Jordan Journal of Natural History, 9 (2), 2022 Pages: 11-20

Further Collection of Scorpions from Saudi Arabia

Abdulhadi Aloufi[1], Bassam Abu Afifeh[2], Zuhair S. Amr[3]*

[1] Department of Biology, Taibah University, Al-Madinah Al-Munawwarah, Kingdom of Saudi Arabia; [2] Ministry of Education, Al-Rumman Secondary School, Amman; [3] Department of Biology, Jordan University of Science and Technology, Irbid, Jordan

Received: June 29, 2022; Revised: August 7, 2022; Accepted: August 18, 2022

Abstract

Additional distributional data on the scorpions of Saudi Arabia are presented for eight species, covering 31 localities in Al Madinah Al Monawwarah, Jazan, Riyadh, and Tabuk provinces. In addition, high resolution images are provided for each species. Such data are useful for mapping the scorpions of Saudi Arabia.

Key words: Scorpions, Saudi Arabia, distribution, Buthidae, Scorpionidae.

Introduction

In the past two decades, growing interest in the scorpions of Saudi Arabia resulted in several publications (Al-Asmari *et al.*, 2007, 2009a, b, 2013; Desouky and Alshammari, 2010; El-Hennawy, 2009; Lowe *et al.*, 2014; Alqahtani *et al.*, 2019). Most of these studies did not include high quality images for the scorpions. Abu Afifeh *et al.* (2021) described *Compsobuthus khaybari* from Khaybar area. Recently Aloufi *et al.* (2021) reported on the scorpions of Tabuk including high resolution images for eight species.

The main purpose of this paper is to provide high quality images for the scorpions of Saudi Arabia, along with major diagnostic characteristics for eight species, as well as to document recent records from Al Madinah Al Monawwarah, Jazan, Riyadh, and Tabuk provinces.

Materials and Methods

Scorpions were collected from 31 localities in Al Madinah Al Monawwarah, Jazan, Riyadh,

*Corresponding author: amrz@just.edu.jo

Table 1. Localities from where the scorpions were collected.

Locality	N	E
Ain Al Akhdhar	27° 38' 18.53"	36° 49' 13.46"
Al Atafeah village	24° 27' 28.10"	39° 53' 58.20"
Al Auruf village	24° 12' 07.30"	40° 26' 55.60"
Al Boqa'a	17° 20' 29.04"	43° 09' 43.90"
Al Dyear	25° 00' 52.04"	39° 51' 10.75"
Al Fegrah	24° 21' 44.34"	38° 57' 44.75"
Al Makhrameah	28° 53' 43.08"	36° 07' 28.94"
Al Mendasah	24° 37' 50.93"	39° 19' 12.84"
Al Mulaeleeh	24° 48' 58.65"	39° 09' 05.80"
Al Qarnaen	19° 07' 58.45"	45° 08' 27.06"
Alaab	24° 06' 13.08"	38° 55' 48.13"
Buwat	24° 43' 45.23"	39° 12' 45.23"
Dhabua'h	24° 26' 51.00"	39° 29' 21.00"
Herma	24° 34' 16.83"	40° 20' 51.30"
Jabal Al Ward	26° 24' 06.78"	37° 17' 02.97"
Jabal khasher	17° 20' 08.57"	43° 10' 09.46"
Mughera'a	26° 23' 55.40"	38° 03' 21.20"
Nofoud Al Thumamah	25° 21' 14.00"	46° 29' 37.90"
Quraeah	28° 47' 05.35"	36° 00' 14.93"
Rowdhat Malham	25° 10' 20.70"	46° 29' 34.50"
Sha'eeb Huraymila	25° 05' 34.10"	46° 03' 27.40"
Shajwa	25° 02' 51.77"	38° 59' 47.24"
Sultan Al Feridi farm	24° 21' 58.78"	39° 32' 57.15"
Wadi Al Fara'a	23° 19' 22.14"	39° 36' 42.56"
Wadi Al Garhan	17° 21' 14.33"	43° 05' 57.96"
Wadi al Jal a'b	24° 44' 25.80"	39° 42' 57.29"
Wadi Al Muataf	17° 19' 19.50"	43° 08' 40.50"
Wadi Awed	17° 20' 32.30"	43° 10' 39.80"
Wadi Jora	17° 21' 54.90"	43° 07' 46.10"
Wadi Reem	24° 10' 13.58"	39° 19' 50.03"
Wadi Reem (Al Aseel)	23° 55' 06.50"	39° 18' 05.50"

and Tabuk provinces (Table 1) either by flipping stones or by using ultraviolet torches at night. Specimens were photographed while being alive, and then preserved in 75% ethyl alcohol with glycerol for further identification. The species were identified based on taxonomic keys according to Hendrixson (2006) and Alqahtani and Badry (2021).

Results

In this study, nine species of scorpions belonging to two families (Buthidae and Scorpionidae) were reported from 31 localities from several provinces in Saudi Arabia. High quality images are provided.

