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The genus *Buthacus* Birula, 1908 in Jordan: description of a new species and comments on possible micro-endemic populations (Scorpiones: Buthidae)

Скорпионы рода *Buthacus* Birula, 1908 в Иордании: описание нового вида и замечания о возможных микро-эндемичных популяциях (Scorpiones: Buthidae)

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KEY WORDS: Scorpion, *Buthacus*, new species, micro-endemic populations, Jordan, Al-Qattafi region.

КЛЮЧЕВЫЕ СЛОВА: скорпион, *Buthacus*, новый вид, микро-эндемичные популяции, Иордания, район Аль-Каттафи.

ABSTRACT. The genus *Buthacus* Birula, 1908 (family Buthidae) has been the subject of an impressive number of studies in the past 25 years. Most of the species considered in these studies come from North Africa, in particular from countries such as Morocco, Algeria and Mauritania. Nevertheless, species were also described from the near and far Middle East. In this contribution we start the study of all the *Buthacus* populations present in Jordan which will be based on a precise survey of different biotopes in the country. A new species is described from the desert areas of Al-Qattafi. This preliminary study, which will be followed by others, seems to suggest the presence of micro-endemic populations in limited geographical zones of the desert.

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РЕЗЮМЕ. Скорпионы рода *Buthacus* Birula, 1908 (семейство Buthidae) стали объектом значительного числа исследований в последние 25 лет. Большинство рассматриваемых в них видов обитают в Северной Африке, в частности, в Марокко, Алжире и Мавритании. Другие виды этого рода известны также с Ближнего Востока. В данной работе начато исследование всех популяций *Buthacus* Иордании, которое основано на детальном исследовании различных биотопов этой страны. Новый вид описан из пустынной области Аль-Каттафи. Результаты этого предварительного исследования предполагают наличие микро-эндемичных популяций в ограниченных пустынных регионах.

Introduction

As already exposed in several previous publications (e.g. Lourenço [2006]; Lourenço, Sadine [2015]; Lourenço *et al*. [2016a, 2017]), the genus *Buthacus* was erected by Birula [1908] as a subgenus of *Buthus* Leach, 1815, having as its type species *Buthus leptochelys* (Ehrenberg, 1829), described from Sinai (Palestine) as *Androctonus* (*Leiurus*) *leptochelys*. Since its creation, *Buthacus* has been considered as a subgenus or as a genus by to different authors. It was finally defined as a valid genus, related to *Buthus*, by Vachon [1949, 1952]. In his important study of the North African scorpions, Vachon [1949, 1952] discussed the wide distribution of the genus *Buthacus*, which was then known from the Atlantic coast of Africa to Palestine. Today the known distribution of this genus is much wider since species are known from Afghanistan and

even India [Lourenço, 2004; Zambre, Lourenço, 2010]. Vachon [1952] drew the attention to the extreme complexity of this genus and, stated that no one could be certain about its precise composition. He also drew attention to the fact that *Buthacus leptochelys* and *Buthacus arenicola* Simon, 1885 could represent two complexes of forms or species. In their '*Fauna Palaestina'* Levy & Amitai [1980] equally attempted to divide the genus *Buthacus* in two groups mainly on basis of the structure of the dentition of the movable finger. They also discussed the difficulties of making a precise definition of several forms, and stated as follows: *'These groups could be further divided according to other characters however, the definite position of several forms from North Africa is still uncertain'*. This opinion follows that of Vachon [1952] in the sense that *Buthacus leptochelys* and *B. arenicola* undoubtedly represent not individual species but rather complexes of species.

Lourenço [2006] attempted to clarify the status of several *Buthacus* populations from North Africa, what was followed by the description of a significant number of species, in particular from Algeria [Lourenço, 2006; Lourenço, Sadine, 2015; Lourenço *et al*., 2016a, 2017]. This was largely possible thanks to a cooperative project which exists between Academic scholars from Algeria and France, and mostly to the methodological field work performed by some of the Algerian authors. In relation to the the species of the near and far Middle East, following the synthetic work '*Fauna Palaestina'* by Levy & Amitai [1980], other publications were produced (e.g. Vachon [1979]; Sissom [1994]; Hendrixson [2006]), but in most cases these proved to be conservative and brought few taxonomic changes. Very recently Cain *et al*. [2021] produced a remarkable monographic work on the genus *Buthacus*, covering mainly the near Middle East, but also parts of the African fauna. The positive side of this contribution was the demonstration of a much more diverse *Buthacus* fauna in the region of near Middle East, as it was already suggested in Africa, mainly for the Algerian fauna.

Within the present project of cooperation between Academic scholars from Jordan and France, precise methodological field work is continually performed by some of the Jordan authors in most of the regions of Jordan deserts [Lourenço *et al*., 2021a,b; Al-Saraireh *et al*., 2021]. This fieldwork already leaded to the collection of several *Buthacus* specimens. A precise analysis of some of these specimens confirmed the population from Al-Qattafi as a new species, distinct from *Buthacus yotvatensis* Levy, Amitai et Shulov, 1973 species also present in Jordan, in the region of Wadi Araba. The description of this new species attests to a considerable degree of diversity found in the Jordan deserts [Lourenço *et al*., 2021a,b; Al-Saraireh *et al*., 2021] but most suggests the presence in these deserts of micro-endemic populations. Micro-endemic populations have already been defined for scorpion species in different regions of the world, e.g. Madagascar and Amazonia [Lourenço, 1986; Lourenço *et al*., 2015, 2016b], but remained unsuspected until now in most arid and desert regions of North Africa and now of the Middle East. We tentatively attempt to expose the possible ecological gradients responsible for the pattern of distribution of some species.

Material and 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 and other images were photographed using a stereo microscope with a camera (efix). Measurements follow Stahnke [1970] and are given in mm. Trichobothrial notations are those of Vachon [1974] and morphological terminology mostly follows Vachon [1952] and Hjelle [1990]. The specimens studied herein are deposited in the Muséum national d'Histoire naturelle, Paris, and in the collections of the University of Jordan, Amman, Jordan.

Taxonomic treatment

Buthidae C.L. Koch, 1837
Buthacus Birula, 1908

Buthacus yotvatensis Levy, Amitai et Shulov, 1973
Figs 1–2, 8A–C.

Material examined: Jordan, ♂ and ♀, Al Ghwaibeh, Wadi Araba (30°43′43.4″N 35°23′47.3″E), 17.IV.2021 (B. Abu Afifeh & M. Al-Saraireh leg.).

