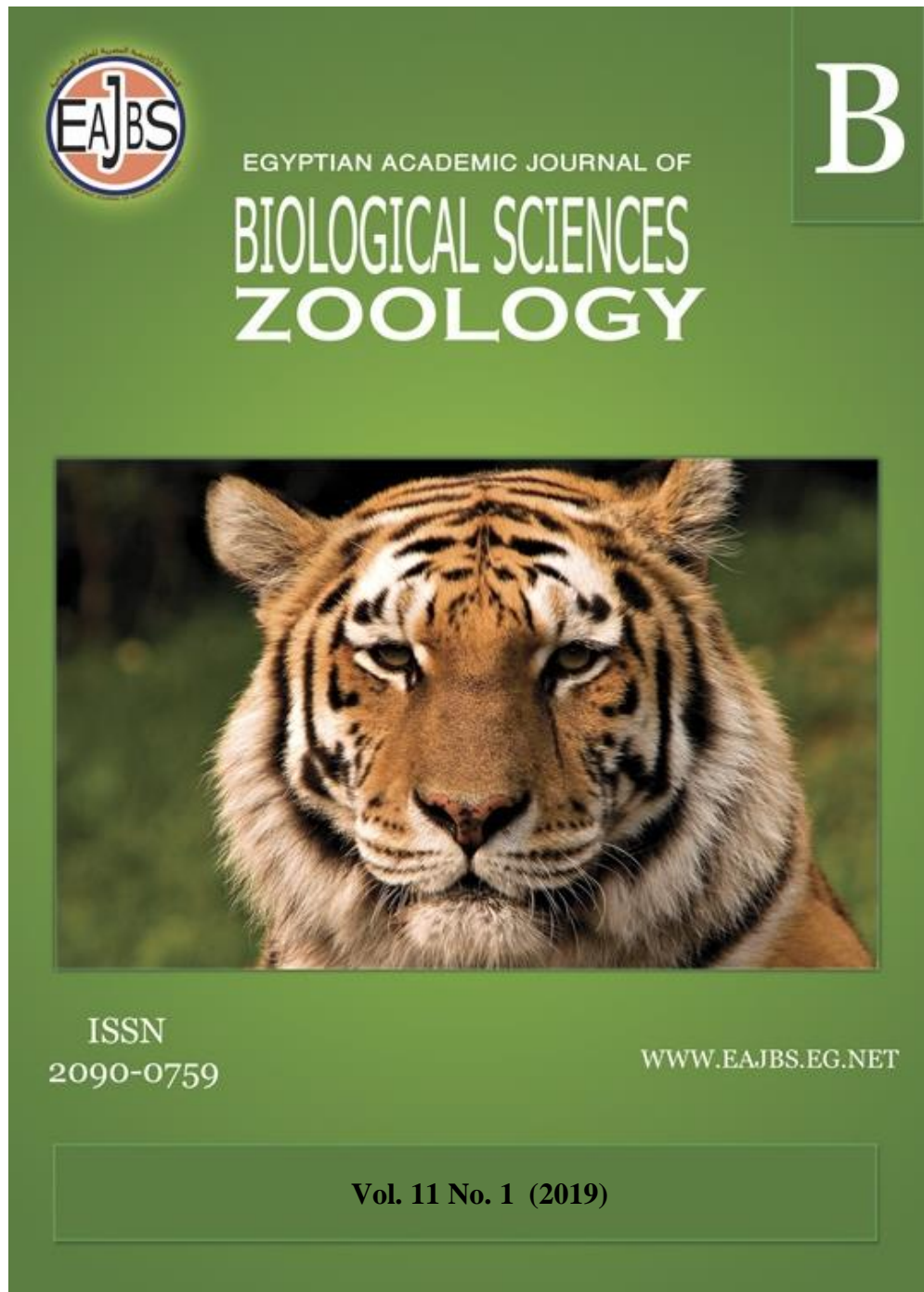


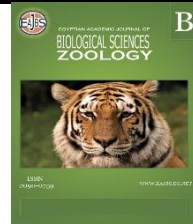
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## The Scorpion Fauna of the Southwestern Part of Saudi Arabia

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### ABSTRACT

The diversity of the scorpion fauna of the southwestern part of Saudi Arabia was examined based on a large collection covering most of four major regions. Fifteen scorpion species were collected during field expedition and identified in a light of recent revisionary systematics. Family Buthidae was represented by twelve species in nine genera (*Androctonus*, *Buthacus*, *Compsobuthus*, *Hottentotta*, *Leiurus*, *Orthochirus*, *Parabuthus*, *Trypanothacus* and *Vachoniolus*) and family Scorpionidae by three species in two genera (*Nebo* and *Scorpio*). *Buthacus yotvatensis* is recorded for the first time in Saudi Arabia.

### INTRODUCTION

Scorpiones comprise a highly diverse and a successful order of Arachnida, with approximately 2363 recognized extant species (Lourenço, 2018). Scorpions distributed over all continents except Antarctica (Francke, 1982; Lamoral, 1980; Sissom, 1990). They occupy a great range of habitats in tropical and temperate regions of the world, including forest, savanna and desert (Anderson, 1983).

