Plant Archives Volume 20 No. 2, 2020 pp. 6711-6725 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

NEW DATA OF SCORPION FAUNA, INCLUDE TWO NEW RECORDS WITH IDENTIFICATION KEY OF SCORPION SPECIES (ARACHNIDA: SCORPIONES) IN IRAQ

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Abstract

Scorpion is a vital member of our ecosystem, but the patterns of its composition and distribution are still unmapped. This study has been conducted to find species composition and biodiversity of health-threatening scorpion species in Kurdistan Region-Iraq. Samples were collected randomly during the daytime and by the use of UV light at night. During this study a total number of 676 scorpion specimens were collected in the investigated area including three provinces (Erbil, Duhok and Sulaymaniyah) and they were identified as following: *Hottentotta saulcyi* (35.5%), *Androctonus crassicauda* (26.6%), *Scorpio maurus* (13.2%), *Orthochirus fomichevi* (8.4%), *Compsobuthus matthiesseni* (6.4%), *Hemiscorpius lepturus* (3.8%), *Mesobuthus phillipsii* (3.1%), *Buthacus macrocentrus* (2.9%). *Orthochirus fomichevi* was identified as new species in the world and *Buthacus macrocentrus* with *Hemiscorpius lepturus* as a new recorded in Kurdistan Region-Iraq. This present study demonstrated a wide diversity of scorpion species in the Kurdistan region- Iraq consisting of three scorpion families, with the current information on fauna diversity indicate that there is great potential for new scorpion species to be discovered even at some of the most extensively studied locations.

Key words: Scorpion, fauna, biodiversity, arachnids, identification keys.

Introduction

Scorpions are usually defined as predatory arachnids of phylum Arthropoda. Their body very tough and ranged between 3 to 18 cm in length. Morphologically the scorpion body is divided into two portions, cephalothorax and opisthosoma with toxic device that set on the end of its metasoma part that contains two toxic glands, which are located inside a thick chitinous vesicle (Nejati *et al.*, 2018). Scorpions are found as nocturnal creatures in deserts, mountains, caves and even under rocks; when disturbed, they are known to unintentionally sting and endanger human life (Sari and Hosseinie 2011). Given the progress made in awareness of various scorpion fauna, such as tropical America, tropical Asia, Africa, Madagascar and the Nearctic and Palearctic regions, it can be predicted that the total number of species will reach 5000 or even more in the coming decades. Scorpions can be found almost everywhere in the world. They are classified in 18-20 different families and more than 2000 species described (Lourenço 2018). There are near to 50 scorpion species worldwide that are dangerous to humans (Allen 1992; Cala-Riquelme and Colombo 2011; Schwerdt *et al.*, 2016). Scorpions are important venomous arthropods which kill many people annually across the world, their sting is an important health problem in Iraq (Morad 2016). Although numbers of researches on Scorpio fauna have been carried out in some provinces, yet the complete information on these arachnids are incomplete. The scorpions of Iraq consist of four families: Buthidae, Scorpionidae, Bothriuridae and Hemiscorpiidae (Al-Azawi 2017; Khalaf 1963; Khalaf 1962). Among these, some genera, such as *Androctonus* and *Hemiscorpius* are known as medically important species in the world and also in Iraq (Bavani *et al.*, 2017; Kassiri *et al.*, 2015). Therefore, information about scorpions' fauna can be very useful in running control programs of scorpions and scorpionism. The fundamental relationship between biodiversity and human health is generally unappreciated by policymakers and the public, and as a result, the preservation of habitats and species is given a low priority (Bell *et al.*, 1997). The biodiversity, which is a manner of distribution and individual number of some dangerous species can threaten the human health. The

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present study designed to determine the biodiversity and species composition of scorpions in Kurdistan-Iraq. This kind of studies will provide a clue for preventing and control of fatal scorpions and can reduce their stings.

Materials and Methods

The Provinces Erbil, Duhok and Sulaymaniyah sit in the northern Kurdistan - region of the Iraq. The area lies between 34°42 'N and 37°22' N latitudes, and 42°25 'and 46°15' East longitudes. The lowest point in the area is Kifri, which is 140 meters above sea level (amsl), and the highest point is the Erbil Governorate's Hasarost peak., measuring 3607 meters amsl. Kurdistan region mainly extends across the Zagross mountain up to the Taurus mountains in Turkey. The region shares its borders with Syria in the west, Turkey in the north and Iran in the east (Saeed 2015), Fig. 1. The field studies were carried out between May 2018 and December 2019. A total of 676 specimens have been collected from 40 different localities in this three Provinces Fig. 1. The specimens were mostly collected by ultraviolet light detection at night, al-though some were collected by hand under stones or excavating burrows during daytime. The mature adult specimens were subjected for morphological study and they preserved in 80% ethanol alcohol. Many sample were send to each of NMPC (National Museum of Natural History, Prague, Czech Republic) and AMNH (American Museum of Natural History, New York, USA) for confirming their identification and the voucher collection deposited KMNH (Kurdistan Museum of Natural History- Erbil/ Iraq). The measurements follow (Stahnke 1970) and are given in mm. Trichobothrial notations are those developed by (Vachon 1974) and the morphological terminology mostly follows (Vachon 1952) and (Hjelle 1990). The specimens were photographed with Nikon camera D810 105 mm macro lens and the identifications were made by using a dissecting Microscope (OPTIKA SN260723).

Results

List of scorpion species from Kurdistan -Iraq

A total of 676 scorpions representing 8 species belonging to 3 families (Buthidae, Scorpionidae and Hemiscorpiidae) were collected from the study area table 1.

Family: Buthidae C.L. Koch 1837

Hottentotta saulcyi (Simon 1880)

Androctonus crassicauda (Olivier 1807)

Orthochirus fomichevi (Kovarik 2018)

Compsobuthus matthiesseni (Thorell 1876)

Mesobuthus phillipsii (Pocock 1889)

Buthacus macrocentrus (Birula 1905)

Family: Scorpionidae (latreille 1802)

Scorpio maurus (Linnaeus 1758)

Family: Hemiscorpiidae (Pocock 1893)

Hemiscorpius lepturus (Peters 1861)

Family Buthidae Koch 1837

Hottentotta saulcyi (Simon 1880)

Type material: Korre (36.404238N, 44.237007E), 2 males, 6 females. Bardbr (36.0474381N, 44.322364E), 6 males, 9 females. Malaomer (36.298264N, 44.134432E), 4 males, 12 females. Shexan (36.268190N, 44.369644E), 6 males, 11 females. Kosenjaq (36.086053N, 44.661593E), 5 males, 9 females. Alkan (36.4840N, 44.754E), 6 males, 10 females. Korak (36.262737N, 44.145452E), 2 males, 2 females. Qatawi (36.127501N, 43.959315E), 9 malse, 10 females. Chneran (36.368986N, 44.387404E), 5 males, 8 females. Baherka (36.334368N, 44.019195E), 8 males, 10 females. Makhmor (35.776911N, 43.599369E), 3 males, 5 females. Kasnazan (36.255408N, 44.099772E), 7 males, 10 females. Smaquly (36.200228N, 44.490951E), 5 males, 8 females. Kanigani (36.166913N, 44.165507E), 2 males, 4 females, Erbil province. Morelan (36.2521N, 43.4544E), 3 males, 5 females. Akre (36.739460N, 43.898330E), 3 males, 5 females. Banenan (36.2159N, 43.4557E), 2 males, 3 females. Chamaka (36.3514N, 44.1059E), 9 males, 10 females. Mahad (36.643554N, 43.419319E), 2 males, 2 females. Bahadra (36.711236N, 36.711236N), 3 males, 5 females, Duhok province. Zarayan (35.311486N, 45.668440E). 2 females. Chaqzhi chwaroo (35.626307N, 45.199277E), 2 males, 5 females. Halabja (35.197105 N, 46.005934E), 1 female, Sulaymaniyah province table 2.

