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Species composition, sex ratio, geographical distribution, seasonal and monthly activity of scorpions and epidemiological features of scorpionism in Zarrin-dasht County, Fars Province, Southern Iran

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ABSTRACT

Objective: To determine the fauna, density, geographical distribution, sex ratio of scorpions and epidemiology of scorpionism in Zarrin-dasht County, south of Iran.

Methods: This descriptive and practical research was done during 2010-2011 for bioecology of scorpions and during 2008-2009 for epidemiology of scorpionism. The specimens of scorpions were captured by rock-rolling, black light and burrow excavation methods.

Results: The found species and subspecies were as follows: *Odontobuthus odonturus* (42.1%), *Scorpio maurus townsendi* (40.1%), *Olivierus (Mesobuthus) caucasicus* (8.3%), *Mesobuthus eupeus kirmanensis* (4.4%), *Compsobutus matthiesseni* (1.6%), *Compsobuthus rugosulus* (1.2%), *Androctonus crassicauda* (0.4%), *Hemiscorpius lepturus* (0.4%), *Sassanidotus zarudnyi* (0.4%), *Mesobuthus eupeus afghanus* (0.4%), *Mesobuthus eupeus philippovitschi* (0.4%) and *Mesobuthus eupeus philipsi* (0.4%). Also, the majority of specimens were caught in the summer season (43.3%). Scorpion sting cases were more frequently reported at summer (69%), on feet (52.6%) and in urban areas (54.7%).

Conclusions: Zarrin-dasht County (with 12 scorpion species and subspecies) has the high level of diversity in scorpion community. Planning prevention, control and treatment programs based on the identified species are suggested.

1. Introduction

Scorpion stings are one of the most serious public health problems in different regions of the globe[1]. Approximately, 1 230 000 scorpion stings happen annually in the global while the number of deaths is about 3 250[2]. The status of scorpions differs in various places of the world, in connection with socio-economic situation, habitation, health services, behavior of people and various species of scorpions taking place in different geographical zones[3]. About 2 000 species of scorpions are reported in the world[4]. Of these species, only 30 species have medical importance[5]. In the Middle East, fatal scorpion species comprise *Androctonus crassicauda* (Olivier, 1807) (*A. crassicauda*), *Mesobuthus tamulus* (Fabricius, 1798), *Mesobuthus eupeus* (C. L. Koch, 1839) (*M. eupeus*), *Parabuthus liosoma* (Ehrenberg, 1828), *Buthus occipitanus* and *Leiurus quinquestriatus* (Ehrenberg, 1828)[3].

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According to scientific reports, there are minimum 51 species of scorpions in Iran, belonging to 18 genera and 4 families, namely, Diplocentridae (Karsch, 1880), Scorpionidae (Latreille, 1802), Hemiscorpiidae (Pocock, 1893) and Buthidae (C. L. Koch, 1837) [6]. Annually, 40000-50000 people are stung by different species of scorpions in Iran[7]. In Iran, the main significance of the scorpion stings are associated with three species of scorpions including M. eupeus, A. crassicauda and Hemiscorpius lepturus (Peters, 1861) (H. lepturus). While, Hottentota (Buthotus) saulcyi (Simon, 1880), Odontobuthus doriae (Thorell, 1876) (O. doriae), Olivierus (Mesobuthus) caucasicaus (Nordmann, 1840) and Apistobuthus pterygosercus (Finnegan, 1932) have secondary importance in scorpion envenomation[8]. Furthermore, there are two species of scorpions whose stings frequently result in dying (H. lepturus and A. crassicauda). H. lepturus, mainly in Khuzestan Province is the most perilous scorpion. This species is found in abundance in South West and South Areas[3,8,9].

Prevalence suffered from scorpion sting agents' in various regions of Iran revealed that *M. eupeus* and *Buthotus schach* were the maximum and the minimum, respectively. The collecting outcomes were recorded as follows: *M. eupeus* (34.5%), *O. doriae* (26.2%), *A. crassicauda* (21%), *H. lepturus* (11%), *Orthochirus scrobiculosus*

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(3.5%), Compsobuthus matthiesseni (1.7%) (C. matthiesseni), Olivierus caucasicus (1.6%) (O. caucasicus), Buthotus saulcyi (0.3%) and Buthotus schach (0.2%)[2].

