Original Article

The First Data on the BioEcology of Scorpions (Arachnida: Scorpiones) in Bavi County, Southwestern Iran (2016–2017)

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Abstract

Aims: The purpose of this study was to determine the scorpion species, abundance, distribution, monthly activity, comparisons between different scorpion collecting methods, and sex ratio in Bavi County, during 2016–2017. **Materials and Methods:** Collection of scorpions was made during the night examinations using the ultraviolet (UV) light and ordinary flashlight. Meanwhile, during the day, scorpions were gathered through rock rolling and pouring water in-ground holes. Scorpions were hunted using a long forceps and then transferred to the laboratory in separate glass containers containing alcohol 75%. All the specimens were identified based on valid taxonomic keys. **Results:** A total of nine species in nine genera from three families were identified. *Androctunus crassicauda*, *Hemiscorpius lepturus,* and *Mesobuthus phillipsii* were the most abundant in the investigated areas. The most scorpion activity was recorded in the summer. The most of the specimens were collected through UV light. The sex ratio was 1: 1.2 in favor of females. **Conclusion:** There are three medically major scorpion species including *H. lepturus*, *A. crassicauda, and M. philipsi in* Bavi County. Among them, *H. lepturus* is the most venomous scorpion in the investigated region. Therefore, inhabitants must be careful of its sting, in particular in children.

Keywords: Abundance, capturing techniques, distribution, monthly activity, scorpion, sex ratio, species composition

Introduction

Scorpions can be considered as living fossils, because they have changed little over the past 400 million years.[1] In general, the order of scorpions includes 28 families that about half of these families became extinct. Scorpios belong to the Arachnida class and Scorpionida order (Lamarck, 1801). These creatures are as one of the most significant natural hazards and introduced as dangerous arthropods. The fearful appearance and painful venomous stings of scorpions have caused human phobia. These animals have poisonous stings from which to use for hunting of insects and also their defend against enemies. For this reason, when they feel threatened by human beings, they sting them to defend themselves. Scorpion venom, which is a protein substance, is clear and colorless when fresh. Their habitats are frequently in deserts and uninhabited regions. Scorpions are nocturnal, and during the day, they rest in their habitats such as cracks in the walls, cavities in the ground, under rocks, drilled holes by themselves, and under the leaves and bark of trees, and at night, they leave the nest for hunting and other biological activities. They are viviparous.[2-4]

Scorpion stings are one of the health and medical issues of underdeveloped tropical and subtropical countries in the world that endanger the lives of thousands of people every year. Scorpion envenomation is a health problem in Southern Africa, the Middle East, the South America (Mexico), and the Indian subcontinent. Out of about 2000 scorpion species in the globe, few (30–50 species) cause intense toxicity including more than

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1.23 million stings yearly, of which about 3250 (0.27%) cause death. About 1.2 billion people in the world live in areas where scorpion stings are likely. Iran, Colombia, and Mexico are the most affected countries.[5-7]

In Iran, out of nearly 100,000 scorpion sting cases including children (75%), just 36000–50,000 cases are reported in the official form, with a 7–60 fatality rate annually.[5,6] In Iran, the main important of the scorpion envenomation is associated with three scorpion species inclusive *Hemiscorpius lepturus (Peters, 1861), Mesobuthus eupeus* (C. L. Koch, 1839), and *Androctonus crassicauda* (Olivier, 1807), whereas *Apistobuthus pterygosercus* (Finnegan, 1932), *Odontobuthus doriae* (Thorell, 1876) *Olivierus* (*Mesobuthus*) *caucasicaus* (Nordmann, 1840), and *Hottentota* (*Buthotus*) *saulcyi* (Simon, 1880) have secondary significance in scorpion sting. Meanwhile, there are two scorpion species whose stings generally cause death (*A. crassicauda* and *H. lepturus*). *H. lepturus*, frequently in Khuzestan Province, is the most deadly scorpion. This scorpion species is collected abundantly in South and southwestern regions.[7-9]

Species diversity and distribution of scorpions in Iran are relatively significant in each region due to the diversity of geographical locations and different climatic conditions. Existence of suitable geographical conditions and tropical climatic has caused the presence of various and also dangerous species of scorpions in the western and southern regions of the country.[10]