DIAGNOSIS. Scorpions of moderate to large size with a total lengths ranging from 65 to 85 mm for adult males and females (Table). General coloration of tergites olivaceous; appendages and in particular pedipalps, pale yellow to faded yellow. Pedipalps with 9-9 rows of granules on the fixed and movable fingers; internal and external accessory granules present and well marked. Larger granules dividing rows are moderate to strong. Trichobothriotaxy A-b (beta) orthobothriotaxic; fixed fingers with trichobothria **dt** basal to **et** and, trichobothria **db** proximal to **est**. Dorsal and latero-dorsal carinae on metasomal segments I to IV without any well marked spiniform granules; latero-ventral carinae on segment V with small spinoid granules and some inconspicuous lobes. Tibial spurs moderate to weak on legs III and IV. Large pectines; pectinal tooth count 32 to 37 in males and 25 to 28 in females. Metasomal segments, telson and pedipalps covered with a marked chaetotaxy. Tarsi typical of a psamophilous species.

***Buthacus bicolor* sp.n.**
Figs 3–9.

Type material. Jordan, Al-Qattafi (31°54'N – 37°32'E), 13-14.V.2021 (B. Abu Afifeh & M. Al-Saraireh leg.). Holotype: one adult male. Paratypes: five adult males, one adult and one subadult female. Holotype and two paratypes deposited in the Muséum national d'Histoire naturelle, Paris. Other paratypes deposited in the collections of the University of Jordan, Amman, Jordan.

ETYMOLOGY. Name refers to the variation in body coloration of the new species.

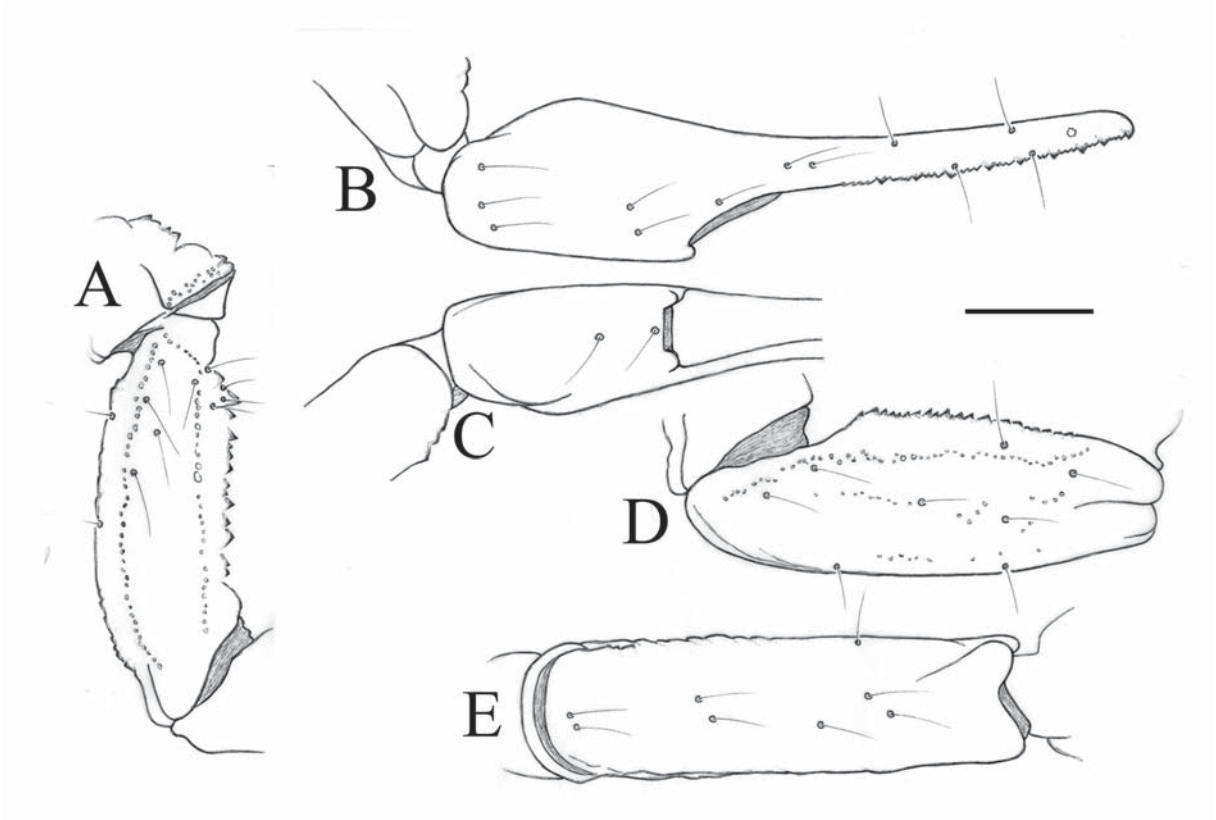

Fig. 1. *Buthacus yotvatensis* from Wadi Araba, trichobothrial pattern in male: A — femur, dorsal aspect; chela: B — dorso-external aspect, C — ventral aspect; patella: D — dorsal aspect, E — external aspect. Scale bar 2 mm.

Рис. 1. *Buthacus yotvatensis* из Вади Араба, трихоботриотаксия самца: A — бедро, дорсально; хела: B — дорсально-снаружи, C — вентрально; колено: D — дорсально, E — снаружи. Масштаб 2 мм.

Fig. 2. *In vivo* female of *Buthacus yotvatensis* from Al Ghwaibeh, Wadi Araba.

Рис. 2. Прижизненное фото самки *Buthacus yotvatensis* из Al Ghwaibeh, Вади Араба.

Table. Comparative morphometric values (in mm) of *Buthacus bicolor* sp.n. and *Buthacus yotvatensis* from Wadi Araba.
Таблица. Промеры (в мм) *Buthacus bicolor* sp.n. и *Buthacus yotvatensis* из Вади Араба.