Diagnosis: The most common scorpion from all collection sites, collected from under stones, in cranny. This species belongs to Buthidae family and considers as the most common scorpion in the country about (35.5%). A total two hundred forty specimens were collected in our study area including ninety-two males and one-hundred forty-eight females table 1. Total length 80-110 mm, Generally male smaller than female. Trichobothrium db on the fixed finger of pedipalp situated between trichobothria et and est. Male with slightly longer metasomal segments and slenderer, pedipalp chela width equal for both sexes. Pectinal teeth total 28-36 in male and 24-29 in female. Nearly whole body hirsute, pedipalps, mesosoma dorsal surface, legs, metasomal segment lateral and ventral surfaces and strongly hirsute vesicle. Pedipalps patella hair are long. Black chelicerae, only reticulate. A

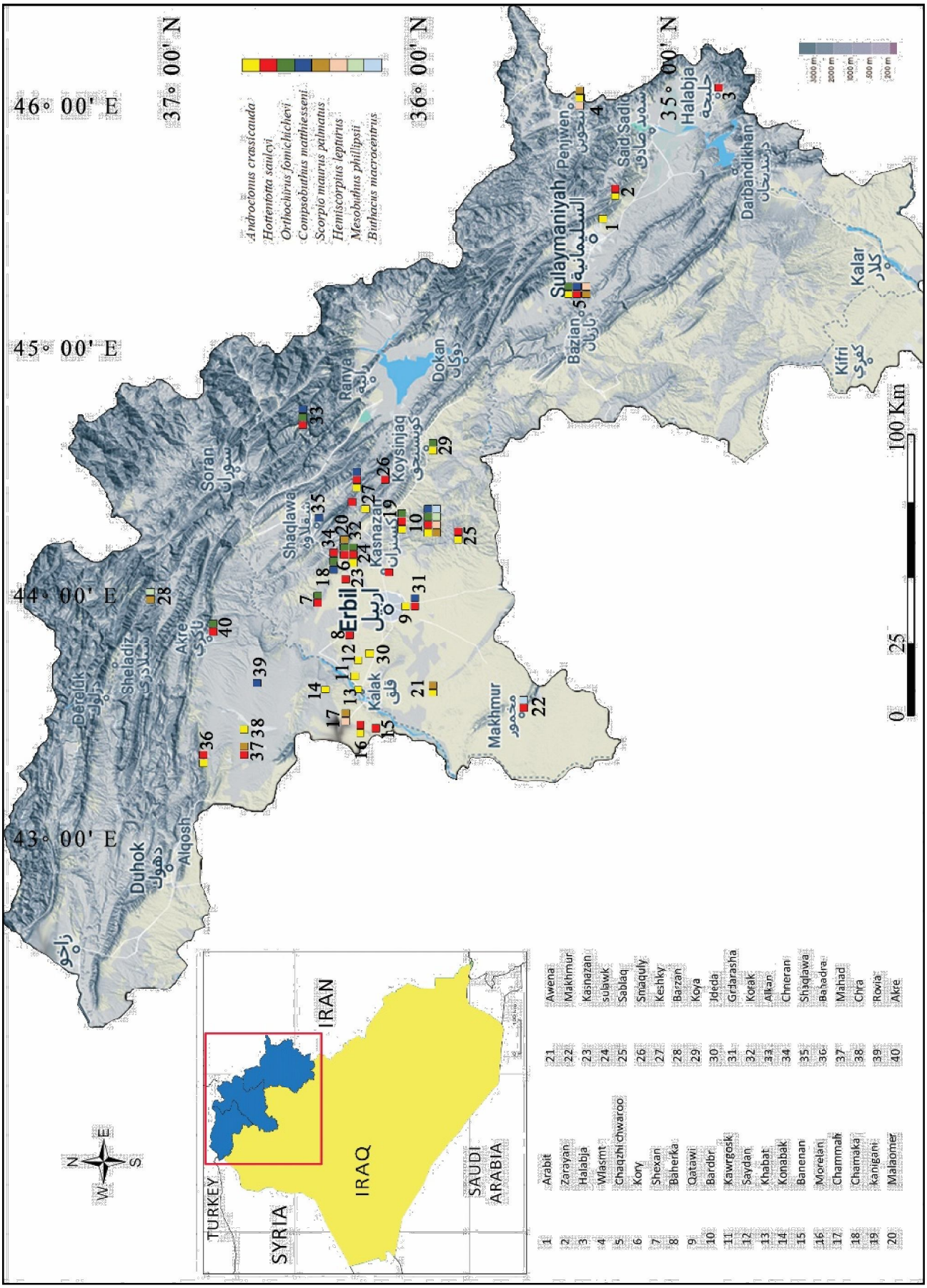

Fig. 1: Iraq map of collected eight scorpion species samples within forty different sites.

yellow to yellowish green or brown color, except for the anterior part of the carapacae, telson and the fifth metasomal segment are black. third and fourth metasomal segments also have black ventral carinae. Femur of pedipalp with fife carinae. While Patella with 4-8 carinae. Chela does not have carinae. pedipalps Movable fingers with 14-16 rows of granules and 5 or 6 terminal granules. Seventh metasomal segment with four well -marked carinae at the ventral side. First segment of metasomal with 10 carinae; while 8 or 10 carinae found on the second and third segments; fourth segment with 6-10 carinae; fifth segment with 5 carinae, 3 ventrals (1 median, 2 lateral) and 2 dorsal. Metasomal segments carinae always smooth. All metasomal segments are smooth, in between carinae without granules. In both sexes the metasomal segments First and Second are longer than the wide. Second to fourth ratio of metasomal segment widths inferior to 1.2 Fig. 2.

Distribution: Afghanistan, Iran, West Azerbaijan, Iraq and Turkey.

Reference: (Akbari 2007; Gharakhloo *et al.*, 2018; Kovarik, 1997b; Kovaøík 2007; Moradi *et al.*, 2015; Pirali-Kheirabadi *et al.*, 2009).

Androctonus crassicauda (Olivier 1807).

Type material: Shexan (36.436003N, 44.123317E), 1 male, 1 female. Bardbr (36.0474381N, 44.322364E), 1 male, 4 females. Kawrgosk (36.351382N, 43.806316E), 1 male, 3 females. Khabat (36.271734N, 46.669400E), 1 female. Malaomer (36.298264N, 44.134432E), 3 males, 3 females. Awena (36.072610N, 43.756160E), 1 female. Sulawk (36.299016N, 44.423349E), 1 male. 2 females. Sablaq (35.980206N, 44.263094E), 1 male, 1 female. Keshky (36.268190N, 44.369644E), 1 male, 2 females. Koysenjaq (36.086053N, 44.661593E), 1 male. Jdeda (36.285696N, 43.792273E), 1 male, 3 females. Grdarasha (36.114992N, 44.023626E), 3 males, 5 females. Kanigani (36.166913N, 44.165507E), 4 males, 6 females. Saydan (36.335479N, 43.868381E), 1 male, 2 females, Erbil province. Konabak (36.486106N, 43.671596E), 21 males, 42 females. Morelan (36.2521N, 43.4544E), 2 males, 5 females. Bahadra (36.711236N, 36.711236N), 1 male, 4 females. Chra (36.640083N, 43.526201E), 1 male, 3 females, Duhok province. Arbat (35.423853 N, 45.58391E), 1 male, 3 females. Zarayan (35.311486N, 45.668440E), 3 males, 4 females. Wlasmt (35.526558N, 45.972226E), 3 males, 7 females. Chaqzhi chwaroo (35.626307N, 45.199277E), 9 males, 18 females, Sulaymaniyah province table 2.