Dehghani and Kassiri reported 64 species of scorpions in Iran, 4.5% (n = 3) belonged to the Scorpionidae family, 9.5% (n = 6) to the Hemiscorpiidae family, and 86% (n = 55) to the Buthidae family. The three families contained twenty genera. The Buthidae family is noticed as the most diverse and the largest family of scorpions in Iran. Buthidae family species are included in 17 genera. It has a vast geographical distribution in Iran. The species of Scorpionidae in Iran comprised *Nebo hengamicus* and *Scorpio maurus*. The *Hemiscorpius lepturus* is one of the deadly members of the Hemiscorpiidae family. One genus and six species of the Hemiscorpiidae family have been identified in Iran.[4,11-13] Barahoei et al. introduced 68 definite species belongs to 19 genera and four families and 6 doubtful species (in Buthidae family), for the scorpion fauna of Iran. Furthermore, 31 species of scorpions have been reported in Khuzestan Province, Southwestern Iran.[14]

The purpose of this study was to determine the scorpion species which live in different regions of Bavi County as a contribution to widen our knowledge of Iranian scorpion fauna. Other objectives of the study, in addition to determining the scorpion fauna, were abundance, distribution, monthly activity, comparison of capturing techniques, and sex ratio. This was the first study of scorpions in this county.

Materials and Methods

Bavi County (31°28′15″N 48°51′37″E) is a county in Khuzestan Province in Iran. The capital of the county is Mollasani. It was separated from Ahvaz County in 2010. The county is subdivided into two districts: the Central District and Veys District. The county has three cities: Mollasani, Sheyban, and Veys. The area of Bavi County is 2130 square kilometers.

The study was approved by the Committee of Ethics in Research, Ahvaz Jundishapur University of Medical Sciences and registered. This study was conducted after obtaining ethical approval (IR.AJUMS.REC.1396.531). The field studies were carried out between April and March 2016–2017. A total of 719 specimens have been gathered and examined from 17 different localities (based on geographical situation and scorpion sting cases) in Bavi County.

This study is a descriptive research that was done by random capturing method of scorpions. Sampling was performed in all seasons (1–3 times per season) of the year with emphasis on spring and summer in scorpion-prone areas of Bavi County. Scorpions were collected in cracks of walls, ground holes, rodent nests, livestock feces in livestock farms, under rocks, construction debris, under leaves, and the bark of the tree.

The sampling was done at night (from dusk to midnight) using a black light-ultra violet (UV) light and an ordinary flashlight. At day time, the methods of rock rolling and pouring water in-ground holes were used. Scorpions were collected using the long forceps and then transferred to the laboratory in separate glass containers. All the collected specimens were placed in 75% ethyl alcohol. Several main information such as village and town name, date, scorpion capturing technique, and place was noted. All the scorpions were identified using a Stereo Microscope Leica based on taxonomic keys.[12,14] The gender of scorpions was also determined according to Farzanpey method.[15] Data related to scorpions were inputted into IBM SPSS software/Singapore Pte Ltd, version 22.0. The detailed information of sampling places has been shown in Tables 1-3.

Results

In this study, a total of 719 specimens (nine species in nine genera) from three families, Buthidae (82.6%, n = 594), Scorpionidae (0.3%, n = 2) (Latreille, 1802), and Hemiscorpiidae (17.1%, n = 123), were identified. *A. crassicauda* (32.4%), *H. lepturus* (26.7%), and *Mesobuthus phillipsii* (Pocock, 1889) (21.4%) were the most abundant in the investigated areas. The other six species were identified as *Compsobuthus matthiesseni* (Birula, 1905), *Orthochirus iranus* (Kovařík, 2004), *Apistobuthus susanae* (Lourenço 1998), *Razianus zarudnyi* (Birula, 1903), *Buthacus macrocentrus (Ehrenberg, 1828),* and *Scorpio maurus* (Linneaus, 1758). Overall, 399 females and 320 males were identified showing M/F sex ratio of about 1:1.2 [Table 1]. The most scorpion activity was recorded in the summer (59.7%, n = 429), followed by spring (34.5%, n = 248), autumn (3.2%, n = 23), and winter (2.6%, n = 19). Scorpions had their maximum activity period in September (24.1%, n = 173) and August (19.5%, n = 140), respectively [Table 2]. Most of the collected specimens belonged to animal husbandry (20%) and

Table 1: The scorpions captured according to species, abundance, relative frequency, gender and sex ratio, Bavi County, Khuzestan Province, Southwestern Iran, 2016-2017