Family Buthidae

***Androctonus crassicauda* (Olivier, 1807) (Figure 2).**

Material examined: 2 ♀♀, 1 subadult ♂, Quraeah (Tabuk Province), 23.7.2017, *leg*. A. Aloufi. 1 ♂, Buwat (Al Madinah Al Monawwarah Province), 11.5.2017, *leg*. A. Aloufi. 1 ♂ juv., Al Mendasah (Al Madinah Al Monawwarah Province), 9.8.2018, *leg*. A. Aloufi. 1♂, Wadi Al Fara'a (Al Madinah Al Monawwarah Province), 1.4.2018, *leg*. A. Aloufi. 1 ♀ subadult, Dhabua'h (Al Madinah Al Monawwarah Province), 17.9.2017, *leg*. A. Aloufi. 2 ♀♀, 3 ♂♂ subadults, 1 ♀ subadult, 5 juv. Rowdhat Malham (Riyadh Province), 26.11.2021, *leg*. A. Aloufi. 2 ♂♂ subadults, 1 ♀ subadult, Sha'eeb Huraymila (Riyadh Province), 30.9.2021, *leg*. A. Aloufi. 1 ♀ subadult, 1 ♂, Al Atafeah village , Al Suedrah city (Al Madinah Al Monawwarah Province), 12.4.2022, *leg*. A. Aloufi. 1 ♂, Al Auruf village , Al Suedrah city (Al Madinah Al Monawwarah Province), 20.4.2022, *leg*. A. Aloufi. 1 ♀, Sultan Al Feridi farm (Al Madinah Al Monawwarah Province), 12.5.2022, *leg*. A. Aloufi. 1 ♀, Jabal Al Ward (Al Ula Governorate, Al Madinah Al Monawarah Province), 14.5.2017, *leg*. A. Aloufi. 1 ♀, Hermah, Al Suedrah city (Al Madinah Al Monawwarah Province), 3.6.2022, *leg*. A. Aloufi. 2 ♂♂,1 ♀, Al Dyear, Al Suedrah city (Al Madinah Al Monawwarah Province), 8.6.2022, *leg*. A.

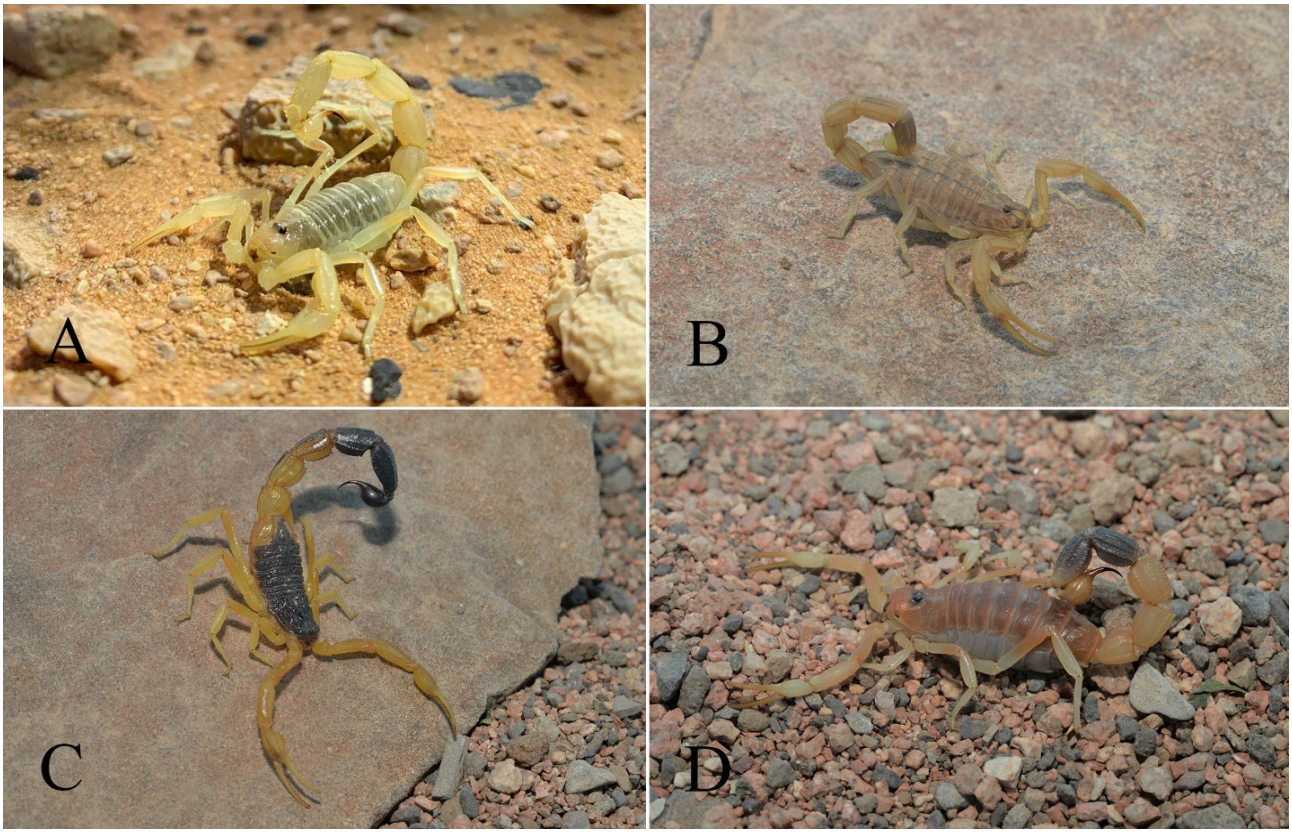

Figure 1. A. *Buthacus* sp. **B**. *Compsobuthus manzonii.* **C**. *Hottentotta scaber.* **D**. *Parabuthus liosoma.*