Historically, the first work dealt with the scorpion fauna of Saudi Arabia was that of Vachon (1979). In his study, fourteen species and subspecies were provided. Later, considerable information about scorpions of Saudi Arabia have been reviewed, synthesized and compiled by several authors (Kinzelbach, 1985; Vachon & Kinzelbach, 1987; El-Hennawy, 1992). Hendrixson (2006) studied the systematics of the buthid scorpion faunal composition, with notes on two other families in the Kingdom of Saudi Arabia. Several studies have contributed significantly to the knowledge about the scorpion sting syndrome (Al-Asmari, et al., 2007; Al-Sadoon & Al-Farraaj, 2008; Jarrar and Al-Rowaily 2008) geographical distribution, scorpion identification and composition (Al-Asmari, et al., 2009a, b; El-Hennawy, 2009; Al-Asmari, et al., 2013;

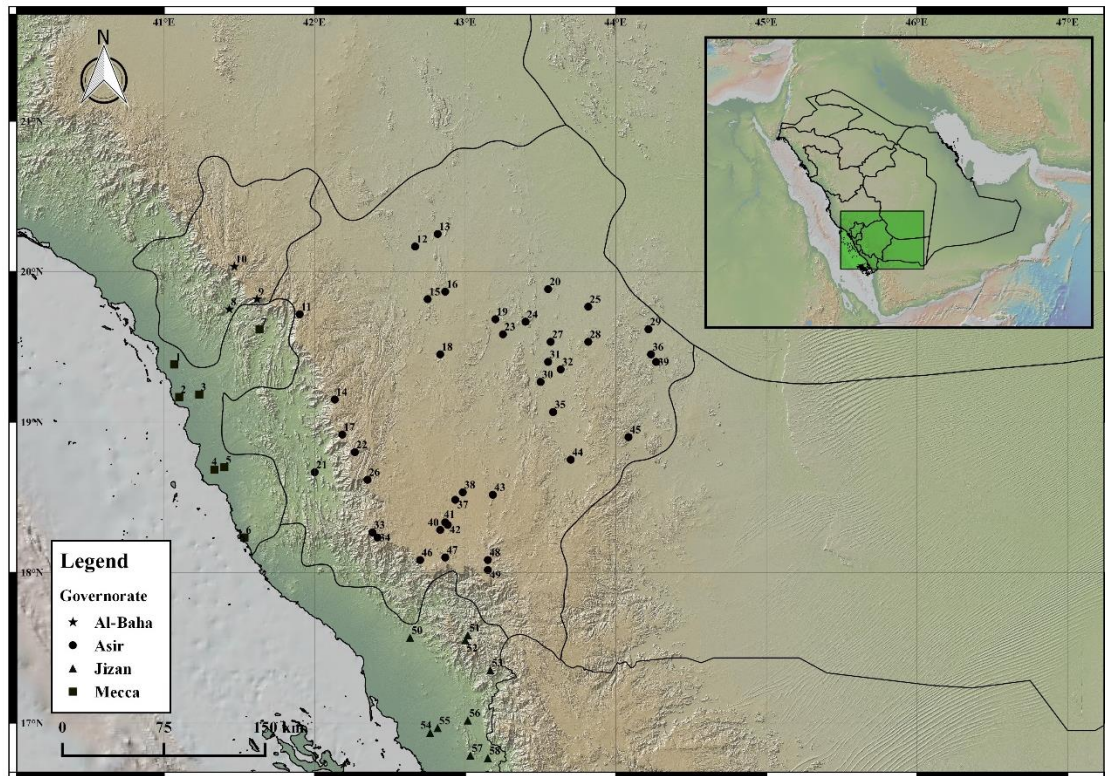
El-Hennawy, 2014; Lowe *et al.*, 2014). Currently, these authors refer to the total number of scorpion species recorded in Saudi Arabia were 35 species. Particularly, little is known about the scorpion fauna from the southwestern part of Saudi Arabia. This study aims to update the information of taxonomical and biogeographical of scorpion fauna of southwestern part of Saudi Arabia.

## MATERIALS AND METHODS

Specimens were collected from 58 localities representing four regions of southwestern part of Saudi Arabia, including: Mecca, Al-Baha, Asir and Jizan (Table 1 and Figure 1). The majority of these specimens were collected during the course of this study (from November 2016 to January 2019). Scorpions were collected by actively searching their potential hiding places, mostly under rocks during daytime (Williams, 1968) and at night using ultraviolet light (Stahnke, 1972). Collected specimens were preserved for future morphological and taxonomical studies, as described by Williams (1968). The specimens were examined with a stereoscopic binocular microscope. The collected scorpions were identified to the species level based on keys and morphological descriptions of El-Hennawy (1987), Sissom (1990), Hendrixson (2006), Kovařík (2007), El-Hennawy (2009) and Lowe (2010).