Without data about the epidemiological aspects of scorpionism and scorpions fauna in an area, in most of the time adopting control methods for different species of scorpions are failed. The aim of the present research was to determine the ecofaunistics of scorpions and the specification of scorpionism in Zarrin-dasht County in order to introduce some preventive health and medical strategies against scorpion sting.

2. Materials and methods

This research was a descriptive study that was conducted based on random cluster sampling method. This study was done during 2010-2011 in the mountainous and low land regions of Zarrin-dasht County, Fars Province, south of Iran. The studied regions were cities and villages, namely, Hajiabad, Zirab, Chahsabz, Hajitahereh, Selimoni, Golkoye and Chahzebr. Collection of scorpions were made during the night examines using the UV light, holding it at an interval of about 20 cm from the ground, brick walls or muddy walls. Meanwhile, during the day, scorpions were collected via digging, rock-rolling, searching gaps of border garden in houses, pouring water in holes, searching lower sections of tree trunks and pulling down ancient walls. Scorpions were gathered by using the forceps and then transferred to the laboratory in separate glass containers containing alcohol 70%. Some main information such as place and date were recorded. Identification of scorpions was done by morphological features based on the national standard diagnostic keys[10]. The scorpionism information was gotten from case history folders in urban/rural health services centers during 2008-2009. These information were analyzed by SPSS software.

3. Results

3.1. Scorpion fauna, sex ratio, geographical distribution, monthly and seasonal activity

Totally, in this study 225 specimens were collected, including 194 (77.0%) females and 58 (23.0%) males (Table 1). In our study, twelve species and subspecies from three families, Buthidae (C. L. Koch, 1837), Scorpionidae (Latreille, 1802) and Hemiscorpiidae (Pocock, 1893) were identified. *O. odonturus* with 106 (42.1%) specimens (Figure 1) and *Scorpio maurus townsendi* (Pocock,

1900) (S. maurus townsendi) with 101 (40.1%) (Figure 2) were the most abundant in the studied regions. The other ten species and subspecies were identified as O. (Mesobuthus) caucasicus (Nordmann, 1840), Mesobuthus eupeus kirmanensis (Birula, 1900), C. matthiesseni (Birula, 1905), Compsobuthus rugosulus (Pocock, 1900), A. crassicauda (Figure 3), H. lepturus (Figure 4), Sassanidotus zarudnyi (Birula, 1903), Mesobuthus eupeus phillipsi (Pocock, 1889), Mesobuthus eupeus philippovitschi (Birula, 1905) and Mesobuthus eupeus afghanus (Pocock, 1889). A. crassicauda, S. zarudnyi and H. lepturus were rare species. There were two major types of habitats in this part of Iran, plains and mountains. The greatest number of the collected scorpions were from the plain areas (89.3%) (Table 1). Abundance distribution of the collected scorpions by the type of environment showed that 1.5% (n = 4), 0.4% (n = 1), 9.5% (n = 24), 6.7% (n = 17), 79.1% (n = 179) and 10.8% (n = 27) were captured in inside house, dooryard, around the building, abandoned place, low land and mountain, respectively. The most abundant scorpions were caught from Hajiabad (n = 107, 42.5%), Chahsabz (n = 31,12.3%), Chahzebr (n = 28, 11.1%), Selimoni (n = 27, 10.7%), Hajitahereh (n = 24, 9.5%), Zirab (n = 19, 7.5%) and Golkoyeh ((n = 16, 6.4%), respectively. They had their most period ofactivity in July (n = 40, 15.9%), August (n = 40, 15.9%) and May (n = 23, 12.7%), respectively. In addition, the analysis showed that 10.4 (n = 26), 6.8 (n = 17), 11.5 (n = 29), 3.5 (n = 9), 2.3 (n = 10)6), 4 (n = 10), 5.1 (n = 13), 6.8 (n = 17) and 5.1% (n = 13) of the scorpions were captured in the months of April, June, September, October, November, December, January, February and March, respectively. Therefore, the most scorpions were hunted in summer (n = 109, 43.3%), spring (n = 75, 29.7%), winter (n = 43, 17.1%)and autumn (n = 25, 9.9%), respectively. Notes on the collected scorpions showed that sex ratios (male to female) on O. odonturus, S. maurus, M. caucasicus, M. eupeus, C. matthiesseni and C. rugosulus were 1:8.64, 1:5.73, 1:0.31, 1:0.55, 1:0.33 and 1:0.50, respectively. Entirely, the sex ratio was 1:3.34 in favor of females. This showed that females of captured scorpions were more prevalent than males.