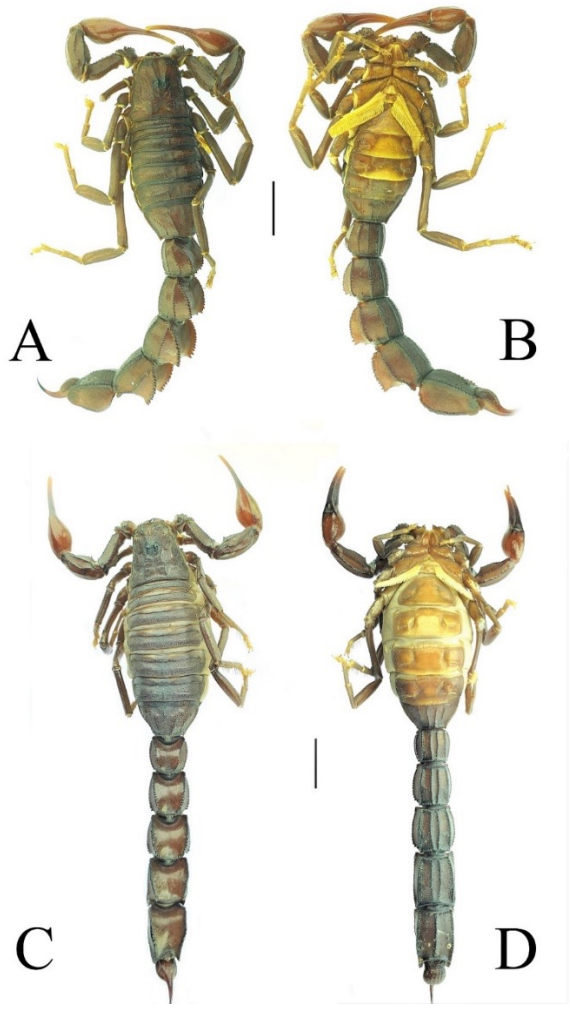

Figure 2. *Androctonus crassicauda.* Male. **A**. Dorsal aspect. **B.** ventral aspect. Female. **C**. Dorsal aspect. **D.** ventral aspect. Scale bar = 10 mm

Aloufi.

Diagnosis: Colour of adults is golden brown to nearly black, pale yellow in juveniles; metasomal segment III wider than long; pedipalp manus broad and stout; outer tooth of basitarsal spur on leg IV generally not bifurcated, mesosomal tergites I and II with at most three carinae (Hendrixon, 2006).

Remarks: This is a widely distributed species across Saudi Arabia (Hendrixon, 2006; Alqahtani and Badry, 2021). Its distribution range extends across all of the Middle East and reaches as far as Armenia and Azerbaijan (Hendrixon, 2006). Alqahtani *et al.* (2022) showed that three distinct clusters of *A. crassicauda* in Saudi Arabia and Iran based on molecular studies.

Figure 3. Dorsal and ventral views of *Apistobuthus pterygocercus* female.

***Apistobuthus pterygocercus* Finnegan, 1932 (Figure 3).**

Material examined: 1♀, Nofoud Al Thumamah (Riyadh Province), 2.12.2021, *leg*. A. Aloufi.

Diagnosis: Carapace with distinct carina, metasomal segment II widely flared, much wider than other segments, pedipalp chela fingers extremely elongated with 13-14 rows of granules, pectinal tooth counts 36-50 in female, 52-57 in males.

Remarks: This species was originally described from Uruq Dhahiqah, Saudi Arabia (Finnegan, 1932). This is a sand dwelling species associated with sand dunes around Hail, Riyadh and Ash Sharqiyah (Alqahtani and Badry, 2021). Widespread throughout the Arabian Peninsula including Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen (Hendrixon, 2006).

***Buthacus* sp. (Figures 1A, 4).**

Material examined 1 ♂ subadult, Sha'eeb Huraymila (Riyadh Province), 30.11.2021, *leg*. A. Aloufi.

Diagnosis: External surface of pedipalp patella with seven trichobothria; pedipalp femoral trichobothrium **d**5 proximal to **e**2; metasomal segments very hirsute; metasomal segment V and/or telson often black; pedipalp chela fingers with inner and

Figure 4. Dorsal and ventral views of *Buthacus* sp. male.

outer accessory granules.

Remarks: The validity of this species is still doubtful. It seems that *Buthacus nigroaculeatus* is the common species, however our specimens do not fit with the description of *B. nigroaculeatus*. For the mean time, we refer to these specimens as *Buthacus* sp.

***Compsobuthus manzonii* (Borelli, 1915) (Figures 1B, 5).**

Material examined 1♀, Wadi al Jal a'b. Al Wahaj farm (Al Madinah Al Monawwarah Province), 6.8.2017, *leg*. A. Aloufi. 1 ♀, Shajwa (Al Madinah Al Monawwarah Province), 8.4.2018, *leg*. A. Aloufi. 2 ♂♂, 2 ♀♀, Alaab (Al Madinah Al Monawwarah Province), 21.3.2019, *leg*. A. Aloufi. 1 ♂, 1 ♀, Ain Al Akhdhar, Harat Al Rahah (Tabuk Province), 5.7.2021, *leg*. A. Aloufi. 1♀, Wadi Al Garhan (Al Dayer Governorate, Jazan Province), 5.12.2021, *leg*. A. Aloufi. 2 ♂♂, 2 ♀♀, Wadi Jora, (Al Dayer Governorate, Jazan Province), 2.5.2022, *leg*. A. Aloufi. 1♀, Al Boqa'a, (Al Dayer Governorate, Jazan Province), 4.5.2022, *leg*. A. Aloufi. 1♂, Wadi Al Muataf , (Al Dayer Governorate, Jazan Province), 5.5.2022, *leg*. A. Aloufi. 4 ♂♂, 1 ♀, Al Fegrah (Wadi Mzaber), (Al Madinah Al Monawwarah Province), 25.5.2022, *leg*. A. Aloufi.