**Table 1.** Locations of the investigated sites during the survey.

N	Site	Gov.	Lat.	Long.	N	Site	Gov.	Lat.	Long.
1	Almuzaylif	Mecca	N 19° 23'	E 41° 04'	31	Al Hafair	Asir	N 19° 24'	E 43° 33'
2	Al-Gunfuda		N 19° 10'	E 41° 06'	32	Aushayrah		N 19° 21'	E 43° 38'
3	Ahad Bani Zayd		N 19° 11'	E 41° 14'	33	Sawda		N 18° 16'	E 42° 23'
4	Al Baydayn		N 18° 41'	E 41° 20'	34	Almaqadha		N 18° 14'	E 42° 25'
5	Keyad		N 18° 42'	E 41° 24'	35	Al Hamdhah		N 19° 04'	E 43° 35'
6	Al Birk		N 18° 14'	E 41° 32'	36	Alyunod		N 19° 27'	E 44° 14'
7	Biny Suhaim		N 19° 37'	E 41° 38'	37	Wadi Al Shaiq		N 18° 29'	E 42° 56'
8	Al Makhwah	Al-Baha	N 19° 45'	E 41° 26'	38	Wadi Lajb	N 18° 32'	E 42° 59'	
9	Baljurashi		N 19° 49'	E 41° 37'	39	Al Hilaya	N 19° 24'	E 44° 16'	
10	Al-Baha	Asir	N 20° 02'	E 41° 28'	40	Khamis Mushait	N 18° 17'	E 42° 50'	
11	Al Bashayer		N 19° 43'	E 41° 54'	41	Wadi Tendaha	N 18° 20'	E 42° 52'	
12	Bisha		N 20° 10'	E 42° 40'	42	Tendaha Dam	N 18° 19'	E 42° 53'	
13	Al Junainah		N 20° 15'	E 42° 49'	43	Tareeb	N 18° 31'	E 43° 11'	
14	Al Namas		N 19° 09'	E 42° 08'	44	Al Amwah	N 18° 45'	E 43° 42'	
15	Al Ataf		N 19° 49'	E 42° 45'	45	Ain Qahtan	N 18° 54'	E 44° 05'	
16	Idhras		N 19° 52'	E 42° 52'	46	Dalagan	N 18° 05'	E 42° 42'	
17	Tanuma		N 18° 55'	E 42° 11'	47	Al Murabba	N 18° 06'	E 42° 52'	
18	Alhafyrah		N 19° 27'	E 42° 50'	48	Sarat Abidah	N 18° 05'	E 43° 09'	
19	Kuhlan		N 19° 41'	E 43° 12'	49	Sabt Bani Basher	N 18° 01'	E 43° 09'	
20	Habaya	Asir	N 19° 53'	E 43° 33'	50	Al Fatiha	Jizan	N 17° 34'	E 42° 38'
21	Turgesh		N 18° 40'	E 42° 00'	51	Al Reeth		N 17° 35'	E 43° 01'
22	Ballasmar		N 18° 48'	E 42° 16'	52	Wadi Amoud		N 17° 33'	E 43° 00'
23	Al Masamah		N 19° 35'	E 43° 15'	53	Khasher		N 17° 21'	E 43° 10'
24	Al Farash		N 19° 40'	E 43° 24'	54	Bahrah Abu Arish		N 16° 56'	E 42° 46'
25	Rabbah		N 19° 46'	E 43° 49'	55	Abu Arish		N 16° 58'	E 42° 49'
26	Ballahmar		N 18° 37'	E 42° 21'	56	Al Aridhah		N 17° 01'	E 43° 01'
27	Tathleth		N 19° 32'	E 43° 34'	57	Alhasma		N 16° 47'	E 43° 02'
28	Morighan		N 19° 32'	E 43° 49'	58	Al-Harth		N 16° 46'	E 43° 09'
29	Abraq Na'am		N 19° 37'	E 44° 13'					
30	Wadi Alrasain		N 19° 16'	E 43° 30'					



**Figure 1:** Location map of the southwestern part of Saudi Arabia and collection localities covered in this study.

## RESULTS

Family Buthidae was represented by twelve species in nine genera (*Androctonus*, *Buthacus*, *Compsobuthus*, *Hottentotta*, *Leiurus*, *Orthochirus*, *Parabuthus*, *Trypanothacus* and *Vachoniolus*) and family Scorpionidae by three species belong two genera (*Nebo* and *scorpio*).

### Scorpion Faunal Composition:

#### Family: Buthidae

##### Genus: *Androctonus*

##### *Androctonus australis* (Linnaeus, 1758) ? (Figure 2a)

**Material: Mecca:** Al-Gunfuda xi.2018, 1♀, 2 juveniles; Ahad Bani Zayd, x.2018, 1 juvenile. Al Baydayn, xi.2018, 2♀♀, 1♂. Keyad, xi.2018, 1♀, 1♂ (Table 1, Figure 1).

**Remarks:** This species was recorded previously from Al-Gunfuda, Aseer, Al-Medina (Al-Asmari, et al., 2013). The taxonomic status of this species will be discussed with details in further studies.

##### *Androctonus crassicauda* (Olivier, 1807) (Figure 2b)

**Material: Mecca:** Al Birk, xi.2018, 3♀♀, 2♂♂, 7 juveniles. **Asir:** Bisha, ix.2017, 5♀♀, 3♂♂, 9 juveniles, iv.2018, 3 juveniles. Al Junainah, x.2018, 2♂♂, 3 juveniles. Al Ataf, iv.2018, 3 juveniles. Idhras, ix.2017, 8 juveniles. Alhafyrah, x.2018, 4♀♀, 2♂. Kuhlan, x.2017, 2♀♀, 1 juvenile. Habaya, x.2017, 4♀♀, 3♂♂. Al Farash, x.2017, 3♀♀, 6juveniles. Rabbah, iv.2018, 3♀♀, 4♂♂, 6 juveniles. Tathleth, v.2017, 1♀. Morighan, x.2017, 4♀♀, 3♂. Abraq Na'am, iv.2018, 1♂, 3 juveniles. Wadi Alrasain, xi.2018, 2 juveniles. Al Hafair, iv.2017, 1♀, 1♂. Aushayrah, 11/2016, 3♀♀, 4♂♂. Al Hamdhah, iv.2018, 3♀♀, 1♂, 7juveniles. Alyunod, x.2017, 6♀♀, 4 juveniles. Wadi Al Shaiq, x.2017, 5♀♀, 1♂. Al Hilaya, ix.2017, 10♀♀, 6♂♂, 15 juveniles. Tareeb, v.2018, 2♀♀,

2 juveniles. Al Amwah, ix.2017, 11 juveniles. Ain Qahtan, x.2018, 2♂, 7 juveniles (Table 1, Figure 1).

**Remarks:** One of the most medically important scorpion species of family Buthidae. It was recorded from all provinces of Saudi Arabia.

**Genus:** *Buthacus*

*Buthacus yotvatensis* Levy, Amitai & Shulov, 1973 ? (Figure 2c)

**Material:** **Asir:** Al Masamah, ix.2017, 1♀, 1♂. Tathleth, v.2018, 1♂. Al Hafair, vii.2018, 2 ♀♀. Alyunod, 10/2017, 1♀, 2 juveniles. Al Hilaya, iv.2018, 1♀ (Table 1, Figure 1).

**Remarks:** This species was collected and recorded for the first time from Saudi Arabia. It was previously reported from Palestine and Jordan (Levy & Amitai, 1980; Amr *et al.*, 2016). This species is recorded for the first time in Saudi Arabia and its taxonomic status of this species will be discussed with details in further studies.