3.2. Epidemiological data

In total, 152 scorpion sting patients were recorded during 2008-2009. The majority cases were women (89, 58.6%) and the others were men (63, 41.4%). The occurrence of scorpion stings in rural areas (69, 45.3%) was much lower than that in urban areas (83, 54.7%). Scorpion sting cases were more frequently reported at

Table 1
The scorpions captured according to species, sex and geographical area, Zarrin-dasht County, Fars Province, Southern Iran, 2010-2011.

Family	Species	No. of captured (%)	Sex		Geographical area	
			Male No. (%)	Female No. (%)	Plain No. (%)	Mountain No. (%)
Buthidae	C. matthiesseni	4 (1.6)	3 (75.0)	1 (25.0)	4 (100.0)	0 (0.0)
(C. L. Koch, 1837)	A. crassicauda	1 (0.4)	1 (100.0)	0 (0.0)	1 (100.0)	0 (0.0)
	O. odonturus	106 (42.1)	11 (10.3)	95 (89.4)	89 (84.0)	17 (16.0)
	C. rugosulus	3 (1.2)	2 (66.6)	1 (33.4)	3 (100.0)	0 (0.0)
	S. zarudnyi	1 (0.4)	1 (100.0)	0 (0.0)	1 (100.0)	0 (0.0)
	M. caucasicus	21 (8.3)	16 (76.1)	5 (23.9)	21 (0.0)	0 (0.0)
	M. eupeus	14 (5.5)	9 (64.3)	5 (35.7)	14 (100.0)	0 (0.0)
Scorpionidae (Latreille, 1802)	S. maurus townsendi	101 (40.1)	15 (14.8)	86 (85.2)	91 (90.1)	10 (9.9)
Hemiscorpiidae (Pocock, 1893)	H. lepturs	1 (0.4)	0 (0.0)	1 (100.0)	1 (100.0)	0 (0.0)
Total		252 (100.0)	58 (23.0)	194 (77.0)	225 (89.3)	27 (10.7)

summer (105, 69.0%), spring (26, 17.2%), autumn (13, 8.5%) and winter (8, 5.3%), respectively. The most sting cases were found in July (63, 41.4%) and September (31, 20.4%) (Table 2). The highest prevalence of scorpion stings occurred on feet (80, 52.6%), hands (64, 42.1%) and heads-trunks (8, 5.3%). Frequencies of most common scorpions that had stung the patients were 76.9 (n = 117), 18.4 (n = 28) and 4.7% (n = 7) for black, yellow and other scorpions respectively, and in none of the cases the species identification had not been done.



Figure 1. O. odonturus.



Figure 2. S. maurus townsendi



Figure 3. A. crassicauda.



Figure 4. H. lepturus.

Table 2
Distribution of scorpion sting cases by month in Zarrin Dasht County, Fars Province, Souther Iran, 2008-2009.