Diagnosis: This species was the second most common scorpions in the study area (26.6%). This taxon is not a digger species, we found it in and around rural area. Mostly collected at night, inside buildings and houses in the villages table 1. Also the specimens were collected from under stones and piece of cork bark at daytime. A total one-hundred eighty specimens were collected in our study area including sixty males and one-hundred twenty females.

It is overall body color black with length ranging between 65 and 90 mm. The color in the dorsal area is usually black, and the opithosomal ventral surface is yellowish brown, the legs end with yellow ochre lines, yellowish-brown sternites and metasoma and terminal vesicle evenly reddish brown with black carinae. The pedipalp is slender with bulbous chela. Metasomal segments are slightly extended backwards, metasomal

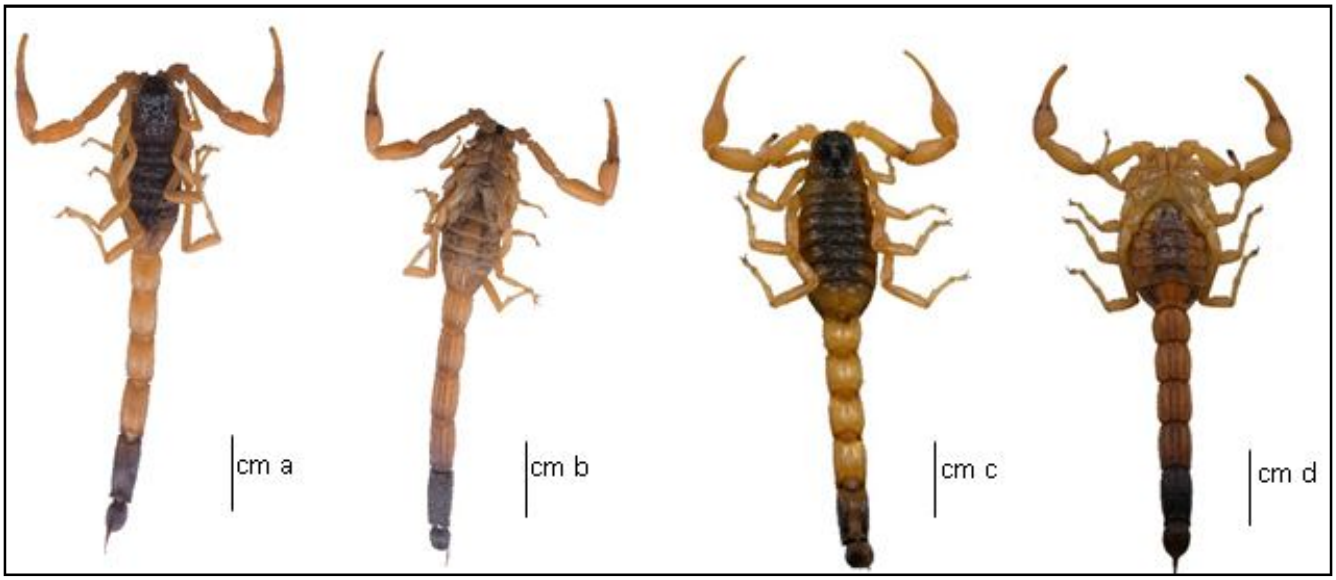

Fig. 2: *Hottentotta saulcyi* a, b male dorsal and ventral view. c, d female dorsal and ventral view.

segments I-IV with carinae are formed strongly. Vesicles have 3 sets of granules, medium curved aculeus as long as the vesicle. Typically, females are more heavy-bodied. A distinct carapace carination of Androctonus: the posteriomedic and centrolateral carinae are fused to form a continuous lyri-form keel Fig. 3.

Distribution: Armenia, Azerbaijan, Bahrain, Egypt (Sinai), Iran, Iraq, Israel, Jordan, Kuwait, Oman, Saudi Arabia, Syria, Turkey, United Arab Emirates and Yemen.

References: (Al-Azawi 2017; Fet *et al.*, 2000; Hendrixson 2006; Khalaf 1963; Lourenco 2005; Ozkan *et al.*, 2006).

Orthochirus fomichevi (Kovarik 2018)

Type material: Koree (36.404238N, 44.237007E), 3 females. Bardbr (36.0474381N, 44.322364E), 5 males, 8

Table 1: Coordinates of collecting sites with presenting of scorpion genera in the study area.

Location	Attitude	Attitude	*Hotte-ntotta*	*Ortho-chirus*	*Sco-rpio*	*Andro-ctonus*	*Comps-obuthus*	*Hemis-corpius*	*Meso-buthus*	*But-hacus*
Arabit	35.423853 N	45.583391E				*				
Zarayan	35.311486N	45.668440E	*			*				
Halabja	35.197105 N	46.005934E	*							
Wlasmt	35.526558N	45.972226E	*		*			*		
chaqzhi chwaroo	35.626307N	45.199277E	*	*	*	*	*	*		
Kory	36.404238N	44.237007E	*	*			*			
Shexan	36.436003N	44.123317E	*			*				
Baherka	36.334368N	44.019195E	*							
Qatawi	36.127501N	43.959315E	*				*			
Bardbr	36.0474381N	44.322364E	*	*	*	*	*	*	*	*
Kawrgosk	36.351382N	43.806316E				*				
Saydan	36.335479N	43.868381E				*				
Khabat	36.271734N	46.669400E				*				
Konabak	36.486106N	43.671596E				*				
Banenan	36.2159N	43.4557E	*							
Morelan	36.2521N	43.4544E	*			*				
chammah	36.3051N	43.5001E			*		*			
Chamaka	36.3514N	44.1059E	*							
kanigani	36.166913N	44.165507E	*	*		*				
Malaomer	36.298264N	44.134432E	*	*		*				
Awena	36.072610N	43.756160E			*	*				
Makhmur	35.776911N	43.599369E	*							*
Kasnazan	36.255408N	44.099772E	*							
sulawk	36.299016N	44.423349E	*			*	*			
Sablaq	35.980206N	44.263094E	*			*				
Smaquly	36.200228N	44.490951E	*							
Keshky	36.268190N	44.369644E				*				
Barzan	36.921839N	44.030585E			*				*	
Koya	36.086053N	44.661593E		*		*				
Jdeda	36.285696N	43.792273E				*				
Grdarasha	36.114992N	44.023626E				*	*			
Korak	36.262737N	44.145452E	*	*	*					
Alkan	36.4840N	44.754E	*	*			*			
Chneran	36.368986N	44.387404E	*						*	
Shaqlawa	36.335439N	44.451854E					*			
Bahadra	36.711236N	43.256787E	*			*				
Mahad	36.643554N	43.419319E	*		*					
Chra	36.640083N	43.526201E				*				
Rovia	36.628152N	43.698215E					*			
Akre	36.739460N	43.898330E	*	*						