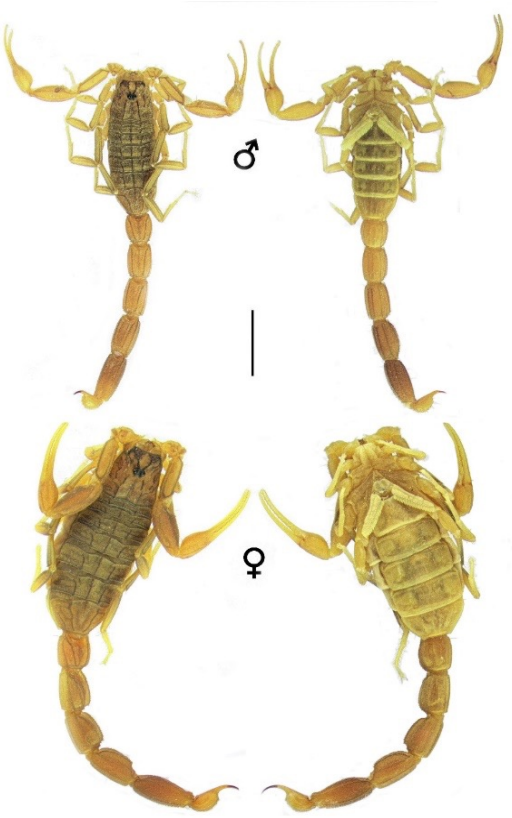

Figure 5. *Compsobuthus manzonii*. Male. **A**. Dorsal aspect. **B.** ventral aspect. Female. **C**. Dorsal aspect. **D.** ventral aspect. Scale bar = 5 mm.

Diagnosis: Adult females to 45 mm in length; body surfaces generally underlined with dusky pigment; pedipalp chela fingers with outer accessory granules; pedipalp chela fingers with 9-11 rows of granules along dentate margin; pectinal tooth counts 19-23 in males, 17-19 in females; median lateral carinae on metasomal segments II and III present at least on posterior three-fourths; pedipalp chela fingers not extremely elongated.

Remarks: This species was firstly recorded from Saudi Arabia as a new species under the name *Compsobuthus fuscatus* Hendrixson, 2006, with its holotype male from Jabal Qishayradh, 21°17' N 40°17› E, this particular form of *Compsobuthus* is distributed throughout the south-western of Saudi Arabia (Hendrixson, 2006, Fig. 13 : 70), and

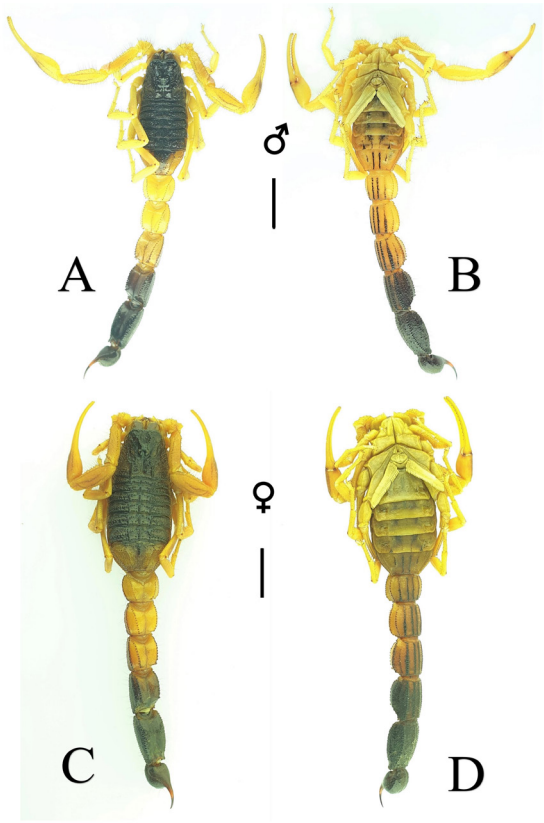

Figure 6.- *Hottentotta scaber*.Male. **A**. Dorsal aspect. **B.** ventral aspect. Female. **C**. Dorsal aspect. **D.** ventral aspect. Scale bar = 10 mm.

throughout the mountainous areas of north-west Yemen (Sissom, 1994, Fig. 13 : 70)
This species was recorded from Asir, Jazan and Mecca (Alqahtani *et al.*, 2019). The present records extend its distribution range further into northwestern Saudi Arabia. According to Kovařík, (2013), *Compsobuthus fuscatus* Hendrixson, 2006 is synonymized with *Compsubuthus manzonii* (Borelli, 1915).

***Hottentotta scaber* (Ehrenberg, 1828) (Figure 1C, 6).**

Material examined: 1♂, Jabal khasher, (Al Dayer Governorate, Jazan Province), 5.12.2021, *leg*. A. Aloufi. 1 subadult ♂, Wadi Al Garhan, (Al Dayer Governorate, Jazan Province), 1.5.2022, *leg*. A. Aloufi. 1 ♀, 1 ♂ juv., Wadi Jora, (Al Dayer Governorate, Jazan Province), 2.5.2022, *leg*. A. Aloufi. 2 subadult ♀, Wadi Awed, (Al Dayer Governorate, Jazan Province), 3.5.2022, *leg*. A. Aloufi. 2 ♂♂, 2 ♀♀, Al Boqa'a, (Al Dayer Governorate, Jazan Province), 4.5.2022, *leg*. A. Aloufi. 2 ♂♂, 2 ♀♀, 2 subadults ♂♂, 5 subadults ♀♀, Wadi Al Garhan, (Al Dayer Governorate, Jazan Province), 2.7.2022, *leg*. A. Aloufi.