**Genus:** *Compsobuthus*

*Compsobuthus arabicus* Levy, Amitai & Shulov, 1973 (Figure 2d)

**Material:** **Asir:** Kuhlan, iv.2018, 3 juveniles. Al Farash, iv.2018, 3♀♀. Morighan, x.2018, 3♀♀, 1 juvenile. Abra q Na'am, v.2018, 1♀. Alyunod, x.2018, 4♀♀, 1♂. Al Hilaya, x.2018, 2♀♀. Ain Qahtan, x.2018, 1♀, 2juveniles (Table 1, Figure 1).

**Remarks:** *Compsobuthus arabicus* was previously reported from Daugha; Ramlat Enfel; Khor Enfel; Wadi Mughohin; SW and NW Dhahran; Quwayiyah; El Khubra, Ath Thamamah, north of Riyadh (Levy, Amitai & Shulov, 1973; Vachon, 1979; Hendrixson, 2006; Al-Asmari, *et al.*, 2009b; El-Hennawy, 2009). Our materials extend its geographical distribution to the southwestern part of Saudi Arabia.

*Compsobuthus fuscatus* Hendrixson, 2006 (Figure 2e)

**Material:** **Mecca:** Al Birk, xi.2018, 1♀. **Asir:** Al Murabba, viii.2018, 3♀♀, 1♂. Al Fatiha, x.2017, 2♀♀, 4 juveniles. Al Reeth, x.2017, 3♀♀. **Jizan:** Wadi Amoud, x.2017, 2♀, 2♂. Khasher, i.2019, 2♀♀, 1 juvenile. Al Aridhah, x.2018, 3♀♀, 2♂♂, 3 juveniles (Table 1, Figure 1).

**Remarks:** *Compsobuthus fuscatus* is a relatively common, small buthid scorpion species. Occurs in a variety of arid and semi-arid desert wadis with variable amount of vegetation cover.

*Compsobuthus setosus* Hendrixson, 2006 (Figure 2f)

**Material:** **Asir:** Al Ataf, v.2018, 1♂. Kuhlan, v.2018, 1♂, 1 juvenile. Habaya, x.2017, 4♀♀, 2♂♂. Morighan, x.2017, 3 ♀♀, 2♂♂. Abra q Na'am, iv.2018, 2♀♀, 6 juveniles. Aushayrah, ix.2018, 2♀♀. Alyunod, x.2017, 1♀, 1♂. Al Hilaya, x.2018, 2♂♂. Al Amwah, v.2018, 3♀♀, 1♂. Ain Qahtan, x.2018, 2♀♀ (Table 1, Figure 1).

**Remark:** An endemic species for Saudi Arabia, its type locality is only in Khashm Khafs, Riyadh province. Our specimens extend its distribution range to include southwestern part of Saudi Arabia.

**Genus:** *Hottentotta*

*Hottentotta scaber* (Ehrenberg, 1828) (Figure 3g)

**Material:** **Jizan:** Khasher, i.2019, 2 ♀, 2♂, 3 juveniles. Al Aridhah, xi.2018, 1♀ (Table 1, Figure 1).

**Remarks:** *Hottentotta scaber* was known in Saudi Arabia previously from island Seir Farasān Kebir (Kovařík and Whitman, 2005; Kovařík, 2007). The general distribution of this species includes localities from Egypt, Eritrea, Ethiopia, Sudan, Iraq and Yemen (Kovařík, 2007; Kaltsas *et al.*, 2008). Our material provides the first definitive distribution in the southwestern parts of Saudi Arabia. Kovařík 2007, noted that the records from Egypt and Iraq should be considered dubious. However, Badry *et al.*

(2018), refer to such biogeographical pattern observed belong several elements of the fauna and flora makes its occurrence plausible.

**Genus: *Leiurus***

***Leiurus haenggii* Lowe, Yagmur & Kovařík, 2014 (Figure 3h)**

**Material: Mecca:** Keyad, xi.2018, 1♀, 6 juveniles. Al Birk, xi.2018, 1♂. **Al-Baha:** Baljurashi, x.2018, 1♀. Al-Baha, iv.2018, 5♀, 7 juveniles. **Asir:** Al Bashayer, vii.2017, 1♀. Al Namas, 3♀. iv.2018, 3 juveniles. Tanuma, iv.2018, 1♂, 2 juveniles. Turgesh, ix.2018, 6 juveniles. Ballasmar, iv.2018, 8♀♀, 4♂♂, 6 juveniles. Al Farash, vi.2017, 2♀♀. Ballahmar, iv.2018, 2♀♀, 2♂, 4 juveniles. Almaqadha, viii.2018, 2♀♀, 4 juveniles. Wadi Lajb, x.2017, 7♀♀, 6♂♂, 9 juveniles. Khamis Mushait, viii.2018, 1♂. Tendaha Dam, viii.2018, 3♀♀, 5 juveniles. Al Murabba, x.2018, 2♀♀. Sarat Abidah, v.2018, 1♀, 1♂. Sabt Bani Basher, i.2019, 1♀, 1♂, 3 juveniles. Al Fatiha, x.2017, 4♀♀, 3♂. Al Reeth, x.2017, 2♀♀, 2♂♂, 3 juveniles. **Jizan:** Wadi Amoud, i.2019, 1♂ (Table 1, Figure 1).

**Remarks:** Lowe et al. (2014) made a full revision of the genus *Leiurus*, mainly with the populations from the Arabian Peninsula. Three species were recorded from Saudi Arabia belong genus *Leiurus* includes: *Leiurus arabicus*, *Leiurus jordanensis* and *Leiurus haenggii*. The geographical distribution of this species extends along Red Sea coast of Saudi Arabia and Yemen. Our materials extend its distribution belong to Sarawat highland including the east hills and the open area in northeastern Asir.