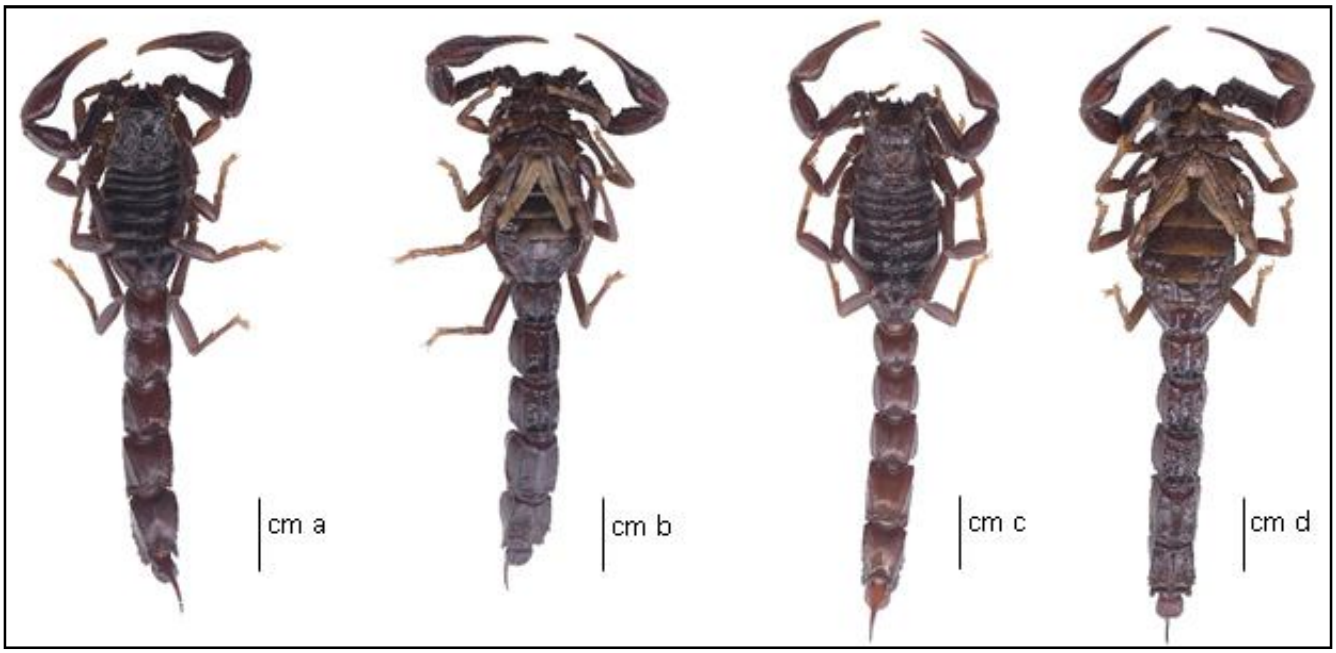

Fig. 3: *Androctonus crassicauda* a, b male dorsal and ventral view. c, d female dorsal and ventral view.

females. Malaomer (36.298264N, 44.134432E), 2 males, 3 females. Kanigani (36.268190N, 44.369644E), 1 female. Koya (36.086053N, 44.661593E), 2 females. Alkan (36.4840N, 44.754E), 4 males, 4 females. Korak (36.262737N, 44.145452E), 1 male, 1 female, Erbil province. Akre (36.739460N, 43.898330E), 1 male, 1 female, Duhok province. Chaqzhi xwaroo (35.626307N, 45.199277E), 7 males, 14 females, Sulaymaniyah province Table 2.

Diagnosis: It was the fourth most communal scorpion from all collection sites (8.4%), collected from under stones and under weeds. This species belongs to Buthidae family a total of fifty-seven specimens were collected in our study area including twenty males and thirty-seven females table 1. The whole body color was black, carapace, tergites, and metasoma are black; pedipalps femur, patella and legs are brown to black, while legs tibia, tarsomeres and pedipalp chela are yellowish brown. The sternites are black with yellow to brown glabrows

Table 2: Scorpion species identified in this study with their occurring and percentages.

Scorpion species	Occu-rring	Perce-ntage
Hottentotta saulcyi (Simon, 1880)	240	35.5
Androctonus crassicauda (Olivier, 1807)	180	26.6
Orthochirus fomichichevi sp. n.	57	8.4
Compsobuthus matthiesseni (Birula, 1905)	43	6.4
Mesobuthus phillipsii (Pocock, 1889)	21	3.1
Buthacus macrocentrus (Ehrenberg, 1828)	20	2.9
Scorpio maurus (Ehrenberg, 1828)	89	13.2
Hemiscorpius lepturus (Peters, 1862)	26	3.8

present at the posterior sternite margin III-VI. Telson is reddish brown. Total length of adults 27–40 mm. Trichobothrium *d*2 of dorsal surface pedipalp femur is absent or reduced. Average tibial spurs found on legs III and IV. Pectinal teeth number 21–23 in males and 17–20 in females. Pedipalp mobile and fixed fingers with 8–9 rows of denticles, with internal and external denticles and 5 subterminals. Dorsal carinae patella smooth on a pedipalp. Metasoma I with 10 carinae, metasoma II with 8 carinae. Ventrally punctuate Metasoma IV–V with the ventrolateral carinae present; smooth spaces between puncttae, without granules. Ventral and laterally smooth metasoma II–III without granules, punctatous and humpy. Dorsal surface of metasoma I with numerous granules, smooth metasoma II–IV, and finely granulated metasoma V. Granulate of sternite VII, with current granulate carinae rather sparsely hirsute, somewhat glabrous pedipalp, metasoma and telon. Tarsomere I of legs composed of 4–8 bristles with bristlecombs. Ratio of metasome V length / width in males 1.14–1.16 Fig. 4.

Distribution: Kurdistan region- Iraq.

Reference: (Kovaøík *et al.*, 2019).

Compsobuthus matthiesseni (Thorell 1876)

Type material: Bardbr (36.0474381N, 44.322364E), 3 males, 5 females. Sulawk (36.299016N, 44.423349E), 2 males, 4 females. Grdarasha (36.114992N, 44.023626E), 4 males, 4 females. Korre (36.404238N, 44.237007E), 2 males, 2 females. Qatawi (36.127501N, 43.959315E), 4 males, 5 females. Alkan (36.4840N, 44.754E), 1 female. Shaqlqwa (36.335439N, 44.451854E), 1 male, 2 females, Erbil province. Chammah (36.3051N, 43.5001E), 1 male.

Fig. 4: *Orthochirus fomichichevi* sp. n. a, b male dorsal and ventral view. c, d female dorsal and ventral view.