Diagnosis: Total length 60–85 mm. Male with slightly longer and narrower metasomal segments. Pectinal teeth number 34–37 in males, 28–33 in females. Pedipalps and legs densely hirsute, metasoma sparsely hirsute, fifth metasomal segment more hirsute than first. The hairs on patella of pedipalps are long. Carapace, mesosoma except seventh tergite (or its posterior part), fifth metasomal segment and telson black. First three metasomal segments, legs and pedipalps including fingers uniformly pale yellow. Ventral carinae on metasomal segments also black. Movable fingers of pedipalps with 14–15 rows of granules and 5 terminal granules. First and second metasomal segments with 10 carinae; third and fourth segments with 8 carinae; fifth segment with 5 carinae, 3 ventral (1 median, 2 lateral) and 2 dorsal. First and second metasomal segments of both sexes wider than long.

Remarks: *H. scaber* has three characters unusual for the genus. It differs from all other species in coloration, with the carapace, mesosoma, the fifth metasomal segment and telson black and all other parts pale yellow. Exceptional is also the combination of densely hirsute pedipalps and sparsely hirsute metasoma, which indicates closeness to *H. jayakari* and *H. salei* inhabiting the same areas. Most unusual are the very broad first and second metasomal segments in relation to the fourth metasomal segment, namely in females. This unusual feature is otherwise present only in *H. jalalabadensis*, which is easily distinguished by other noted characters (pubescence and color).
This African species was first recorded in Saudi Arabia from Seir Farasãn Kebir (Kovařík and Whitman, 2005; Kovařík, 2007), the second record were from Khasher and Al Aridhah (Jizan Province) by Alqahtani *et al*. (2019).

***Leiurus haenggii* Lowe, Yagmur & Kovarik, 2014 (Figure 7).**

Material examined 1 ♂ subadult, Mughera'a (Al Ula Governorate, Al Madinah Al Monawarah Province), 19.7.2017, *leg*. A. Aloufi. 3♂♂, 1♀, 3 ♂♂ subadults, Wadi al Jal a'b, Al Wahaj farm (Al Madinah Al Monawwarah Province), 6.8.2017, *leg*. A. Aloufi. 1 ♂, Al Mulaeleeh, Al Madinah Al Monawwarah Province), 13.9.2017, *leg*. A. Aloufi. 1♀, 1 ♂ subadult, 1 ♀ subadult, Wadi Reem (Al Madinah Al Monawwarah Province), 5.5.2018, *leg*. A. Aloufi. 2 ♂♂, 2 ♀♀, 3 ♂♂ subadults, 2 ♀♀ subadults, Alaab (Al Madinah Al Monawwarah Province), 21.3.2019, *leg*. A. Aloufi. ♂♂, 1♀, Wadi Reem (Al Aseel), (Al Madinah Al Monawwarah Province), 22.5.2022, *leg*. A. Aloufi.

Diagnosis: Mesosomal tergites I and II with five carinae, pedipalp patella in females with L/W less than 3.20, female sternites III–IV with weak to obsolete median carinae (Lowe *et al.*, 2014).

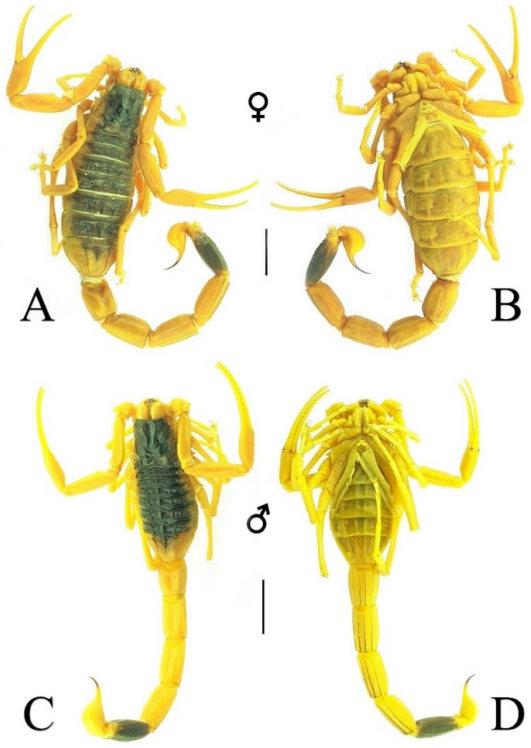

Figure 7. *Leiurus haenggii*. Female. **A**. Dorsal aspect. **B.** ventral aspect. Male. **C**. Dorsal aspect. **D.** ventral aspect. Scale bar = 10 mm.

Remarks: Lowe *et al.* (2014) revised the genus *Leiurus*; all previous records of *Leiurus quinquestriatus* (Ehrenberg, 1828) in Saudi Arabia are described as either: *Leiurus brachycentrus* (Ehrenberg, 1829) known along the southern Red Sea coast of Saudi Arabia and Yemen, *Leiurus arabicus* Lowe, Yagmur & Kovarik, 2014 in central Arabia reaching as far as the southwest of Makkah, and *Leiurus haenggii* Lowe, Yagmur & Kovarik, 2014 extending along the coastal mountains of the Red Sea reaching as far as Yemen and western Oman (Lowe *et al.,* 2014).