Month	No. of sting (%)		
April	7 (4.6)		
May	10 (6.5)		
June	9 (5.9)		
July	63 (41.4)		
August	11 (7.2)		
September	31 (20.4)		
October	4 (2.7)		
November	7 (4.7)		
December	2 (1.4)		
January	1 (0.7)		
February	2 (3.2)		
March	5 (1.3)		
Total	152 (100.0)		

4. Discussion

Scorpionism remains an important health problem in several southern parts of Iran primarily in Khuzestan Province. Iran, with nearly 10 poisonous scorpion species, has the largest number among Middle Eastern countries[6,9]. This research displayed a wide diversity of scorpion species in the Zarrin-dasht County, with three families and a minimum of twelve species and subspecies. According to the latest reports, in the current study seven species and subspecies, namely, O. odonturus, O. (M.) caucasicus, C. rugosulus, S. zarudnyi, Mesobuthus eupeus philippovitschi, Mesobuthus eupeus afghanus and Mesobuthus eupeus kirmanensis are reported for the first time from Fars Province[11]. Navidpour et al. reported eighteen species of scorpions belonging to three families from the Fars Province of Iran as follows: A. crassicauda, Compsobuthus persicus (Navidpour, Soleglad, Fet and Kova ík, 2008), C. matthiesseni, Compsobuthus petriolii (Vignoli, 2005), Hottentotta saulcyi (Simon, 1880), Hottentotta schach (Birula, 1905), Hottentotta zagrosensis (Kova ík, 1997), Iranobuthus krali (Kova ík, 1997), Mesobuthus eupeus persicus (Pocock, 1899), Mesobuthus phillipsii (Pocock, 1889), Odontobuthus bidentatus (Lourenço and Pézier, 2002), O. doriae (Thorell, 1876), Orthochirus farzanpayi (Vachon and Farzanpay, 1987), Orthochirus zagrosensis (Kova ík, 2004), Razianus zarudnyi (Birula, 1903), S. maurus townsendi, H. lepturus and Hemiscorpius

sp. [Hemiscorpius gaillardi (Vachon, 1974)][11].

H. lepturus and *A. crassicauda* are the most dangerous scorpions, especially in Khuzestan Province. They are found in south and south-west of Iran plentifully and their stings cause great hurts mostly in children[2,9]. In this study, the prevalence of *H. lepturus* was 0.4% only. It has been captured from Khuzestan Province with prevalence 24.9%, from Kerman Province with prevalence 0.9%, from Hormozgan Province with prevalence 21.6% and from Ilam County with frequency 5.56%[7,12,13]. This species has wide distribution in provinces of Khuzestan, Fars, Kurdistan, Ilam, Hormozgan, Kohgilouyeh Va Boyer Ahmad, Bushehr, Kermanshah, Semnan and Lorestan[7,12]. *H. lepturus* also occurs in Iraq, Pakistan and Yemen[14]. Some studies showed that envenomation by *H. lepturus* was responsible for ninety percent of reported deaths in the southern provinces of Iran[7,15].

In the current survey, *A. crassicauda* has hunted with prevalence 0.4%. This species responsible for 41% scorpion stings in province of Khuzestan[7]. This species was collected in Khuzestan Province with prevalence 28.7%, in Kerman Province with prevalence 28.5% and in Ilam County with prevalence 25.44%[7,12]. *A. crassicauda* has large distribution in all regions of Iran including provinces of Hormozgan, Khorasan, Kermanshah, Ilam, Kerman, Bushehr, Semnan, Khuzestan, Kurdistan and West Azerbaijan[16]. It is distributed around the world from Palestine, Egypt, Syria, Jordan, Azerbaijan, Armenia, Turkey and Iraq to the Arabian Peninsula[7].

In the our studied regions, *M. eupeus* with prevalence 5.5% considered as the fourth prevalent scorpions. This species is a common scorpion in Iran. The prevalences of this species were 21.7% in Khuzestan Province, 24% in Hormozgan Province, 10.09% in Ilam County and 21.43% in Taibat in Northeast Iran[7,15,17]. It was reported in Iran of the provinces of Kurdiatan, Khorasan, Kermanshah, Khuzestan, Golestan, Hormozgan, Tehran, Ilam, West Azerbaijan, Kerman and Mazandaran[7]. It is distributed in Pakistan, Turkmenistan, Afghanistan and Iraq[7]. This species is liable for 45% of scorpion sting cases in Iran[7]. The results of Mirshamsi *et al.* study confirmed the hypothesis that *M. eupeus* is a polytypic species complex and possibly includes more than one valid species. Therefore, according to comparative morphological analysis, *Mesobuthus eupeus phillipsi* was raised to the species level[18].