	Buthacus bicolor sp.n.					*Buthacus yotvatensis*	
	♂ holotype	♀ paratype	♂ paratype	♂ paratype	♂ paratype	♂	♀
Total length (including telson)	54.7	58.1	51.5	62.0	64.7	68.4	74.6
Carapace: Length / Anterior width / Posterior width	**5.7 / 3.6/ 6.5**	**6.2 / 4.2 / 7.4**	**5.3/ 3.0/ 5.8**	**6.0 / 3.5 / 6.7**	**6.5 / 3.8 / 7.1**	**6.8 / 4.3 / 7.3**	**7.3 / 4.1 / 8.6**
Mesosoma length	**12.5**	**13.6**	**11.2**	**15.3**	**14.5**	**14.4**	**18.5**
Metasomal segment I:							
Length/ width	**5.3 /3.8**	**5.3 /3.8**	**4.5/3.5**	**5.0/4.0**	**5.6/4.5**	**6.6 /4.3**	**6.2 /4.3**
Length/ width ratio	**1.39**	**1.39**	**1.29**	**1.25**	**1.24**	**1.53**	**1.44**
Metasomal segment II:							
Length/ width	**5.4 / 3.7**	**5.5 / 3.7**	**5.3/3.3**	**6.2/3.7**	**6.5/4.0**	**7.4 / 4.2**	**7.3 / 4.2**
Length/ width ratio	**1.46**	**1.49**	**1.61**	**1.68**	**1.63**	**1.76**	**1.74**
Metasomal segment III:							
Length/ width	**5.7 / 3.4**	**6.1 / 3.6**	**5.5/3.1**	**6.5/3.6**	**6.8/3.9**	**7.8 / 4.0**	**7.5 / 3.9**
Length/ width ratio	**1.68**	**1.69**	**1.77**	**1.81**	**1.74**	**1.95**	**1.92**
Metasomal segment IV:							
Length/ width	**6.6 / 3.0**	**6.7 / 3.2**	**6.0/2.7**	**7.3/3.2**	**7.7/3.4**	**8.4 / 3.6**	**8.1 / 3.4**
Length/ width ratio	**2.20**	**2.10**	**2.22**	**2.28**	**2.15**	**2.33**	**2.38**
Metasomal segment V:							
Length/ width/ depth	**7.2 / 2.9 / 2.7**	**7.6 / 3.1 / 2.8**	**6.5 / 2.5 / 2.4**	**7.5 / 2.9 / 2.7**	**8.3 / 3.2 / 2.8**	**9.3 / 3.3 / 3.2**	**9.3 / 3.2 / 3.1**
Length/ width ratio	**2.48**	**2.45**	**2.60**	**2.59**	**2.59**	**2.82**	**2.91**
Telson:							
length/ width/ depth	**6.3 / 2.2 / 2.2**	**6.5 / 2.4 / 2.4**	**6.0 / 2.0 / 2.0**	**7.0 / 2.3 / 2.3**	**7.2 / 2.4 / 2.5**	**7.7 / 2.8 / 2.8**	**8.5 /2.8 / 2.8**
Pedipalp							
Femur: length/ width	**4.9 / 1.7**	**5.2 / 1.8**	**4.8/1.5**	**5.5/1.8**	**5.6/1.8**	**6.2 / 2.1**	**6.0 / 2.1**
Patella: length/ width	**6.0 / 2.0**	**6.2 / 2.2**	**5.7/1.8**	**6.3/2.0**	**6.8/2.1**	**7.4 / 2.6**	**7.2 / 2.1**
Chela: length/ width/ depth	**8.5 / 1.6 / 1.7**	**8.9 / 1.6 /1.8**	**8.0/1.5/1.5**	**9.0/1.8/1.9**	**9.4/1.8/2.0**	**10.6 / 2.0 / 2.2**	**11.0/ 2.1 / 1.9**
Movable finger : length	**5.5**	**6.0**	**5.1**	**6.0**	**6.3**	**7.0**	**7.5**

DIAGNOSIS. Scorpions of moderate size with a total length of 50 to 65 mm for adult males and females (see Table). General coloration yellowish-orange to orange, without marked spots in adults. Pedipalps with 9-9 rows of granules on the fixed and movable fingers; internal and external accessory granules present and well marked. Larger granules dividing rows are moderate to strong. Trichobothriotaxy A-b (beta) orthobothriotaxic; fixed fingers with trichobothria **dt** at the same level of **et** and, trichobothria **db** largely proximal to **est**. Dorsal and latero-dorsal carinae on metasomal segments I to IV without any well marked spiniform granules; latero-ventral carinae on segment V with spinoid granules and several conspicuous lobes. Tibial spurs moderate on legs III and IV. Large pectines; pectinal tooth count 30 to 33 in males and 24 to 25 in females. All metasomal segments, telson and pedipalps covered with an impressive chaetotaxy. Tarsi typical of a psammophilous species.

DESCRIPTION based on male holotype and male and female paratypes (measurements in Table). Coloration: Adult males generally yellowish orange to orange (ochraceous), female tergites equally marked by some olivaceous pigmentation. Prosoma: carapace basically yellowish-orange to slightly olivaceous-yellow; eyes surrounded by black pigment. Mesosoma: yellowish-orange, slightly olivaceous on anterior edges of tergites. Metasomal segments yellow. Vesicle yellow; aculeus yellow at the base and reddish at its extremity. Venter yellow; pectines pale yellow. Chelicerae yellow; denticles dark red to almost blackish. Pedipalps: yellowish-orange with chela fingers paler than manus; rows of granules on the dentate margins of the fingers reddish; pectines pale yellow. Legs are bicolored; proximally the trochanters, femora and patellae are yellowish-orange similar to the body, distally the tibiae, basitarsi and telotarsi are much paler greenish-yellow.

MORPHOLOGY. Anterior margin of carapace not emarginated, with a minute convexity. Carapace carinae weakly developed (Figs. 3A and 4A); anterior median carinae obsolete; central median, posterior median and central lateral