***Parabuthus liosoma* (Ehrenberg, 1828) (Figures 1D, 8).**

Material examined: 3 ♂♂, 1♂ juv., Wadi Al Garhan (Al Dayer Governorate, Jazan Province), 5.12.2021, *leg*. A. Aloufi. 1♂, Wadi Al Garhan (Al Dayer Governorate, Jazan Province), 2.7.2022, *leg*. A. Aloufi.

Diagnosis: Pedipalp femoral trichobothria arranged in alpha-configuration; a stridulatory patch present on the dorsal surface of metasomal segments I-III (Hendrixon, 2006).

Remarks: The genus *Parabuthus* is represented by several species in the Horn of Africa (Kovařík *et al.*, 2016). In their study, Kovařík *et al.* (2016) split *P. liosoma* into three sibling species; *P. abyssinicus* Pocock, 1901 confined to Eritrea, Djibouti, central and north-eastern parts of Ethiopia), *P. liosoma* (Ehrenberg, 1828) known from Yemen and Saudi Arabia and *P. maximus* Werner, 1913 from Tanzania and Kenya). Recorded previously from southwestern Saudi Arabia including Jeddah and Jizan (Hendrixon, 2006), Al Baha. Jazan and Mecca (Alqahtani *et al.*, 2019) and Tabuk (Aloufi *et al.*, 2021).

***Vachoniolus globimanus* Levy, Amitai & Shulov, 1973 (Figure 9).**

Material examined: 1♀, Al Makhrameah (Al Wabari Farm, Tabuk Province), 23.7.2017, *l*eg. A. Aloufi. 1 ♂, Al Qarnaen

(Uruq Bani M'arid Protected Area, Yadamah Governorate, Najran Province), 5.5.2019, *leg*. A. Aloufi.

Diagnosis: Carapace lacking distinct carinae; external surface of pedipalp patella with eight or nine trichobothria; pedipalp femoral trichobothrium d_5 distal to e_2; male pedipalp chela swollen and globular (Hendrixon, 2006).

Figure 8. Dorsal and ventral views of *Parabuthus liosoma* male.

Remarks: This species is widely distributed across Oman, Saudi Arabia and the United Arab Emirates (Lowe, 2010; Alqahtani & Badry, 2021). It was previously recorded from Riyadh and El-Baha (Hendrixson, 2006; Al-Asmari *et al.*, 2009a). The present record extends its distribution range to the northwest of Saudi Arabia in Tabuk. Both Al Makhrameah in Tabuk and Al Qarnaen in Najran have extensive sand plains.

***Scorpio kruglovi* Birula, 1910 (Figure 10, Figure 11A-C).**

Material examined: 1♀, 1♂, Quraeah, (Tabuk Province), 23.7.2017, *leg*. A. Aloufi.

Diagnosis: Adults greater than 5 cm long , general color of the body straw yellow or light brown; fingers of pedipalp chela darkened, anterior margin of carapace with shallow median notch, median eyes located in the middle of carapace, three pairs of lateral ocelli, pedipalps orthobothriotaxic, with 26 trichobothria, pedipalp chela trichobothrium ***it*** placed basally along fixed finger near ***ib***, chela rather narrow (its maximum width is smaller than the length from the basal joint

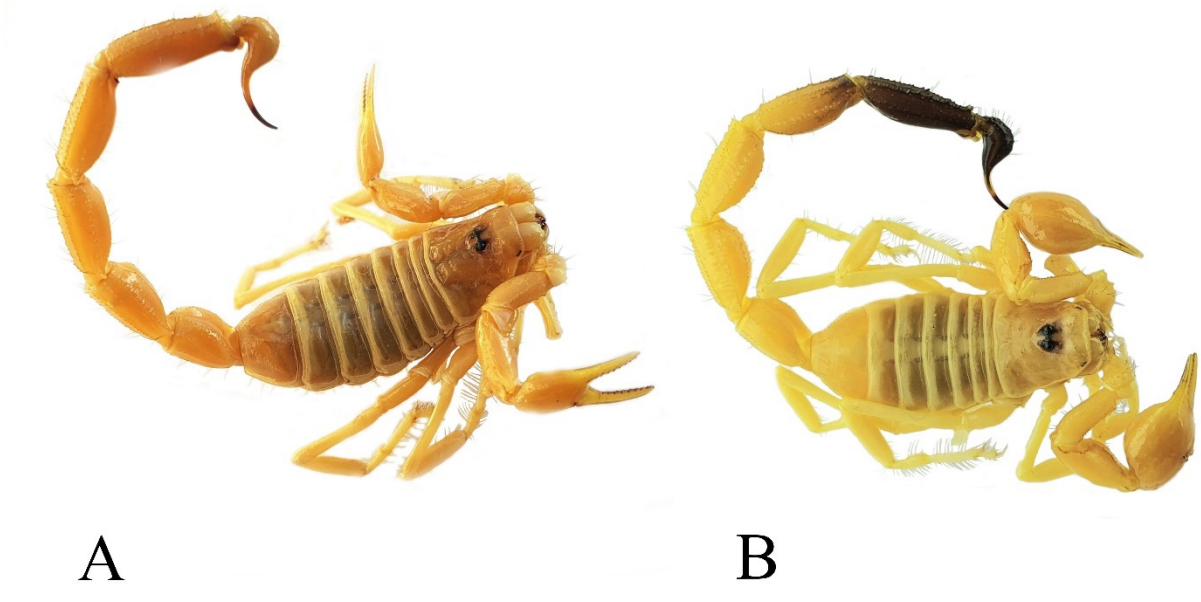

Figure 9. A. Dorsal view of *Vachoniolus globimanus* female. **B.** Dorsal view of *Vachoniolus globimanus* male.