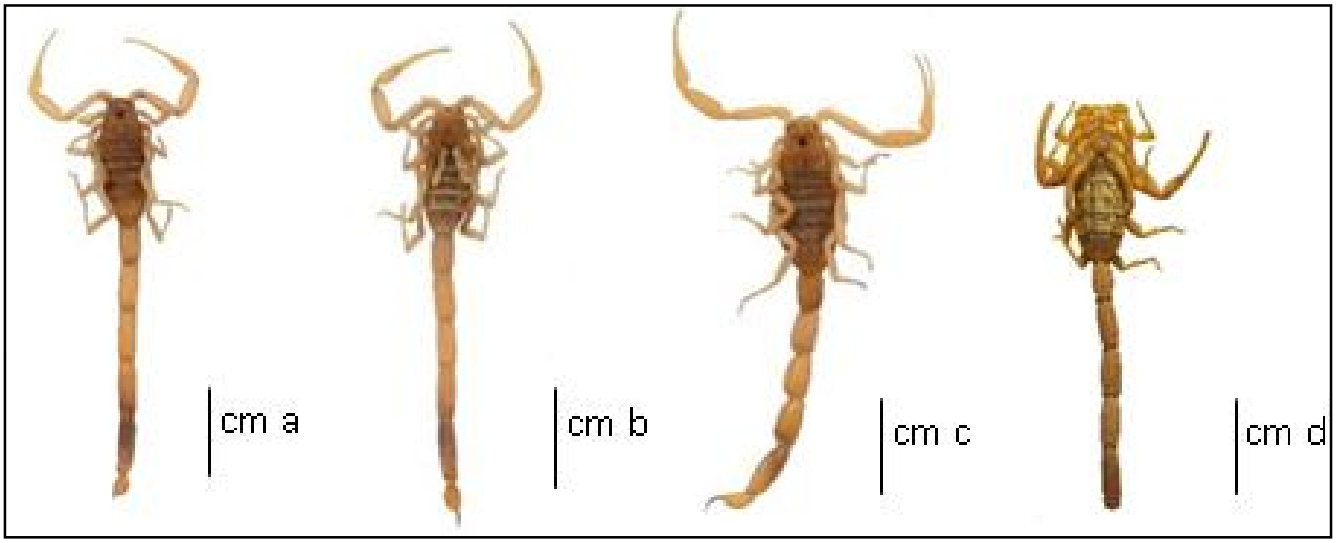

Fig. 5: *Compsobuthus matthiesseni* a, b male dorsal and ventral view. c, d female dorsal and ventral view.

Rovyia (36.628152N, 43.698215E), 1 female, Duhok province. Chaqzhi xwaroo (35.626307N, 45.199277E), 17 males, 2 females, Sulaymaniyah province table 2.

Diagnosis: This species was found under rocks and inside the old closets. It is ratio was (6.4%) in present study and forty-six scorpion specimen including twenty-six females and seventeen males were collected in the above mention area table 1. With its slender body and elongated metasoma and pedipalps, this species is quite distinct compared to other species of Compsobuthus genus, it also has more robust metasomal segments, slightly larger body size (30-39 mm), Higher pectinal tooth counts (22-22 teeth males, 19-20 females), a wider telon, and fused central and posterior median Fig. 5.

Distribution: Iraq, Syria, Iran and Turkey.

References: (Khalaf 1963; Kovaøík 1992; Kovaøík 2003; Navidpour 2008; Sissom and Fet, 1998; Yaðmur *et al.*, 2008a).

Mesobuthus phillipsii (Pocock 1889)

Type material: Bardbr (36.0474381N, 44.322364E), 8 males, 10 females. Barzan (36.921839N, 44.030585E), 1 male, 1 female. Chneran (36.368986N, 44.387404E), 1 female, Erbil province table 2.

Diagnosis: Generally, about twenty-one scorpions collected during present study, with ratio (3.1%) among the scorpion collection, were including nine males and twelve females table 1. This species is not a digger scorpion. The entire body was yellow to yellowish-brown and mesosomal tergites and metasomal segments with carapace are relatively uniform in coloration. Mesosomal tergites often had blackish-brown longitudinal stripes which were irregular. Relatively inflated Pedipalp chelae and broader than patella, Fingers had a large basal lobe and a combination of notches. Medium-sized buthids, adults 39-44 mm in total length ,with pectinal teeth 24-25 in male and 18-20 in female; With generally yellow coloring, with brownish yellow mesosoma, yellowish chela and the legs

pale yellow, Ventral surface with five distinct longitudinal dark marks on tergites, more darker than the dorsal surface; *M. phillipsi* is distinguished from *M. eupeus* by the following features: Uniting central and post-median carinae on one or either side of prosoma; dorsal surface of femur pedipalp finely granular; dorso-median carinae of patella special; faintly developed ventral carinae on metasomal segments II and III with minor granules; tiny and sharp basal denticles of ventrolateral carinae of metasomal segments V; more slenderer the segment of metasoma, aculeus is short; Hairy metasomal segments on tergites and five longitudinal, dark stripes (missing in some specimens) Fig. 6.

Distribution: Iran, Iraq.

References: (Mirshamsi *et al.*, 2011; Morad 2016).

Buthacus macrocentrus (Birula 1905)

Type material: Bardbr (36.0474381N, 44.322364E), 7 males, 13 females. Makhmor (35.776911N, 43.599369E), 1 female, Erbil province tab. 2.

Diagnosis: It was collected from under stones and deep burrows. This species belongs to Buthidae family and consider as the least scorpion species in the country (2.9%). Only 20 specimens collected in Bardbr village that including seven males and thirteen females with one female from Makhmore tab. 1. Color of this species is varying from light yellow to dull yellow. Total adult length 43–61 mm, Adult yellow to yellowish green standard color. Movable pedipalp fingers carry 9 or 10 rows of granules with one inner and one outer granules and 4 distal granules. Tarsomeres with bristlecombs, from first to third legs. Strong tibial leg spurs of the leg III and IV and larger on IV. Smooth pedipalp, only the dorsal surface of the femur can bear several granules. Femur with granulate carinae, outdated carinae patella, chela without carinae. Female chela is as broad as patella. Male chela as large as or wider than patella, very slightly twisted or straight base of male fingers. Ventrally, seventh mesosomal segment with four obsolete or minutely granulated carinae. Broad pectin, with 23 to 25 teeth in females and 29 to 31 in males. 10 carinae found on the first metasomal segment, while eight carinae present on the second to fourth segments (On lateral surface of second segment granule rows cover less than anterior half and do not form distinct carinae). Third metasomal lateral surface with several granules which reach a maximum of one third of the segment length (usually more pronounced and longer in males). Fourth metasomal segment with either smooth or granulated dorsal carinae and strongly granulated ventral carinae. The fifth metasomal segment typically lacks carinae but carries a ventromedian carina and two ventrolateral carinae consisting of irregular granules. Smooth metasoma found between carinae, granulate only on fifth segment ventral surface Densely hirsute metasoma and teleson Fig. 7.

Distribution: Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Oman, Qatar, Saudi Arabia, Syria and United Arab Emirates.

References: (Lourenço 2006; Yaðmur *et al.*, 2008).

Family: Scorpionidae (latreille 1802)

Scorpio maurus (Linnaeus 1758)

Type material: Bardbr (36.0474381N, 44.322364E), 7 males, 10 females. Korak (36.262737N, 44.145452E), 3 males, 3 females. Grdarasha (36.114992N, 44.023626E), 10 males, 15 females. Awena (36.072610N, 43.756160E), 2 females. Barzan (36.921839N, 44.030585E), 5 males, 10 females, Erbil province. Mahad (36.643554N, 43.419319E), 1 male, 2 females. Chammah (36.3051N, 43.5001E), 1 female, Duhok province. Chaqzhi Xwaroo (35.626307N, 45.199277E), 5 males, 7 females. Wlasmt (35.526558N, 45.972226E), 3 males, 5 females,

Fig. 6: *Mesobuthus phillipsii* a, b male dorsal and ventral view. c, d female dorsal and ventral view.