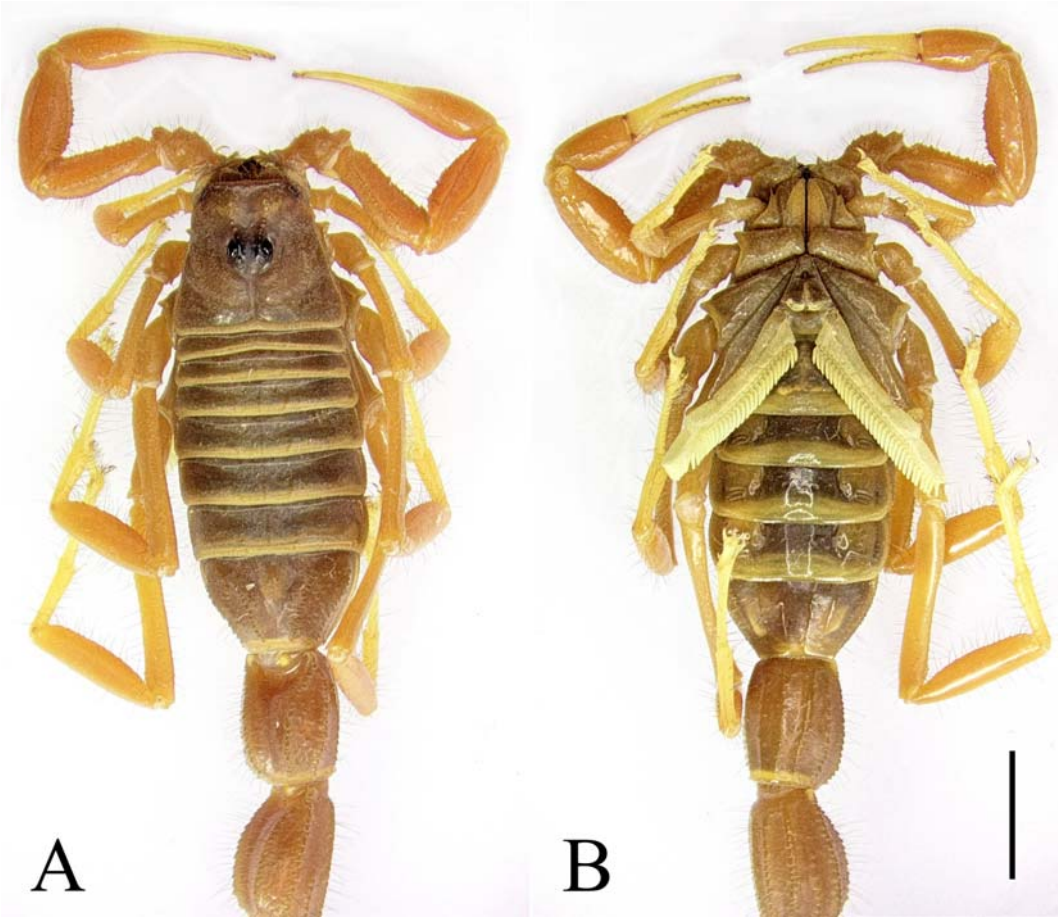

Fig. 3. *Buthacus bicolor* sp.n., male holotype, prosoma and mesosoma: A — dorsal aspect, B — ventral aspect. Scale bar 5 mm.
Рис. 3. *Buthacus bicolor* sp.n., голотип самец, просома и мезосома: A — дорсально, B — вентрально. Масштаб 5 мм.

carinae weak to obsolete. All furrows weak to obsolete. Intercarinal spaces weakly granular. Median ocular tubercle slightly anterior to the centre of the carapace; median eyes separated by almost two ocular diameters. Five pairs of lateral eyes; four disposed in one line, the fifth situated behind eye four and vestigial. Mesosoma: Tergites I to VI tricarinate; all carinae very weak; lateral carinae vestigial on segment I; tergite VII pentacarinate, with lateral pairs of carinae moderate; median carinae present on proximal one-half, weakly marked. Intercarinal spaces weakly granular to smooth (Figs. 3A and 4A). Sternites: carinae absent from sternites III–VI; weak on VII (Figs. 3B and 4B). Pectines large and long; pectinal tooth count 31–31 for male holotype and 24–24 for female paratype (Figs. 3B and 4B) (see diagnosis for variation). Metasoma: metasomal segment I with 10 carinae; II–IV with 8 carinae; intermediate carinae incomplete on II and III, absent on IV. Ventral carinae weak on segments I, moderate on II–IV; dorsal carinae without any well marked spinoid granules on segments I to IV. Segment V with five carinae; ventrolateral armed with spinoid granules and several conspicuous lobes. Dorsal furrows in all segments weakly developed. Dorsal intercarinal surfaces very finely granular on I–V, lateral intercarinal surfaces smooth or very finely granular on I–II; finely granular on III–V, ventral intercarinal surfaces smooth on I; finely granular on II–V. Metasomal setation strongly marked (Fig. 8D–I). Telson: telson vesicle dorsal surface smooth; ventral surface finely granular anteriorly, smooth posteriorly; lateral and ventral surfaces densely setose; aculeus with a similar length to that of vesicle; subaculear tubercle absent (Fig. 8D–I). Chelicerae movable finger with external distal denticle similar in length to internal distal; two well marked denticles at the base of the movable finger [Vachon, 1963]. Pedipalps: trichobothrial pattern A-b (beta) orthobothriotaxic, as defined by Vachon [1974, 1975]; fixed fingers with trichobothria **dt** at the same level of **et** and trichobothria **db** largely proximal to **est**. Femur pentacarinate; all carinae strongly crenulate. Patella with well marked internal carinae; chela without carinae almost smooth (Fig. 5). Dentate margins on fixed and movable fingers (Fig. 7) composed of 9-9 almost linear rows of granules; internal and external accessory granules represented by strong basal granules; external and internal accessory granules well marked; the dentate margins granulation is not masked by setation. Legs (Fig. 6): ventral aspect of tarsi with numerous long thin setae; general setation typical of a psammophilous species. Tibial spurs moderate to strong on legs III–IV. Pedal spurs moderate on all legs.

SEXUAL DIMORPHISM. Adult males differed from females as follows: Intercarinal surfaces of male carapace are more densely granular than female surfaces. Genital operculum is completely divided longitudinally, with over-