**Genus: *Orthochirus***

***Orthochirus scrobiculosus* (Grube, 1873) (Figure 3i)**

**Material: Asir:** Tathleth, iv.2017, 3♀♀, 2♂♂, 2 juveniles, xi.2018, 4♀♀, 3♂♂ (Table 1, Figure 1).

**Remarks:** Hendrixson (2006) refer to all specimens record from Saudi Arabia, that belong to *O. innesi* and *O. scrobiculosus negebensis*. However, Lourenco and Leguin, (2011) refer to the distribution of *O. innesi* has been limited to north of Egypt, Libya and Algeria, and its occurrence in the Middle East most certainly can be rejected.

**Genus: *Parabuthus***

***Parabuthus liosoma* (Ehrenberg, 1828) (Figure 3j)**

**Material: Mecca:** Almuzaylif, iv.2018, 1♀, 1 juvenile. Biny Suhaim, i.2019, 1♂. **Al-Baha:** Al Makhwah, vii.2018, 1♂. **Jizan:** Al Fatiha, x.2018, 1♀. Khasher, i.2019, 2♀♀. Bahrah Abu Arish, x.2018, 1♀, 1♂. Abu Arish, x.2018, 2 juveniles. Al Aridhah, xi.2018, i.2019, 1♂, 5 juveniles. Alhasma, i.2019, 3 juveniles. Al-Harth, i.2019, 1 juvenile (Table 1, Figure 1).

**Remarks:** Kovařík et al., (2016) have published a major review of several species of the genus *Parabuthus* Pocock, 1890, distributed belong the Horn of Africa and Arabia. The above authors refer to the present geographical distribution of *Parabuthus liosoma* is restricted to Saudi Arabia and Yemen.

**Genus: *Trypanothacus***

***Trypanothacus buettikeri* (Hendrixson, 2006) (Figure 3k)**

**Material: Asir:** Wadi Al Shaiq, x.2017, 1♂. Tendaha Dam, viii.2018, 1♂ (Table 1, Figure 1).

**Remarks:** *Trypanothacus buettikeri* was reported previously as *Buthacus buettikeri* from Saudi Arabia by Hendrixson (2006). Recently, Lowe et al., (2019) *Buthacus buettikeri* was transferred to the new genus *Trypanothacus*, based on ecological and morphological studies.

**Genus: *Vachoniolus***

***Vachoniolus globimanus* Levy, Amitai & Shulov, 1973 (Figure 3l)**

**Material: Asir:** Al Junainah, ix.2018, 1♂ (Table 1, Figure 1).

**Remarks:** *Vachoniolus globimanus* was previously reported from Riyadh and El-Baha (Hendrixson, 2006; Al-Asmari, et al. 2009a). Our specimens from Asir, Al Junainah extend its distribution range to the south.

**Family:** Scorpionidae

**Genus:** *Nebo*

*Nebo hierichonticus* (Simon, 1872) (Figure 4m)

**Material:** **Asir:** Sawda, viii.2018, 1♀, 1♂. Almaqadha, viii.2018, 2 juveniles. Wadi Tendaha, vii.2018, 1♀, 1 juvenile. **Jizan:** Khasher, i.2019, 1♀ (Table 1, Figure 1).

**Remarks:** The localities of this species indicated represent a wide range of biotopes (Hendrixson, 2006; Al-Asmari, et al. 2007; Al-Asmari, et al. 2009a). It occurs under rocks and between crevices and constructs its own burrows.

**Genus:** *Scorpio*

**Remarks:** Historically, *Scorpio maurus* has long been known as a widespread, polymorphic species (Fet & Lowe, 2000). In 1910, Birula made the first revision for all *S. maurus* populations in North Africa and the Middle East. He divided all of *S. maurus* subspecies forms into two main groups as “*maurus*” and “*propinquus*”. That author (Birula, 1910) refers to the geographical distribution of “*S. maurus* members” are in Africa and the members of “*S. m. propinquus*” in Asia, with the exception of *S. m. palmatus* is belong to the Middle east. Recently, Talal et al., (2015) elevated the two subspecies *S. maurus palmatus* and *S. m. kruglovi* to species level, based on genetic, morphological and behavioral evidence support.

*Scorpio kruglovi* Birula, 1910 (Figure 4n)

**Material:** **Asir:** Dalagan, vii.2018, 1♀, 2 juveniles. Almaqadha, viii.2018, 1♂. Sawda, viii.2018, 2 juveniles (Table 1, Figure 1).

*Scorpio palmatus* (Ehrenberg, 1829) (Figure 4o)

