.19	1.19-1.37	1.13
Metasomal segment IV L/W	1.30-1.54	<u>1.59-1.72</u>	<u>1.55-1.92</u>	1.44
Metasomal segment IV L/D	1.44-1.70	1.83-1.94	1.55-2.23	1.71
Metasomal segment V L/W	1.60-1.89	<u>1.97-2.25</u>	<u>1.90-2.20</u>	2.00
Metasomal segment V L/D	2.00-2.18	2.26-2.58	1.73-2.70	2.50
Telson L/W	1.97-2.32	1.97-2.32	2.27-2.67	2.37
Telson L/D	2.15	2.25-2.56	2.52-2.54	NA
Vesicle L/W	1.17-1.34	1.15-1.22	1.23-1.33	1.32
Vesicle L/D	1.27	1.29-1.38	1.32-1.43	NA
Vesicle W/D	1.09	1.06-1.17	1.07-1.11	NA

Abbreviations: length (L), width (W), depth (D), not available (NA). Ratios underlined are reported in the comparisons of main features in the text.

Table II. – Comparative table of total length and selected morphometric ratios of *Buthus* adult males.*Buthus maamora* sp. n. (n=1; Morocco, Kenitra, Vachon, 1952)*Buthus occitanus* (n=13; France and Spain, MHNL, EYCP, Teruel & Turiel, 2020)*Buthus atlantis* (n=3; Morocco, Sidi Kaouki, EYCP; Morocco, Essaouira, Vachon, 1952)*Buthus parroti* (n=1; Morocco, Taroudant, Vachon, 1952)

Adult males	<i>B. maamora</i> sp. n.	<i>B. occitanus</i>	<i>B. atlantis</i>	<i>B. parroti</i>
Total L	69	<u>54-64</u>	66-85	<u>59</u>
Pedipalp L / Carapace L	3.31	3.59-3.70	3.57-3.73	3.69
Pedipalp chela L/W	4.50	4.88-5.26	4.50-4.96	4.72
Pedipalp chela manus L/W	1.50	<u>1.68-1.87</u>	1.50-1.86	<u>1.60</u>
Pedipalp chela manus L/D	NA	1.43-1.61	1.68-1.71	NA
Pedipalp chela L / Movable finger L	1.50	1.49-1.57	1.50-1.54	1.51
Pedipalp Movable finger L / Chela manus L	2.00	1.76-2.03	1.86-2.00	1.95
Pedipalp chela manus W / Patella W	1.00	<u>0.87-0.99</u>	<u>0.85-0.88</u>	<u>0.89</u>
Metasoma L / Carapace L	4.19	4.66-5.16	4.81-5.50	4.26
Metasomal segment I L/W	0.92	<u>1.03-1.13</u>	<u>1.08-1.22</u>	0.94
Metasomal segment I L/D	1.10	1.15-1.29	1.30-1.49	1.13
Metasomal segment IV L/W	1.40	<u>1.63-1.83</u>	<u>1.60-2.08</u>	<u>1.63</u>
Metasomal segment IV L/D	1.75	1.86-2.04	2.00-2.35	1.71
Metasomal segment V L/W	1.78	<u>2.21-2.30</u>	<u>2.00-2.58</u>	<u>2.14</u>
Metasomal segment V L/D	2.29	2.44-2.65	2.37-3.04	2.50
Telson L/W	2.23	<u>2.30-2.41</u>	<u>2.58-2.86</u>	<u>2.67</u>
Telson L/D	NA	2.44-2.62	2.68-2.88	NA
Vesicle L/W	1.25	<u>1.27-1.39</u>	<u>1.42-1.48</u>	<u>1.40</u>
Vesicle L/D	NA	1.37-1.50	1.42-1.54	NA
Vesicle W/D	NA	1.06-1.10	1.00-1.04	NA

Abbreviations: length (L), width (W), depth (D), not available (NA). Ratios underlined are reported in the comparisons of main features in the text.

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Illustration de la couverture : Forêt de la Maâmora, Maroc.

Crédits:

Eric Ythier : Fig. 1-7

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