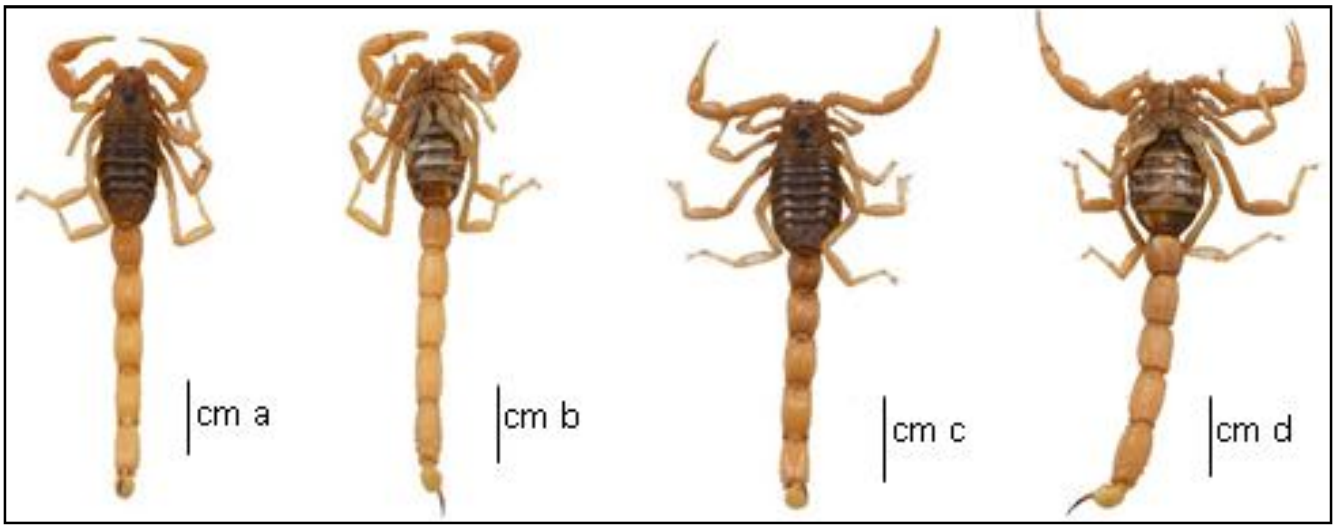

Fig. 7: *Buthacus macrocentrus* a, b male dorsal and ventral view. c, d female dorsal and ventral view.

Sulaymaniyah province table 2.

Diagnosis: *Scorpio maurus* was the third most common scorpion from all collection sites (13.2%), a total eighty-nine specimens were collected during day and night including thirty -four males and fifty - five females (Tab.1). The specimens were collected within burrows during the daytime, and specimen were collected at night by using UV light Fig. 1. This species is a digger species which can dig burrows with 20 - 70 cm deep. Most had a yellow to red brown color, the tip of the claws was usually dark red-brown. Pedipalp femur with three trichobothrias, only one of them on the inner surface. Patella pedipalp with 19 trichobothria, three of them ventrally located and 13 on external surface. Pedipalp chela, with 26 trichobothria. Absence of Retrolateral pedal spurs. Tarsi lateroapical margins developed into rounded lobes. paired ventral submedian carinae presented on the Metasomal segments I to IV. Stridulatory organ absent. Total length 30 to 40mm, with 13-14 pectinal teeth in male and 11 in female. Fig. 8.

Distribution: Africa (Algeria, Egypt, Libya, Mauritania, Morocco, Senegal, Tunisia), Asia (Iraq, Iran, Israel, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, Syria, Turkey, Yemen).

References: (Kovaøík and Affilastro 2009; Levy and Amitai 1980; Rutin 1996; Warburg and Elias 1998; Warburg and Elias 1999).

Family: Hemiscorpiidae (Pocock 1893)

Hemiscorpius lepturus (Peters 1861)

Type material: Bardbr (36.0474381N, 44.322364E), 5 males, 2 females, Erbil province. Wlasmt (35.526558N, 45.972226E), 7 males, 3 females. chaqzhi chwaroo (35.626307N, 45.199277E), 4 males, 5 females, Sulaymaniyah province table 2.

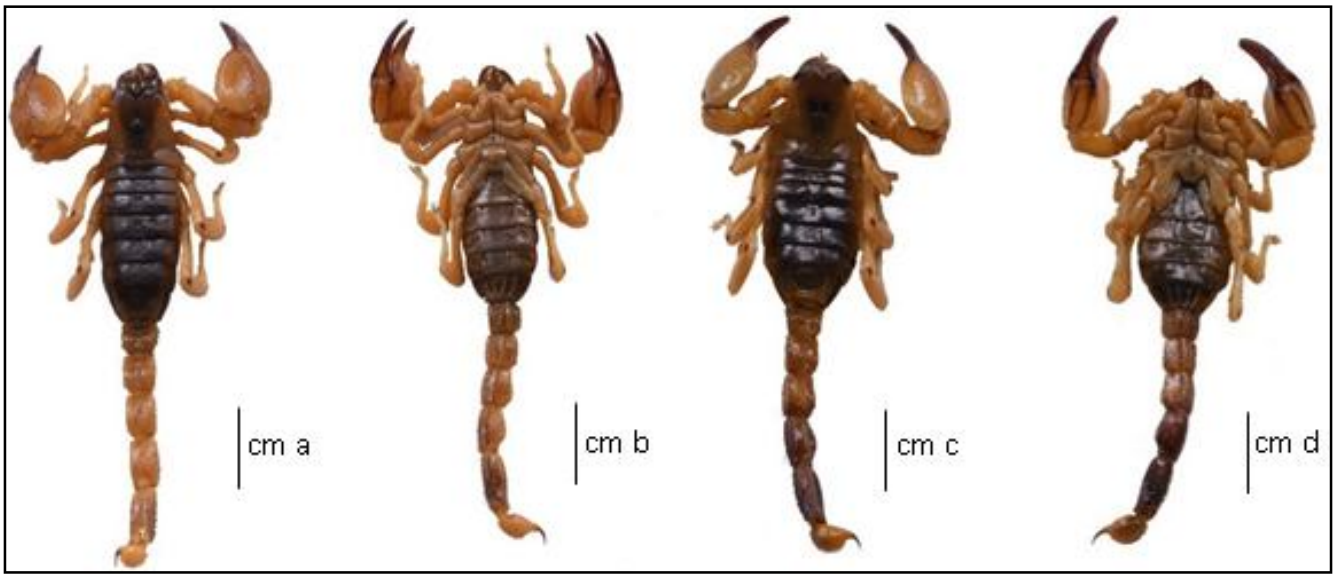

Fig. 8: *Scorpio maurus* a, b male dorsal and ventral view. c, d female dorsal and ventral view.

Diagnosias: Twenty-six specimens (3.8%) of this species were found in the area including ten females and sixteen males Table 1. Eight specimens collected from inside the old shoes and disposable things while eighteen other specimens were found with digging the ground in Bardbr and Welasmt. This species is a digger scorpion belongs to the family Scorpionidae. It is considering as the second most dangerous scorpion in the region. The collected specimens were yellow-brown yellowish and Had a dark stripe on Carapace mesosome longer than normal, Quite finely granular with smooth and minutely pitted anterior part, and Very finely granular area around median ocular tubercle, Smooth lateral margins, with no granules, superciliary carinae weak, smooth, The pedipalps are stout and voluminous, Slightly shorter chela fingers than chela manus, internodorsal carina of patellar protuberance smooth, Pedipalp patella orthobothriotaxic with 1-2 small granules, external side with 13 trichobotria (1 *est* and 2 *esb*), Ventral side: 3 trichobothria, elongated and slender metasoma of males, with sparse spiniform granules on dorsal carinae (anterior segments with weaker granules) and ventral and ventrolateral carinae of segments IV-V designed as ridges with slight spiniform granules (Segment V carinae, with more distinct spiniform granules in the last half), male taleson of highly elongated with a pair of blunt tuberculiform processes at the base of the aculeus, Lateral rugose surfaces, without different granules, metasoma of segments I-IV of the female with dorsal carinae and ventral and ventrolateral carinae at segment V bearing solid spiniform granules, the total length about (36-63mm), male have 14-15 pectinal teeth and female with 10-11 pectinal teeth Fig. 9.

Distribution: Asia (Iran, Iraq, Pakistan and Yemen)

References: (El-Hennawy 1992; Khalaf 1963; Lourenço 1989; Lowe 2010; Pérez 1974; Salari and Sampour 2017; Vachon 1966).