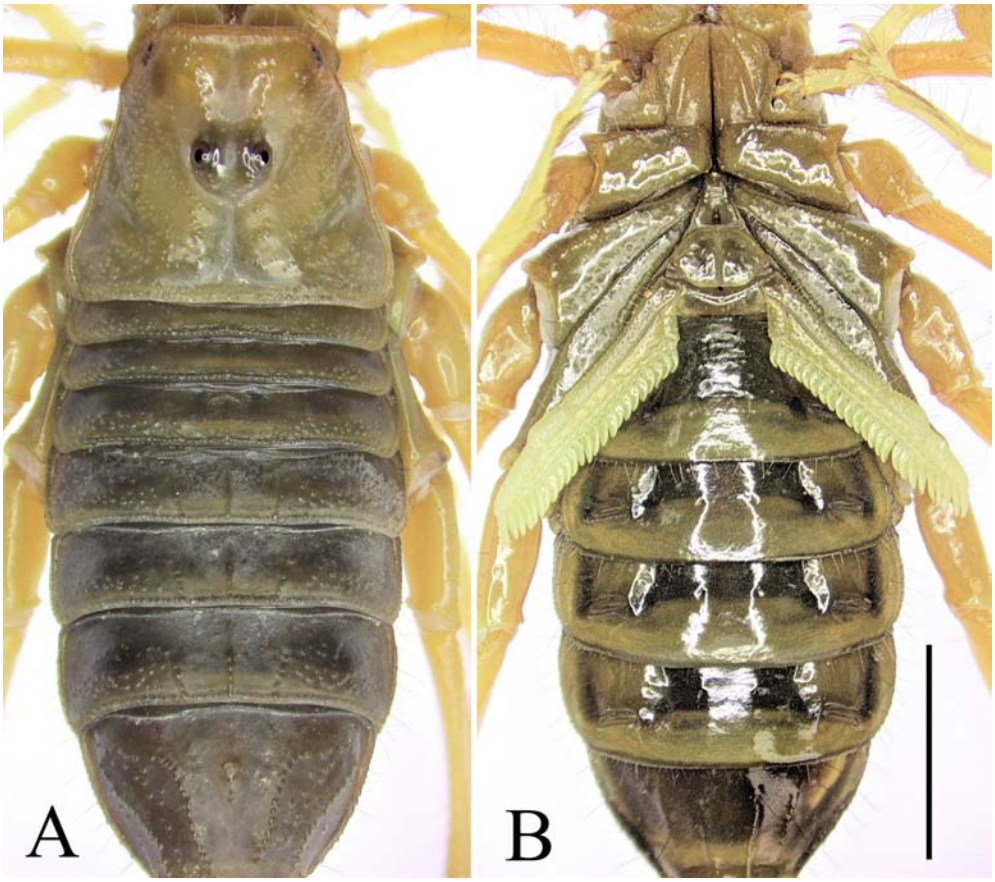

Fig. 4. *Buthacus bicolor* sp.n., female paratype: A — carapace and tergites, B — coxosternal area and sternites. Scale bar 5 mm.
Рис. 4. *Buthacus bicolor* sp.n., паратип самка: A — карапакс и тергиты, B — коксостернальная область и стерниты. Масштаб 5 мм.

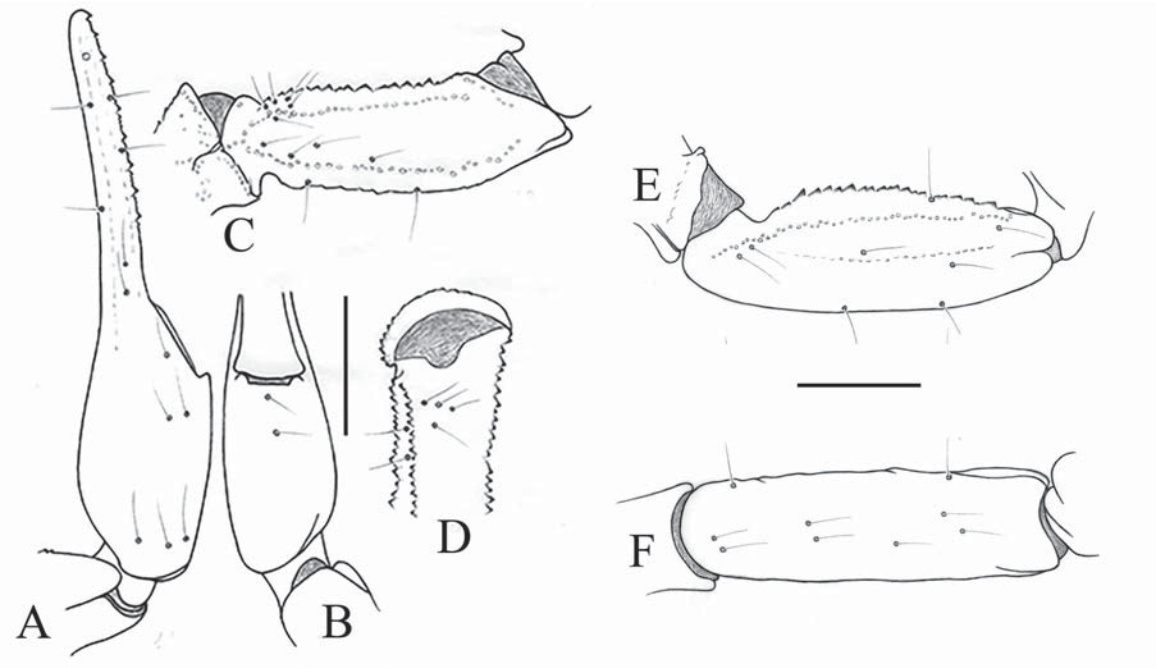

Fig. 5. *Buthacus bicolor* sp.n. male holotype, trichobothrial pattern. Chela: A — dorso-external aspect, B — ventral aspect; femur: C — dorsal aspect, D — internal aspect; patella: E — dorsal aspect, F — external aspect. Scale bar 2 mm.
Рис. 5. *Buthacus bicolor* sp.n., голотип самец, трихоботриотаксия. Хела: A — дорсально-снаружи, B — вентрально; бедро: C — дорсально, D — изнутри; колено: E — дорсально, F — снаружи. Масштаб 2 мм.

Fig. 6. *Buthacus bicolor* sp.n., female paratype, left legs III–IV, retrolateral aspect.
Рис. 6. *Buthacus bicolor* sp.n., паратип самка, левые ноги III–IV, ретролатерально.

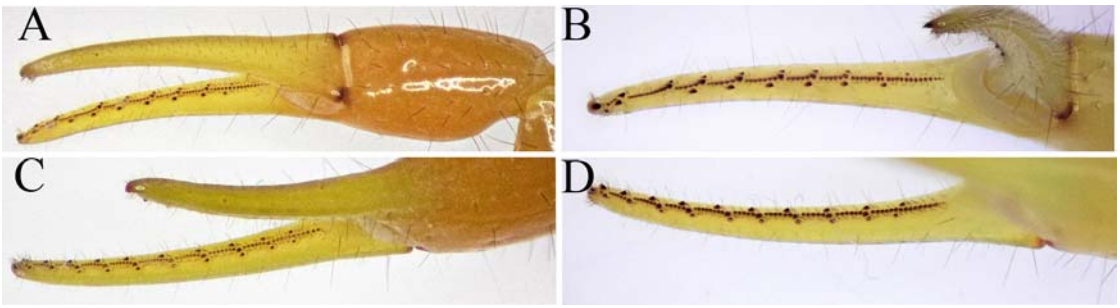

Fig. 7. *Buthacus bicolor* sp.n., male paratype: A — fixed finger, C — movable finger; paratype female: B — fixed finger, D — movable finger.
Рис. 7. *Buthacus bicolor* sp.n., паратип самец: A — неподвижный палец, C — подвижный палец; паратип самка: B — неподвижный палец, D — подвижный палец.

lapping rounded margins in males, but partially fused longitudinally in females. Pectinal tooth count is higher in males (30–33) than in females (24–25). The ventrosubmedian carinae on metasoma II–III, and the ventrolateral carinae of segment V are less prominent in male than in female (Fig. 8F, I). The colour of carapace and tergites in the male is brownish to yellowish-orange, while it is olivaceous in the female (Figs. 3 and 4).