to the edge of the fixed finger, in females the external surface of chela almost smooth mostly with a sculptural structure of barely raised punctate fine whorls; the internal surface almost smooth; only covered with barely noticeable, very finely dotted small spots; in males the external surface of chela with rather unequal small, isolated, covered with rounded, somewhat pointed granules, internal surface of chela is rather sparsely covered with pointed granules over almost two-thirds of its surface. Sternite VII with paired ventrosubmedian and ventrolateral carinae, metasomal segments I-IV each with paired ventrosubmedian and ventrolateral carinae; ventrosubmedian carinae of metasomal segment IV smooth, telson lacking subaculear tubercle; telson vesicle granular ventrally; telson vesicle rather narrow, elongated, almost as long as the moderately curved aculeus, female pecten with long narrow basal median lamella; of the same length the untoothed area as the region bearing the teeth. Pectinal tooth count 9-10, tibial spurs absent, tarsi armed only with prolateral pedal spurs, tarsi ending in rounded lateroapical lobes; 6 spines on the external surface of the tarsi of legs IV and 9 on the internal surface (the formula being 6-7/8-10), stridulatory organs absent.

Remarks: *S. kruglovi* was first recorded from Wadi Hanifa and near Riyadh by Vachon (1979). The characters of the 5 females examined by Vachon, whose size is about 5 cm, correspond well to those possessed by the subspecies *kruglovi* Birula whose type locality is Deir-Al Zur, upper Euphrates / Syria. The important and special character to this form is, in his opinion, that drawn from the structure of the pectines; the basal median lamella of which is long and narrow (Fig. 10A), the untoothed region of pecten of the same length as the region bearing the teeth. All examined females with pectinal tooth count 9 or 10. Talal *et al.* (2015) elevated this subspecies to the species level as *Scorpio kruglovi* Birula, 1910.

In their identification keys Barahoei *et al.* (2020) and Alqahtani & Badry (2021) reversed the character "*Base of pectin with or without denticle*" to distinguish between *S. kruglovi* and *S. palmatus*. According to Birula (1910) plates and figures; females of *S. kruglovi* has a slender basal median lamella of pecten devoid of denticles basally (Fig. 11A). In contrast, *S. palmatus* has a stocky, basal median lamella with more denticles (Fig. 11D).

Figure 10. Dorsal and ventral view of female *Scorpio kruglovi*.

Discussion

The scorpions of Saudi Arabia are still in dire need for further studies. With the large area of Saudi Arabia, many species are awaiting exploration that will certainly results in additional new species. Recent studies by Abu Afifeh *et al.* (2021) and Alqahtani *et al.* (2022) added more to our knowledge on the scorpions of Saudi Arabia.

The scorpions of the southwestern region

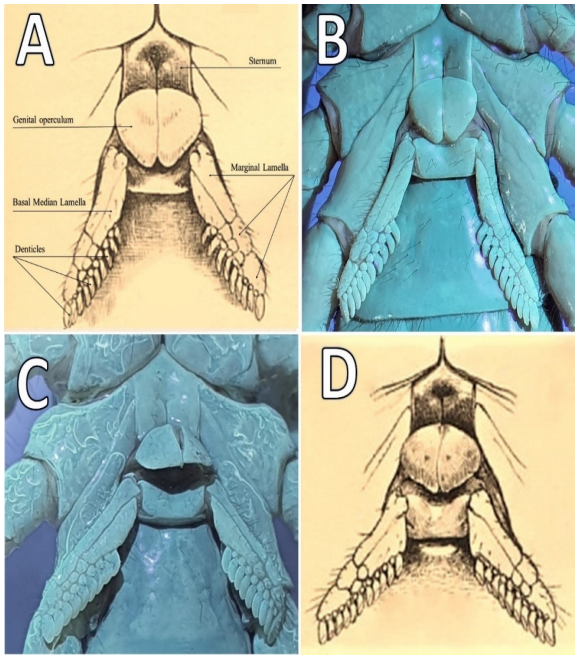

Figure 11. Pectines, genital operculum and sternum. **A.** Female *Scorpio kruglovi* (Birula, 1910, Fig. 14, plate XIII). **B.** Female *Scorpio kruglovi* (Quraeah, Tabuk). **C.** Male *Scorpio kruglovi* (Quraeah, Tabuk). **D.** Male *Scorpio palmatus* (Birula 1910, Fig. 7, plate XII).

of Saudi Arabia are still to be investigated, especially the status of species of the genus *Nebo*. It is anticipated that a new species of this genus will be described based on our personal observations. We have collected specimens from many parts of the country that are still under investigation. Species of the genus *Scorpio* are still a challenge to reveal their identity, and certainly new species of this genus will be described shortly. On the other hand, species of the genus *Compsobuthus* are still to be explored due to high variations between the different populations in Saudi Arabia.

References

Abu Afifeh, B, Aloufi, A, Al-Saraireh, M and Amr, Z. 2021. A new species of *Compsobuthus* from Saudi Arabia. *Zoology in the Middle East*, **67**: 365-372.

Al-Asmari, AK, Al-Saif, AA and Abdo, NM. 2007. Morphological identification of scorpion species from Jazan and Al-Medina Al-Munawara regions, Saudi Arabia. *Journal of Venomous Animals and Toxins including Tropical Diseases*, **13**: 821–843.