**Material:** **Asir:** Tareeb, 5/2018, 1♂ (Table 1, Figure 1).

## Conclusion

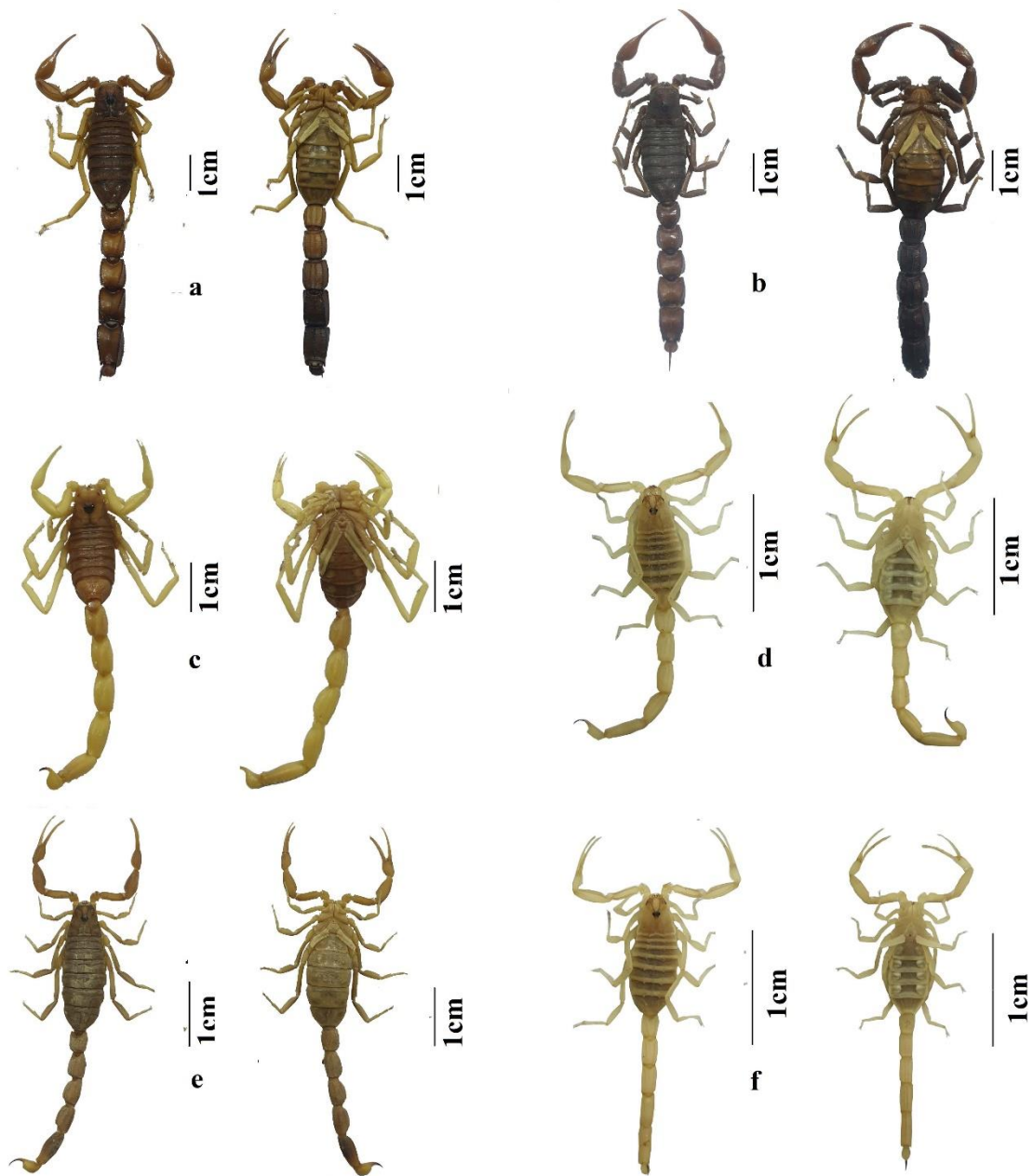
Fifteen species were collected and recorded during the course of this study from 58 collection localities, of which representing four major regions. The recorded species are currently recognized species, with well documented material within the boundaries of Saudi Arabia, with the exception of *Buthacus yotvatensis*, is recorded for the first time. Further investigations are required to clarify the taxonomic status of species of *Androctonus*, *Buthacus*, *Compsobuthus*, *Leiurus*, *Orthochirus*, *Trypanothacus*, *Vachoniolus*, *Nebo* and *Scorpio* and to provide more data on their distribution, ecology and behavior. The study demonstrated that the highest species diversity was in four regions. More sampling using ultraviolet-light detection and conventional methods should be employed in this area.