RELATIONSHIPS. In account of its zone of distribution and the presence of a marked chetotaxy the new species can be related to *Buthacus yotvatensis*, species described from Israel but also present in Jordan, in the region of Wadi Araba in the western borders, in particular from Al Ghwaibeh (30°48′N – 35°34′E) and Qriqreh (30°62′N – 35°39′E). The two species can, however, be distinguished from each other by a number of features: (i) a quite different total size; the new species being smaller (see Table); (ii) carinae on metasomal segment V more conspicuous in the new species; (iii) differences in coloration; males of the new species are generally yellowish-orange to orange, the legs are bicolored in both sexes; proximal parts yellowish-orange similar to the body, distal parts are much paler greenish yellow, in contrast *B. yotvatensis* is uniformly pale yellow to yellowish-olivaceous; (iv) the new species has less slender metasomal segments; the length/width ratios of metasomal segments for five specimens of *B. bicolor* sp.n. and two specimens of *B. yotvatensis* are lower for *B. bicolor* sp.n. when compared to *B. yotvatensis* without any overlapping of the values; the L/W ratios ranged as follows: segment I (1.24–1.39 vs 1.44–1.53), segment II (1.46–1.68 vs 1.74–1.76), segment III (1.68–1.81 vs 1.92–1.95), segment IV (2.10–2.28 vs 2.33–2.38), segment V (2.45–2.60 vs 2.82–2.91) (see Table). Moreover, the two species inhabit quite distinct habitats in the Jordan desert (see ecological section).

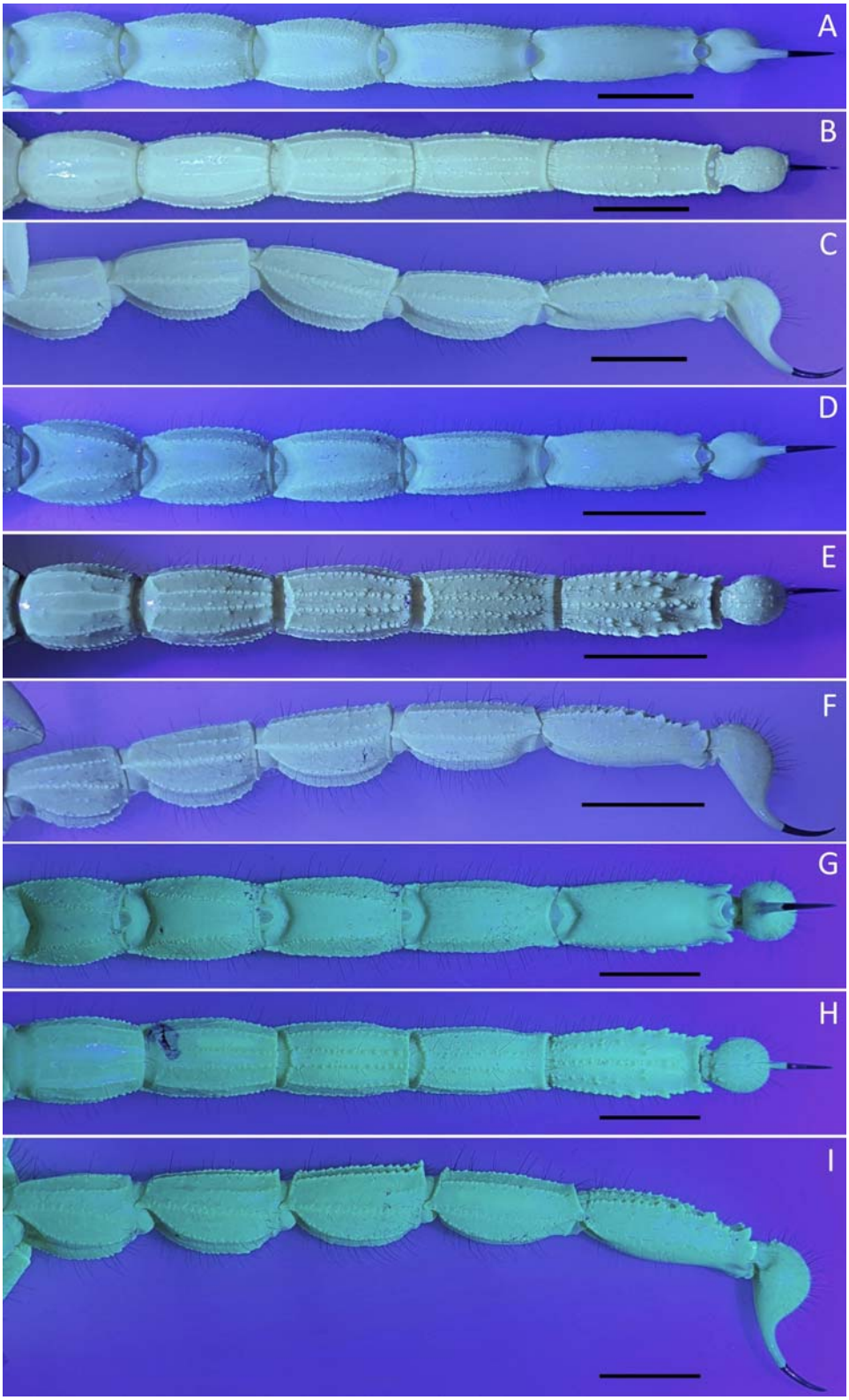

Fig. 8. Metasoma and telson under UV fluorescence. A–C — *Buthacus yotvatensis*, male: A — dorsal aspect, B — ventral aspect, C — lateral aspect; D–F — *Buthacus bicolor* sp.n., male paratype: D — dorsal aspect, E — ventral aspect, F — lateral aspect; G–I — *Buthacus bicolor* sp.n., female paratype: G — dorsal aspect, H — ventral aspect, I — lateral aspect. Scale bars 5 mm.

Рис. 8. Метасома и тельсон в УФ-лучах. A–C — *Buthacus yotvatensis*, самец: A — дорсально, B — вентрально, C — латерально; D–F — *Buthacus bicolor* sp.n., паратип самец: D — дорсально, E — вентрально, F — латерально; G–I — *Buthacus bicolor* sp.n., паратип самка: G — дорсально, H — вентрально, I — латерально. Масштаб 5 мм.

Fig. 9: *In vivo Buthacus bicolor* sp.n., male paratype.
Рис. 9: Прижизненное фото *Buthacus bicolor* sp.n., паратип самец.