The second common species in Zarrin-dasht County was *S. maurus* (40.1%). It is a polymorphic species. Molecular information proposed which includes several sibling (cryptic) species[19]. The frequencies of *S. maurus* in Hormozgan Province and Ilam County were found 3.8% and 18.42%, respectively[7,13]. This species was collected from provinces of Kurdistan, Hormozgan, Tehran, Ilam, Kermanshah, Khorasan, Golestan, Khuzestan and West Azerbaijan[7,16]. In addition to Iran, it has distribution in Mauritania, Algeria, Libya, Morocco, Tunisia, Lebanon, Jordan, Turkey, Iraq, Syria, Yemen, Egypt, Palestine, Saudi Arabia, Senegal, Qatar and Kuwait[14].

In this study, *O. odonturus* was the dominant species (42.1%). *S. maurus* and *O. odonturus* are digger scorpions and build their nests

in plains and mountains with sandy clay soil, as the best places for insect hunting. In a research in Southeastern Iran (Baluchestan Region), A. crassicauda and O. odonturus were considered as the first and second common scorpions, respectively. O. odonturus has been collected from provinces of Khuzestan, Ilam, Kermanshah, Hormozgan, Bushehr, Fars, Yazd and Isfahan[20]. We found C. matthiesseni in Bushehr with prevalence 1.6%. The abundances of this species in Ilam County and Baluchestan region were reported 5.7% and 3.7%, respectively[7,9]. It is distributed in Khuzestan, Bushehr, Hormozgan, Ilam, Kermanshah, Kurdistan, West Azarbaijan, Northern Khorasan and Razavi Khorasan Provinces[20]. Although, O. odonturus and S. maurus are not known as poisonous scorpions, C. matthiesseni belongs to venomous species[7].

Correlation between scorpion abundance and the environmental factors was one of the important findings of this study. Low temperatures in the cold season of the study area caused low activity of scorpions, but this activity increases gradually with increase in temperature, so that in July (15.9%) and August (15.9%) the peak of activity can be observed (because of the favorable temperature and humidity). For this reason, activity of these arthropods decreases during October-March due to unfavorable weather. Scorpions have no activity in temperatures lower than 4-10 °C.

In the study of bioecology of scorpions, the probable locations for their nesting were studied which most of them were located in low lands. This may be due to no human made changes in the environment as well as more available baits for scorpion feeding.

In this study area, the main part of collection were female scorpions. This result was the same as other studies[16,21,22]. Because pregnant females need to more food for their offspring, therefore their foraging activity is higher and captured more than males in this study (77% females in compared to 23% males). In Qeshm Island's study (Southern Iran), the sex ratio on *A. crassicauda* was found 1:1.53[16]. Another study in Hormozgan Province showed more female scorpions (53.8%) in compared with males (46.3%)[21]. In the study of Gonabad scorpions, females were also more than males. The sex ratios for *Odontobuthus*, *Mesobuthus* and *Androctunus* were 1:1.19, 1:3 and 1:1.2, respectively. In our study, male to female ratios were found to be 1:8.64 and 1:5.73 for *O. odonturus* and *S. maurus*, respectively[22]. These results were the same as Gonabad study.

Previous studies have shown that maximum scorpion stings occur in the hot months, mostly in summer season[23,24]. The results of this study showed that the most stings occurred during the hot months, with a peak in July. In our study, scorpionism was more frequent in women. A similar result was found from the southeastern and southwestern of Iran[9,25]. In some researches, scorpionism was reported more frequent in men[26,27]. In the current study, feet, followed by hands, were more frequently stung than other parts of the body. Other studies presented similarly that extremities were more affected[27,28].

Zarrin-dasht County with twelve species and subspecies of three

scorpion families has a high species diversity. The most collected scorpions were *O. odonturus* and *S. maurus*, the species with toxins affecting nervous system and high fatality in children and elderly people. Because treatment of the cases received stings should be conducted based on the scorpion species and type of their venom, it is necessary for planning prevention and treatment based on the scorpion fauna of each area.

Conflict of interest statement

We declare that we have no conflict of interest.

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