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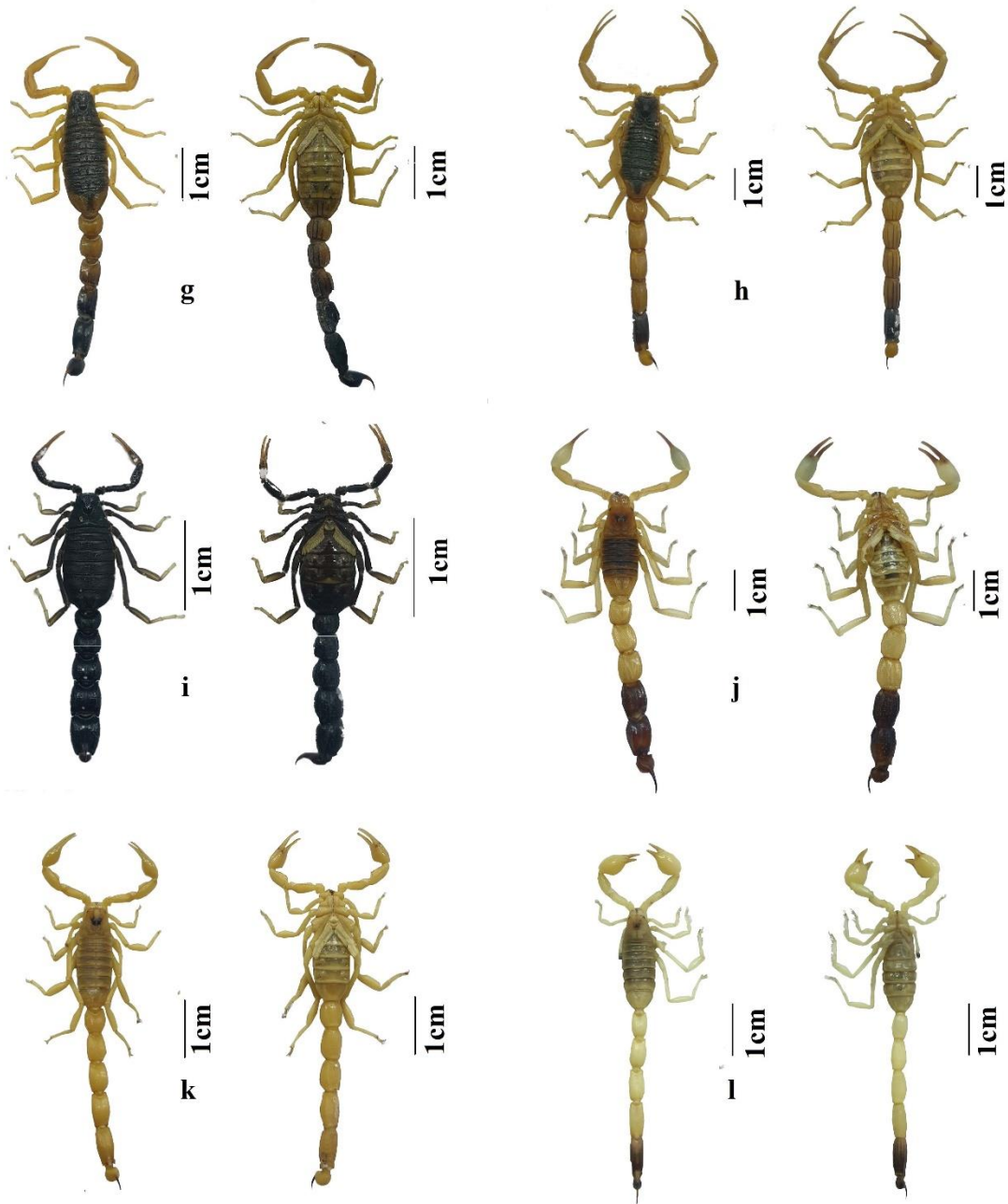
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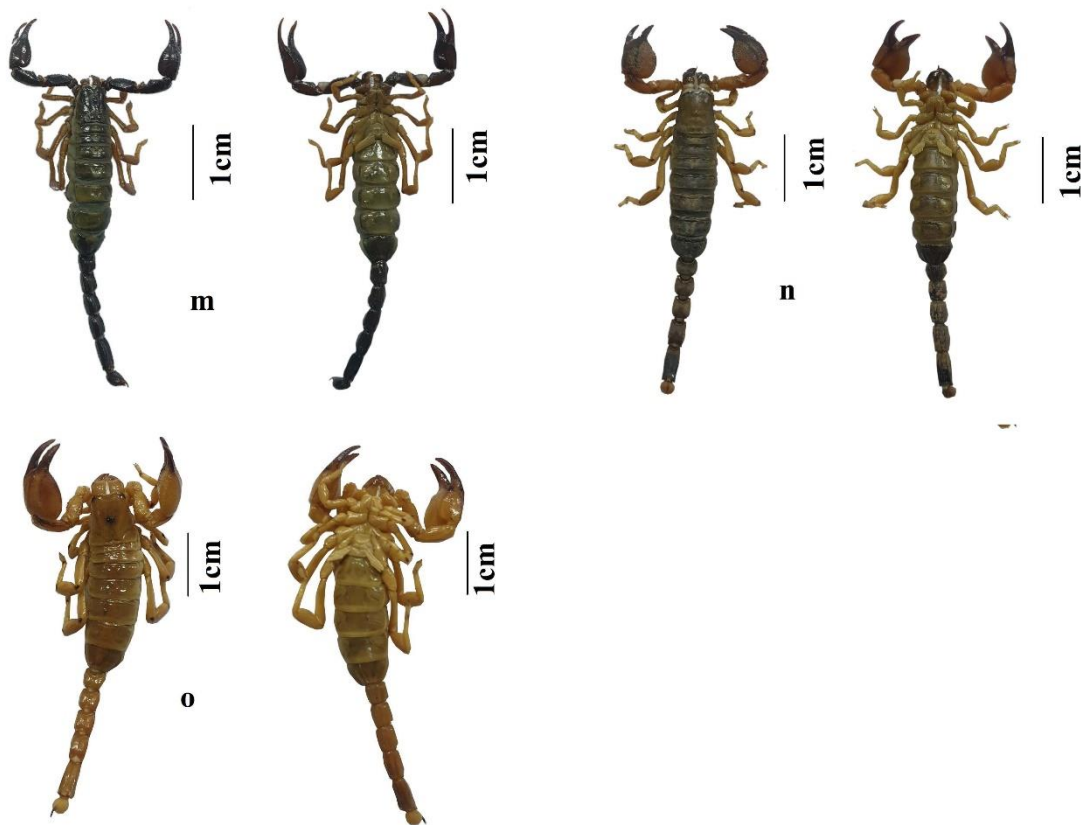


**Figure 2:** a- *Androctonus australis* ? (Al-Gunfuda); b- *Androctonus crassicauda* (Bisha); c- *Buthacus yotvatensis* (Al Hafair); d- *Compsobuthus arabicus* (Al Farash); e- *Compsobuthus fuscatus* (Al Birk); f- *Compsobuthus setosus* (Abraq Na'am).





**Figure 3:** **g-** *Hottentotta scaber* (Al Aridhah); **h-** *Leiurus haenggii* (Tanuma); **i-** *Orthochirus scrobiculosus* (Tathleth); **j-** *Parabuthus liosoma* (Al Fatiha); **k-** *Trypanothacus buettikeri* (Tendaha Dam); **l-** *Vachoniolus globimanus* (Al Junainah).