Identification key for the scorpion families in Iraq:

1. Metasoma of fifth segment with paired ventral median carinae, pedipalp patella without ventral trichobotheria ..... Buthidae

- Metasoma of fifth segment with paired ventral median carinae, pedipalp patella with one or

2. More ventral trichobotheria 2

3. Sternum very narrow, typically less than twice the length ..... Bothriuridae

4. Sternum not narrow, usually as long as wide 3

5. Legs with one pedal spure, movable fingers of pedipalps equipped with inner accessory denticles ..... Euscorpiidae

- Legs with two pedal spure 4

6. 4-Lateroapical margins of tarsi produced into rounded lobes ..... Scorpionidae

7. Lateroapical margins of tarsi straight ..... Hemiscorpionidae

Key to the genus and species of the family Buthidae (Koch 1937):

1- Mesosomal tergites I-IV with three carinae and anal arch with 2 strong lateral lobes and six reduced lobes ..... *Odontobuthus doriae*

- Mesosomal tergites I-III without carinae 2

2- carapace with distinct carinae 3

- carapace without distinct carinae, but smooth or granular 17

2- central lateral and posterior lateral carinae of carapace joined to form a linear continuous sequence of granules to posterior margin total adult length less than

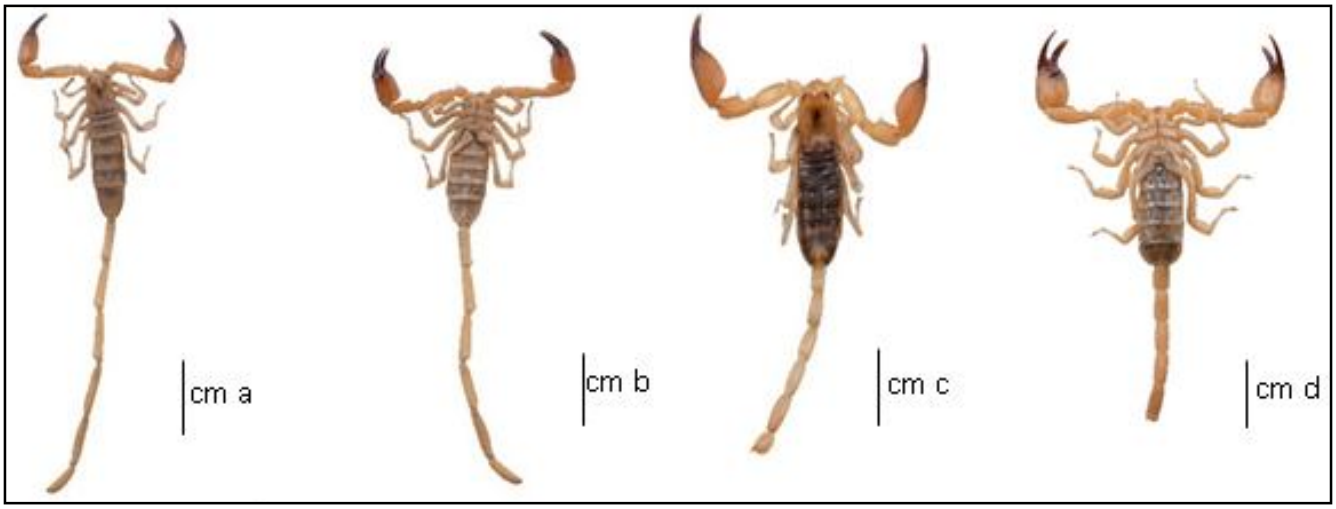

Fig. 9: *Hemiscorpius lepturus* a, b male dorsal and ventral view. c, d female dorsal and ventral view.

55mm, ... *Compsobothus* sp 4

- central lateral and posterior lateral carinae of carapace not joined to form a linear continuous sequence of granules to posterior margin total adult length more than 55mm, ... 7

1- Rows of granules without external granules on movable fingers ..... *Compsobuthus acutecarinatus*

- Rows of granules with internal granules on movable finger 5

2- Male has a metasoma longer than female, pedipalp manus a distance equal in both sexes ..... *Compsobuthus matthiesseni*

- Metasoma length equal to both sexes 6

3- Pectinal teeth number 15-19, telson bulbous and has wider and shorter pedipalp chela ..... *Compsobuthus jakesi*

- Pectinal teeth number 26-27, telson ovals and has longer and slender pedipalp chela ..... *Compsobuthus iraqensis*

4- Pedipalp dentate margin of chela movable finger with 4 granules located just proximal to terminal denticle and one basal and 3 terminal; metasomal segments robust, increasing in width and depth posteriorly. ..... *Androctonus* sp. 8

- Pedipalp dentate margin of chela movable finger with 5-7 granules located just proximal to terminal denticle and one basal and 4-6 terminal 10

5- Pedipalp hands slender, metasomal segment IV broader than long 9

- Pedipalp hands slender, metasomal segment IV longer than wide ..... *Androctonus australis*

6- Black in color, thick and board tail segments, the second and third segments of the postabdomen lateral keels are reduced to only few granules ..... *Androctonus crassicauda*

- The color of the terminal segments of the legs and pedipalp are light browen, the second and third segments of the postabdomen lateral keels of are developed and posses few granules..... *Androctonus bicolor*

10- Trichobothrium db. on tibia of pedipalp located usually between est and dt. Trichobothrium db. may be on level with trichobotrium est or rarely between est and esb. carinae of carapace not forming a lyre-shaped configuration. Ventrolateral carinae with all granules more or less equal in size on the fifth metasomal segment *Hottentotta* sp. 13

- Trichobothrium db on tibia of pedipalp always located usually between est and esb. carinae of carapace forming a lyre-shaped configuration. ventrolateral carinae with irregular granules on the fifth metasomal segment ..... *Mesobuthus* sp. 11

11- Movable finger of pedipalps with 11-12 cutting rows of denticles, 12 row without external

and internal denticles 12

- Movable finger of pedipalps with12-14cutting rows of denticles, if there are only 12 row with external and internal denticles ..... *Mesobothus caucasicus*

12- Metasomal segments II-IV are much more robust with eight complete carinae, pedipalp femur penatacarinate and strongly serrate with large posterior denticles of ventrolateral carinae of metasomal segment V ..... *Mesobuthus eupus*

- Metasomal segments II-III are weakly developed carinae and have small granules, pedipalp femur finely granular and short and basal denticles of ventrolateral carinae of metasomal segment V ..... *Mesobuthus phillipsi*

13- Black color except Reddish brown pedipalp chela. The legs can be reddish brown too 14

- Not entirely black color, but can be fully reddish to yellow 15

14- Pedipalps Movable fingers with 16 rows of granules. Ventral surfaces of metasomal segments and vesicle densely hirsute. Occurs in Iran ..... *Hottentetta zagrosensis*

- Pedipalps Movable fingers with 13-14 rows of granules. Metasoma bears Metasoma bears only a few hairs. Does not occur in Iran ..... *Hottentetta judaicus*

15- First segment of the metasoma of both sexes always wider than long, in female also second metasomal segment wider than long ..... *Hottentotta scaber*

- First and second segments of the metasom of both sexes longer than wide 16

16- General color reddish to reddish yellow without an inverted blackish triangular medium size about 80-87mm, finger of chela curved with 15-16 rows of granules ..... *Hottentotta mesopotamicus*

- General color light yellow with an inverted blackish triangular-large size about 90-120 mm, finger of chela strongly dentate with 11-16 rows of granules and 5-7 terminal granules ..... *Hottentotta saulcyi*

17- Metasomal segment IV and V punctate, telson elongate, aculeua as longer or longer than vesicle ..... *Orthochirus* sp. 18

- Metasomal segment smooth or granulated, telson bulbous or globose, aculeus shorter or longer than vesicle 21

18- Sternite VII rather smooth, without developed granulate carinae ..... *Orthochirus. iraqus*

- Sternite VII granulate, with developed granulate carinae 19

19- Metasoma V dorsal surface mesially densely granulated 20

- Metasoma V dorsal surface mesially smooth Metasoma, Ratio length/width of metasoma V in males 1.27–1.30. Dorsal carinae on pedipalp patella smooth or absent ..... *Orthochirus zagrosensis*

20- Metasoma II–III ventrally and laterally smooth, without granules, punctate and bumpy ..... *Orthochirus. fomichevi* sp. n.