Al-Asmari, AK, Al-Saif, AA, Abdo, NM and Al-Moutaery, KR. 2009a. The scorpion fauna of Al-Baha and Hail regions, *Saudi Arabia. Journal of Biological Sciences*, **9**: 96–108.

Al-Asmari, AK, Al-Saif, AA, Abdo, NM and Al-Moutaery, KR. 2009b. New additions to the scorpion fauna of Riyadh region, Saudi Arabia. *Journal of Venomous Animals and Toxins including Tropical Diseases*, **15**: 612–632.

Al-Asmari, AK, Al-Saif, AA, Abdo, NM, Al-Moutaery, KR and Al-Harbi, NO. 2013. A review of the scorpion fauna of Saudi Arabia. *Egyptian Journal of Natural History,* **6**: 1–21.

Aloufi, A., Abu Afifeh, B. & Amr, Z. 2021. Scorpions of Tabuk Province, Saudi Arabia. *Jordan Journal of Natural History*, **8**:110-117.

Alqahtani, A. R., Badry, R, Aly, H., Amer, S.A.M., Abd Al Galil, A.M., Ahmed, M.A. & Amr, Z.S. 2022. Intraspecific molecular variation among *Androctonus crassicauda* (Olivier, 1807) populations collected from different regions in Saudi Arabia. *Journal of King Saud University-Science*, **34**: 101998.

Alqahtani, AR and Badry, A. 2021. A contribution to the scorpion fauna of Saudi Arabia, with an identification key (Arachnida: Scorpiones). *Journal of King Saud University – Science*, **33**:101396.

Alqahtani, ARM, Elgammal, B, Ghaleb, KI and Badry, A. 2019. The scorpion

fauna of the southwestern part of Saudi Arabia. *Egyptian Academic Journal of Biological Sciences*, **11**: 19–29.

Alqahtani, A. R., Badry, A., Aly, H., Amer, S.A.M., Abd Al Galil, F.M., Ahmed, M.A., Kadasah, S. & Amr, Z.S. 2022. Genetic diversity and population structure of *Androctonus crassicauda* (Scorpiones: Buthidae) in different ecogeographical regions of Saudi Arabia and Iran. *Zoology in the Middle East*, **68(2)**: 171-179.

Barahoei, H., Navidpour, S., Aliabadian, M., Siahsarvie, R. and Mirshamsi, O., 2020. Scorpions of Iran (Arachnida: Scorpiones): annotated checklist, DELTA database and identification key. *J. Insect Biodivers. Systemat*., **6(4)**:375–474.

Birula, A.A. 1910. Ueber *Scorpio maurus* Linné und seine Unterarten. *Horae Societatis Entomologicae Rossicae* **39**: 115-192.

Desouky, M.A.A. and Alshammari, A.M. 2010. Scorpions of the Ha'il Region, Northern Saudi Arabia, and molecular phylogenetics of two common species, *Androctonus crassicauda* and *Scorpio maurus kruglovi*. *Arachnology*,15(6), 193-200,

El-Hennawy, HK. 2009. Scorpions of Saudi Arabia (List of species, their distribution, and identification key). *Serket*, **11(3/4)**: 119–128.

Hendrixson, BE. 2006. Buthid scorpions of Saudi Arabia, with notes on other families (scorpiones: buthidae, liochelidae, Scorpionidae). *Fauna of Arabia*, **21**: 33–120.

Kovařík, F. 2007. A revision of the genus *Hottentotta* Birula, 1908, with descriptions of four new species (Scorpiones, Buthidae). *Euscorpius*, **58**: 1–107.

Kovařík, F. and Whitman, S. 2005. Catalogues of the Florence University Natural History Museum - Zoology Section «La Specola». XXII. Arachnida Scorpiones. Types. Addenda (1988-2004) and checklist (excluding Euscorpiinae). *Atti della Società Toscana di Scienze Naturali, Memorie, serie* B, **111**: 103-119.

Kovařík, F. 2013. Family Buthidae. In: Kovařík, F and Ojanguren Affilastro, AA, (Edits.) Illustrated catalogue of scorpions Part II Bothriuridae: Buthidae I, genera *Compsobuthus*, *Hottentotta, Isometrus, Lychas* and *Sassanidotus*. Prague, Clarion Production. Pp. 145-212.

Kovařík, F., Lowe, G., Plíšková, J. and Šťáhlavský, F. 2016. Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part VII. *Parabuthus* Pocock, 1890 (Buthidae), with description of *P. hamar* sp. n. and *P. kajibu* sp. n. from Ethiopia. *Euscorpius*, **228**: 1-58.

Lowe, G. 2010. The Genus *Vachoniolus* (Scorpiones: Buthidae) in Oman. *Euscorpius*, **100**:1-37.

Lowe, G., Yağmur EA and Kovařík. F. 2014. A review of the genus *Leiurus* Ehrenberg, 1828 (Scorpiones:Buthidae) with description of four new species from the Arabian Peninsula. *Euscorpius*, **191**: 1–129.

Talal, S., Tesler, I., Sivan, J., Ben-Shlomo, R., Muhammad Tahir, H., Prendini, L., Snir, S. and Gefen, E. 2015. Scorpion speciation in the Holy Land: Multilocus phylogeography corroborates diagnostic differences in morphology and burrowing behavior among *Scorpio* subspecies and justifies recognition as phylogenetic, ecological and biological species. *Molecular Phylogenetics & Evolution*, **91**:226-37.

Vachon, M. 1979. Arachnids of Saudi Arabia: Scorpiones. Fauna of Saudi Arabia 1: 30-66.