Fig. 10: Habitat of *Buthacus bicolor* sp.n. at Al-Qattafi in the Eastern Desert.
Рис. 10: Местообитание *Buthacus bicolor* sp n. в Al-Qattafi в Восточной пустыне.

Another species, *Buthacus tadmorensis* (Simon, 1892), described from Palmira Syria, could also have affinities with the new species. Both species can however be distinguished by the presence of conspicuous ventral carinae on metasomal segments II and III, these are strongly developed in *B. tadmorensis* whereas in the new species these are only moderately developed (Fig. 8F, I). For details see Lourenço [2006: 63, Fig. 18], Cain *et al*. [2021a: 52, Fig. 25B; 54, Fig. 27B].

Comparative ecological comments for the regions of Al-Qattafi and Wadi Araba

Al-Qattafi

Al-Qattafi is located in the eastern desert of Jordan, known as the Badia. Tertiary-quaternary continental basalt flows and tuffs cover almost the entire Badia. The area is within the Saharo-Arabian biogeographical

Fig. 11. Habitat of *Buthacus yotvatensis* at Al Ghwaibeh, Wadi Araba.
Рис. 11. Местообитание *Buthacus yotvatensis* в Al Ghwaibeh, Вади Араба.

region and constitutes more than 70% of the total Badia. Leading plants include *Anabasis articulata* and *Seidlitzia rosmarinus*. In addition, scattered occurrence of *Astragalus spinosus* [Allison *et al*., 1998].

In the Badia, rainfall is erratic both spatially and temporally, with a maximum of 200 mm annually. Air temperature fluctuates widely from a daily mean minimum of 10 °C, mean maximum of 24.5 °C and a mean daily temperature of 17.5 °C. Occasionally absolute minimum and maximum temperatures might reach –5 and 46 °C respectively [Allison *et al.,* 1998].

This site is characterized by the presence of black lava rocky cover, Hamada type of desert covered by small gravel, interrupted by small wadi system with windblown sand (Fig. 10). Other scorpions found include *Androctonus crassicuda* (Olivier, 1807), *Orthochirus* spp. and *Compsobuthus jordanensis* Levy, Amitai et Shulov, 1973.

Al Ghwaibeh

The Wadi Araba desert extends about 160 km from the southern tip of the Dead Sea from the north, reaching Aqaba Gulf of to the south. It is bordered by the eastern mountains of Karak, Tafilah, Petra and Petra to the east and Al Naqab desert to the west [Le Béon *et al*., 2012; Saqqa, Atallah, 2013]. The maximum temperature may reach up to 50 °C during summer and drops to 0.0 °C in winter, with annual rainfall less than 100 mm [Saqqa, Atallah, 2013]. Alluvial surfaces are common and scattered along the Wadi, whereas Dahal fan, is the most northern. Al Ghwaibeh is located within the Dahal fan.

Wadi Al Ghwaibeh consists of sand dune area that extends for about 20 km on the eastern side of Wadi Araba Sometimes the sand forms domes with *Haloxylon persicum* shrubs that stabilize the sand, or flat sand dunes interrupted by rocky outcrops (Fig. 11). *Buthacus yotvatensis* was collected from this site, in the presence of a high density of *Orthochirus* sp.

Discussion

So far, a significant number of species of the genus *Buthacus* have been described from the Middle East. In Jordan, the status of this genus is still poorly understood, with previous records which may yet require revision. For example, the records of *Buthacus arenicola* and *B. tadmorensis* from Wadi Rum by Kovařík & Whitman [2004] are questionable. It clearly appears

that most species, if not all, in this genus are psamophilous as in the case of *Buthacus yotvatensis* known from sandy habitats in Wadi Araba. The present new species, Buthacus bicolor sp.n. originates from the black lava desert from eastern Jordan separated from Wadi Araba by at least 300 km. Both Wadi Araba and the eastern desert of Jordan are ecologically very distinct with different geological history.

Lourenço [2017] clearly suggested that micro-endemic populations of *Buthacus* are present in Algeria such as *Buthacus ahaggar* Lourenço, Kourim et Sadine, 2017. Cain et al. [2021] described three new species of *Buthacus* from Al Naqab desert opposite to the Jordanian side of Wadi Araba. They reported *Buthacus arava* Cain, Gefen et Prendini, 2021 from several localities along Wadi Araba, a species that was found along with *B. yotvatensis* in the same locality, Wadi Khanzeerah. *Buthacus arava* is smaller than *B. yotvatensis*, with a total length range of 61.8–75 mm and 71.7–85.1 mm respectively. Also the number of pectine teeth is lower in *B. arava* (18–22 for males and 12–14 for females) compared to *B. yotvatensis* with 32–37 for males and 25–28 for females [Cain *et al*., 2021].

Other populations of *Buthacus* in Jordan should yet require further investigation; for instance the status of the *Buthacus* spp. population in Wadi Rum is not yet totally clarified. Two other populations in Jordan call our attention; one in the centre of the eastern desert and the second one near Al-Mudawwrah, in the southern of Jordan close to the Saudi Arabia's borders.

Disclosure Statement

No potential conflict of interest was reported by the authors.

References

Allison R.J., Higgitt D.L., Kirk A.J., Warburton J., Al-Homoud A., Sunna B.F., White K. 1998. Geology, geomorphology, hydrology, groundwater and physical resources // Dutton R.W., Clarke J.I., Battikhi A. (eds.). Arid land resources and their management: Jordan's desert margin. Kegan Paul International, London. P.21–46.

Al-Saraireh M., Abu Afifeh B., Aloufi A., Amr Z.S., Lourenço W.R. 2021 First record of the genus Trypanothacus Lowe, Kovařík, Stockmann & Šťáhlavský, 2019 in Jordan and description of a new species (Scorpiones: Buthidae) // Serket. Vol.18. P.11–21.

Birula A.A. 1908. Ergebnisse der mit Subvention aus der Erbschaft Treitl unternommenen zoologischen Forschungsreise Dr. F. Werner's nach dem Anglo-Aegyptischen Sudan und Nord-Uganda. XIV. Skorpiones und Solifugae // Sitzungsberichte der kaiserlich-königlichen Akademie der Wissenchaften, Wien. Bd.117. S.121–152.

Cain S., Gefen E., Prendini L. 2021. Systematic revision of the sand scorpions, genus *Buthacus* Birula, 1908 (Buthidae C. L. Koch, 1837) of the Levant, with redescription of *Buthacus arenicola* (Simon, 1885) from Algeria and Tunisia // Bulletin of the American Museum of Natural History. Vol.450. P.1–134.