**Figure 4:** m- *Nebo hierichonticus* (Sawda); n- *Scorpio kruglovi* (Dalagan); o- *Scorpio palmatus* (Tareeb).

#### REFERENCES

- Al-Asmari, A. K., Al-Saif, A. A., & Abdo, N. M. (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(4): 821-843.
- Al-Asmari, A.K., Al-Saif, A.A., Abdo, N.M. & Al-Moutaery, K.R. 2009a. The scorpion fauna of Al-Baha and Hail Regions, Saudi Arabia. *Journal of Biological Sciences*, 9(2): 96-108.
- Al-Asmari, A.K., Al-Saief, A.A., Abdo, N.M. & Al-Moutaery, K.R. 2009b. New additions to the scorpion fauna of Riyadh region, Saudi Arabia. *J. Venom. Anim. Toxins incl. Trop. Dis.*, 15(4): 612-632.
- Al-Asmari, A. K., Al-Saif, A. A., Abdo, N. M., Al-Moutaery, K. R., & Al-Harbi, N. O. (2013). A review of the scorpion fauna of Saudi Arabia. *Egyptian Journal of Natural History*, 6(1): 1-21.
- Al-Sadoon, M., & Al-Farraj, S. (2008). Scorpions, in the Kingdom of Saudi Arabia. 2<sup>nd</sup> ed. Riyadh. 96pp. (in Arabic).
- Amr, Z., Abed, O. A., Al Share, T., Hamidan, N., & Prendini, L. (2016). New records of Jordanian scorpions. *Jordan J Nat Hist.*, 2: 30-38.
- Anderson, R. C. 1983. "Scorpions: The Ancient Arachnids. Idaho Museum of Natural History." *Special Publ.* 8: 1-21.

- Badry, A., Younes, M., Sarhan, M. M., & Saleh, M. (2018). On the scorpion fauna of Egypt, with an identification key (Arachnida: Scorpiones). *Zoology in the Middle East*, 64(1): 75-87.
- Birula, A. A. (1910). Ueber *Scorpio maurus* Linné und seine Unterarten. *Horae Societatis Entomologicae Rossicae*, 35: 115-192.
- El-Hennawy, H. K. (1987): A simplified key to Egyptian scorpion species (Arachnida: Scorpionida). *Serket*, 1(1): 15–17.
- El-Hennawy, H. K. (1992). A catalogue of the scorpions described from the Arab countries (1758-1990) (Arachnida: Scorpionida). *Serket*, 2(4): 95-153.
- El-Hennawy, H. K. (2009). Scorpions of Saudi Arabia (List of species, their distribution, and identification key). *Serket*, 11(3/4): 119-128.
- El-Hennawy, H. K. (2014). Preliminary list of spiders and other arachnids of Saudi Arabia (except ticks and mites). *Serket*, 14: 22-58.
- Fet, V. and Lowe, G. (2000): Family Buthidae C. L. Koch, 1837. Pp. 54–286 in: Fet, V.; Sissom, W. D.; Lowe, G. and Braunwalder, M.E.: *Catalog of the Scorpions of the World (1758–1998)*. The New York Entomological Society, New York.
- Francke, O. F. (1982). Parturition in scorpions (Arachnida, Scorpiones). *Revue Arachnologique*, 4: 27-37
- Hendrixson, B.E. (2006). Buthid scorpions of Saudi Arabia, with notes on other families (Scorpiones: Buthidae, Liochelidae, Scorpionidae). *Fauna of Arabia*, 21: 33-120.
- Jarrar, B., & Al-Rowaily, M. (2008). Epidemiological aspects of scorpion stings in Al-Jouf province, Saudi Arabia. *Annals of Saudi medicine*, 28(3): 183.
- Kaltsas, D., Stathi, I., & Fet, V. (2008): Scorpion of the Eastern Mediterranean. *Advances in Arachnology and Developmental Biology*, 12: 209–246.
- Kinzelbach, R. (1985). *Vorderer Orient. Skorpione (Arachnida: Scorpiones)*. Tübinger Atlas der Vorderer Orients (TAVO), Karte Nr. A VI 14.2.
- 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., & 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., Lowe, G., Plíšková, J., & 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.
- Lamoral, B. H. (1980). A reappraisal of suprageneric classification of Recent scorpions and their zoogeography. In *Verhandlungen. 8th Internationaler Arachnologen-Kongress abgehalten an der Universität für Bodenkultur Wien* (pp. 439–444). Egermann, Vienna.
- Levy, G., and Amitai, P. (1980): Fauna Palaestina. Arachnida I: Scorpiones. Israel Academy of Sciences and Humanities, Jerusalem.
- Levy, G., Amitai, P., and Shulov, A. (1973): New scorpions from Israel, Jordan and Arabia. *Zoological Journal of the Linnean Society*, 52(2): 113–140.
- Lourenço, W. R. (2018). The evolution and distribution of noxious species of scorpions (Arachnida: Scorpiones). *Journal of venomous animals and toxins including tropical diseases*, 24(1): 1.
- Lourenço, W. R., & Leguin, E. A. (2011). Further considerations on the species of the genus *Orthochirus* Karsch, 1891 from Africa, with description of three new species (Scorpiones: Buthidae). *Euscorpius*, 123: 1-19.

- Lowe, G. (2010). The genus *Vachoniolus* (Scorpiones: Buthidae) in Oman. *Euscorpius*, 100: 1-37.
- Lowe G., Kovařík F., Stockmann M. & Šťáhlavský F. (2019). *Trypanothacus* gen. n., a new genus of burrowing scorpion from the Arabian Peninsula (Scorpiones: Buthidae). *Euscorpius*, 277: 1-30.
- Lowe, G., Yağmur, E. A., & 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.
- Sissom, W. D. (1990). Systematics, biogeography and paleontology. *The biology of scorpions*, 65: 64-160.
- Stahnke, H. L. (1972). UV light, a useful field tool. *BioScience*, 22(10): 604–607.
- Talal, S., Tesler, I., Sivan, J., Ben-Shlomo, R., Tahir, H. M., Prendini, L., Snir S. & 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 and evolution*, 91: 226-237.
- Vachon, M. (1979). Arachnids of Saudi Arabia. Scorpiones. *Fauna of Saudi Arabia*, 1: 30-66.
- Vachon, M., & Kinzelbach, R. (1987). On the taxonomy and distribution of the scorpions of the Middle East. *In Proceedings of the Symposium on the Fauna and Zoogeography of the Middle East, Mainz (TAVO)* (Vol. 28, No. 1985, pp. 91-103).
- Williams, S. C. (1968): Scorpion preservation for taxonomic and morphological studies. *The Wasmann Journal of Biology*, 26(1): 133–136.