- Metasoma II–III ventrally and laterally granulate Ratio length/width of metasoma V in males 1.18–1.24. Ventral and lateral surfaces of metasoma IV–V sparsely granulate ..... *Orthochirus mesopotamicus*

21- Pedipalp patella with 7 external trichobothria; carapace granular or smooth; male pedipalp chela not swollen with curved aculeus longer than vesicle; fixed finger of cheliceral with two venteral denticle ..... *Buthacus* sp. 22

- Pedipalp patella with 7 external trichobothria; carapace granular or smooth; male pedipalp chela incrassate, aculeus shorter than vesiclea, fixed finger of cheliceral with single venteral denticle ..... *Razianus zarudnyi*

22- Rows of granules on movable finger with external granules, metasomal segments and sternite VII with four carinae, aculeus tip blackish while vesicle and base aculeus yellow, without developed carinae on the ventral surfaces of II and III ..... *Buthacus leptochelys*

- Rows of granules on movable finger with external granules, metasomal segments and sternite VII granulated without carinae, aculeus dark brown while vesicle yellow, well developed carinae on the ventral surfaces of II and III; ..... *Buthacus macrocentrus*

Key to the genus and species of the family Bothriuridae (Simon 1880):

Sternum much wider than long, often appearing slit like, movable finger of chelicera with one sub distal tooth ..... *Bothriurus* 1

1- Bears six ventral trichobothria in the pedipalp chela, bears two sub distal teeth in the movable finger of chelicerae ..... *Bothriurus nendai*

Key to the genus and species of the family Scorpionidae (Latreillle 1802):

Telson without subaculear tubercle, Stridulation organ absent and Pedipalp patella with 19 trichobothria, 13 of them on external surface ..... *Scorpio maurus* 1

1- Have yellow golden color, male and female sternum of genital organ with one line and chela not smooth ..... *Scorpio marus palmatus*

- Have brown to dark brown color, male and female sternum genital organ with deep sub pentagonal and chela smooth ..... *Scorpio marus kruglovi*

Key to the genus and species of the family Hemiscorpionidae (Pocock 1893):

Ventral trichobotheria on manus number less than 8, second to fourth metasomal segments with a single ventral median carinae ..... *Hemiscorpus* sp. 1

1- Medium sized species, carapace L > 5.5 mm; metasoma I L/W > 1.40; pedipalp patella with well developed, superciliary carinae smooth ..... *Hemiscorpus lepturus*

Key to the genus and species of the family Euscorpiidae (Laurie 1890):

First metasomal segment and fourth metasomal segment with paired parallel ventral median carinae, movable fingers of pedipalp with granules in a single row ..... *Euscorpius* sp.

1- Pedipalp with 5 or more trichobothria (V1 –V4-11, Et1) on ventral surface of chela manus, Pedipalp with supplementary trichobothria series 4-11 on external surface of patella ..... *Euscorpius italicus*

Discussion

Iraq generally and Kurdistan especially, are the significant places for the presence of arthropods, particularly, in the light of its variable climatic and topographical characteristics (Nejati *et al.*, 2018), but scorpion fauna of Iraq is poorly known. Only few reports on the Iraq scorpion fauna found and the earliest report on scorpions collected from Iraq was apparently made by Khalaf (1962) in other words only fourteen scorpion species identified that belong to three families, including Buthidae, Scorpionidae and Hemiscorpionidae in 1962.

In present study, a total number of 676 scorpion specimens were collected in the investigated area including 40 locations within three provinces; Erbil, Duhok and Sulaymaniyah in north part of Iraq and they belonged to three families Buthidae Scorpionidae and Hemiscorpioidae. the results of this arachnological study has shown that six scorpion species belong to family

Buthidae identified, including *Hottentotta saulcyi*, *Androctonus crassicauda*, *Orthochirus fomichichevi*, *Compsobuthus matthiesseni Mesobuthus phillipsii and Buthacus macrocentrus*, the last one are reported for the first time from this area and *Orthochirus fomichichevi*, identified for the first time in the world.

The most abundant scorpion species *Hottentotta saulcyi* distributions in the north of Iraq, it has found from 23 locations out of 40 locations, this species is the wide distribute species from the northern part of Iraq. It has distributed over the Middle East from Syria, Turkey, Iraq, Iran and Afghanistan (Fet *et al.*, 2000; Kovarik 1997a; Yaðmur *et al.*, 2008b). While The last species identified in this area was *Buthacus macrocentrus*, also this genus identified in the south of Iraq (Al-khazali and Yagmur 2019) and Kovaøík (2005) documented the presence of *Buthacus macrocentrus* in the Iraq, Iran and Syria.

Androctonus crassicauda has been recorded from many provinces of Iraq including Baghdad, Ninawa, Babile, Basra, Dewdney and Zeqarr (Al-Azawi 2017; Al-khazali and Yagmur 2019). This species were distributed in the many part of the world such as Egypt, Palestine, Jordan, Syria, Turkey, Armenia, Azerbaijan and Iraq to the Arabian Peninsula (Fet *et al.*, 2000).

Scorpio maurus belong to family Scorpionidae and became the second family that found in the present study ,also this scorpion have many sub species around the world (Kovaøík and Affilastro, 2009), in the other word, *Scorpio maurus kruglovi* well documented and collected in recent study done in Erbil Provence (Ahmed 2015), but it was not observed in this present study.

Hemiscorpius lepturus was only genus that investigated in this study that belong to family Hemiscorpionodae, and reported for the first time in the mention investigated area, while this genus record in the earlier study done by (Khalaf 1962) in Iraq, but found in the Mandali region in Diyala province that located in the middle of Iraq.

Conclusion

The results of one year and half field trip investigations on the scorpions of Kurdistan- region Iraq are presented and discussed. The annotated checklist includes eight genera of three families (Buthidae, scorpionidae and Hemiscorpionidae). Two genera of Buthidae and one genus of Hemiscorpionidae are new for the fauna of the area. A brief description of each species was given together with a discussion on their distribution with a detailed list of localities, an up-to-date checklist of the scorpions of Kurdistan- region /Iraq which includes eight genera of three families is presented. Buthidae, was the most family with the highest diversity in the area, the diversity and distribution of the scorpion fauna in the study area can be explained as a result of its distinctive geographic position and the highly diverse environments of the region.

Acknowledgements

The authors most grateful to Dr. Lorenzo Prendini from American Museum of Natural History, New York (AMNH, New York, USA) for their valuable comments on the identification of scorpion species. and The authors would like to appreciate Mr. František Kovaøík from NMPC (National Museum of Natural History, Prague, Czech Republic) for confirming the new scorpion species, the authors express their gratitude to Dr Wilson R. Lourenço - *Muséum National d'Histoire Naturelle, France* for providing valuable comments.

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