Hendrixson B.E. 2006. Buthid scorpions of Saudi Arabia, with notes on the other families (Scorpiones: Buthidae, Liochelidae, Scorpionidae) // Fauna of Arabia. Vol.21. P.33–120.

Hjelle J.T. 1990. Anatomy and morphology // Polis G.A. (ed.). The Biology of Scorpions. Stanford: Stanford University Press. P. 9–63.

Kovařík F., Lowe G., Šťáhlavský F. 2016. Review of Northwestern African *Buthacus*, with description of *Buthacus stockmanni* sp. n. from Morocco and Western Sahara (Scorpiones, Buthidae) // Euscorpius. Vol.236. P.1–18.

Kovarik F., Whitman S. 2004. Cataloghidel Museo di Storia Naturaledell' Università di Firenze-Sezione di Zoologia «La Specola» XXII. Arachnida Scorpiones. Tipi. addenda (1988–2004) e checklist dellacollezione (Euscorpiinaeesclusi) // Attidella Società Toscana de Scienze Naturali – Memorie serie B. Vol.111. P.103–119.

Le Béon M., Klinger Y., Mériaux A-S., Al-Qaryouti M., Finkel R.C., Mayyas O., Tapponnier P. 2012. Quaternary morphotectonic mapping of the Wadi Araba and implications for the tectonic activity of the southern Dead Sea fault // Tectonics. Vol.31. P.TC5003.

Levy G., Amitai P. 1980. Fauna Palaestina. Arachnida I. Scorpiones. Jerusalem: The Israel Academy of Sciences and Humanities. 130 pp.

Levy G., Amitai P., Shulov A. 1973. New scorpions from Israel, Jordan and Arabia // Zoological Journal of the Linnean Society. Vol.52. P.113–140.

Lourenço W.R. 1986. Diversité de la faune scorpionique de la région amazonienne; centres d'endémisme; nouvel appui à la théorie des refuges forestiers du Pléistocène // Amazoniana. Vol.9. P.559–580.

Lourenço W.R. 2004. Description of a new species of *Buthacus* Birula (Scorpiones, Buthidae) from Afghanistan // Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg. Vol.14. P.205–210.

Lourenço W.R. 2006. Further considerations on the genus *Buthacus* Birula, 1908 (Scorpiones, Buthidae), with a description of one new species and two new subspecies // Boletin de la Sociedad Entomológica Aragonesa. Vol.38. P.59–70.

Lourenço W.R. 2017. Further amendments to the taxonomy of the genus *Buthacus* Birula, 1908 (Scorpiones: Buthidae) // Arachnida – Rivista Aracnologica Italiana. Vol.12. P.31–39.

Lourenço W.R., Abu Afifeh B., Al-Saraireh M., Abu Baker M., Amr Z. 2021a. New insights on the taxonomy of the genus *Buthus* Leach, 1815 in Jordan and description of a new species (Scorpiones: Buthidae) // Zoology in the Middle East. Vol.67. P.168–176.

Lourenço W.R., Al-Saraireh M., Abu Afifeh B., Abu Baker M., Katbeh-Bader A., Amr Z. 2021b. New insights on the taxonomy of the genus *Birulatus* Vachon, 1974 (Scorpiones: Buthidae), and description of a new remarkable species from Jordan. // Bulletin de la Société Entomologique de France. Vol.126. P.123–132.

Lourenço W.R., Bissati S., Sadine S.E. 2016a. One more new species of *Buthacus* Birula, 1908 from the region of Ghardaïa, Algeria (Scorpiones, Buthidae) // Arachnida – Rivista Aracnologica Italiana. Vol.8. P.2–11.

Lourenço W.R., Kourim M.L., Sadine S.E. 2017. Scorpions from the region of Tamanrasset, Algeria. Part I. A new species of *Buthacus* Birula, 1908 (Scorpiones: Buthidae) // Arachnida – Rivista Aracnologica Italiana. Vol.13. P.31–41.

Lourenço W.R., Sadine S.E. 2015. A new species of *Buthacus* Birula, 1908 from the region of Ghardaïa, Algeria (Scorpiones, Buthidae) // Revista Ibérica de Aracnologia. Vol.27. P.55–59.

Lourenço W.R., Waeber P.O., Wilmé L. 2016b. The geographical pattern of distribution of the genus *Tityobuthus* Pocock, 1890, a typical Ananterinae element endemic to Madagascar (Scorpiones: Buthidae) // Comptes Rendus Biologies. Vol.339. P.427–436.

Lourenço W.R., Wilmé L., Waeber P.O. 2015. More about the geographical distribution of the Malagasy genus *Neogrosphus* Lourenço, 1995 (Scorpiones: Buthidae) and description of a vicariant new species // Comptes Rendus Biologies. Vol.338. P.768–776.

Saqqa W.A., Atallah M.Y. 2013. Tectonic geomorphology of alluvial fans east of the Wadi Araba Fault (Dead Sea Transform),

Jordan // Jordan Journal of Earth and Environmental Sciences. Vol.5. P.79–86.

Sissom W. D. 1994. Descriptions of new and poorly known scorpions of Yemen (Scorpiones: Buthidae, Diplocentridae, Scorpionidae) // Fauna of Saudi Arabia. Vol.14. P.3–39.

Stahnke H. L. 1970. Scorpion nomenclature and mensuration // Entomological News. Vol.81. P.297–316.

Vachon M. 1949. Etudes sur les Scorpions. III (suite). Description des Scorpions du Nord de l'Afrique // Archives de l'Institut Pasteur d'Algérie. Vol.27. P.66–100.

Vachon M. 1952. Etudes sur les Scorpions. Alger: Institut Pasteur d'Algérie. 482 pp.

Vachon M. 1963. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les Scorpions // Bulletin du Muséum national d'Histoire naturelle, Paris 2è sér. Vol.35. P.161–166.

Vachon M. 1974. Etude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de, trichobothriotaxie chez les Scorpions // Bulletin du Muséum national d'Histoire naturelle, Paris, 3è sér., n° 140, Zool. Vol.104. P.857–958.

Vachon M. 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de la famille des Buthidae Simon // Comptes Rendus des Séances de l'Académie des Sciences. Ser.D. Vol.281. P.1597–1599.

Vachon M. 1979. Arachnids of Saudi Arabia. Scorpiones // Fauna of Saudi Arabia. Vol.1. P.30–66.

Zambre A.M., Lourenço W.R. 2010. A new species of *Buthacus* Birula, 1908 (Scorpiones, Buthidae) from India // Boletin de la Sociedad Entomológica Aragonesa. Vol.46. P.115–119.

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