Family	Species	Number of captured (%)	Sex		Sex ratio (male/female)
			Male, *n* (%)	Female, *n* (%)	
Buthidae C. L. Koch, 1837	*Androctonus crassicauda*	366 (50.9)	152 (41.5)	214 (58.5)	1:1.4
	Mesobuthus phillipsii	205 (28.5)	101 (49.3)	104 (50.7)	1:1.03
	Compsobuthus matthiesseni	6 (0.8)	1 (16.7)	5 (83.3)	1:5
	Orthochirus iranus	9 (1.2)	4 (44.4)	5 (55.6)	1:1.3
	Apistobuthus susanae	4 (0.6)	1 (25)	3 (75)	1:3
	Razianus zarudnyi	2 (0.3)	1 (50)	1 (50)	1:1
	Buthacus macocentrus	2 (0.3)	1 (50)	1 (50)	1:1
Scorpionidae Latreille, 1802	*Scorpio maurus*	2 (0.3)	1 (50)	1 (50)	1:1
Hemiscorpiidae Pocock, 1893	*Hemiscorpius lepturus*	123 (17.1)	58 (47.1)	65 (52.9)	1:1.1
Total		719 (100)	320 (44.5)	399 (55.5)	1:1.2

Table 2: Distribution of scorpion frequency by month, Bavi County, Khuzestan Province, Southwestern Iran, 2016-2017

Month	*n* (%)
April	63 (8.8)
May	89 (12.4)
June	96 (13.3)
July	116 (16.1)
August	140 (19.5)
September	173 (24.1)
October	17 (2.4)
November	6 (0.8)
December	0
January	0
February	0
March	19 (2.6)
Total	719 (100)

Table 3: Distribution of scorpion frequency captured by environment, Bavi County, Khuzestan Province, Southwestern Iran, 2016-2017

Type of environment	*n* (%)
Animal husbandry	144 (20)
Abandoned site	138 (19.2)
Construction debris	103 (14.3)
Palm farm	73 (10.2)
Cracks in the building	98 (13.6)
Plant debris	37 (5.1)
Home warehouse	37 (5.1)
Garden-Orchard	35 (4.9)
Courtyard	30 (4.2)
Inside the house	20 (2.8)
Sandy ground	4 (0.6)

abandoned site (19.2%) [Table 3]. Most *H. lepturus* specimens were caught in the abandoned sites (29.2%) and construction debris (23.6%). Furthermore maximum *A. crassicauda* samples were collected in the animal husbandry (30.3%) and wall cracks around the houses (16.9%). *M. phillipsii* was captured more in the palm farms (22%) and abandoned sites (21%). The most abundant scorpions were caught from Geisovan (*n* = 85, 11.8%), Khit-Rovas (*n* = 82, 11.6%), Amashie (*n* = 67, 9.3%), Sardahi (*n* = 65, 9.1%), Khavar (*n* = 63, 8.8%), Telbomeh (*n* = 60, 8.3%), Marashi (*n* = 61, 8.5%), Rabikhet (*n* = 57, 7.9%), Anafcheh (*n* = 28, 3.9%), Sheri-Meri (*n* = 26, 3.6%), Nadafieh (*n* = 24, 3.3%), Marvaneh (*n* = 22, 3.1%), Shahrak-Ramin (*n* = 19, 2.6%), Gaeideh (*n* = 18, 2.5%), Seyed-Soltan (*n* = 14, 1.9%), Beit-Mahareb (*n* = 14, 1.9%), and Abasieh (*n* = 14, 1.9%), respectively. Based on the capturing technique of scorpions, most of the specimens collected through UV light (*n* = 361, 50.3%), pouring water into the ground pits (*n* = 145, 20.1%), rock rolling (*n* = 132, 18.3%), and ordinary flashlight (*n* = 81, 11.3%), respectively. Regarding the *H. lepturus*, the most specimens were captured through UV light (*n* = 47, 38.2%) and rock rolling (*n* = 35, 28.4%). Maximum *A. crassicauda* ones were collected through UV light (*n* = 187, 51.1%) and rock rolling (*n* = 70, 19.2%). In the case of the *M. phillipsii*, the largest samples were hunted through UV light (*n* = 104, 50.7%) and pouring water into the ground holes (*n* = 54, 26.3%). *C. matthiesseni*, *O. iranus*, *A. susanae*, *R. zarudnyi,* and *B. macrocentrus* were caught only through UV light. *S. maurus* was hunted only by pouring water into the ground holes.

Discussion

The investigated regions had rich scorpion fauna due to different habitats and topography sites. In the current study, a total of 719 specimens were collected mostly from rural areas, among which nine species were identified: *A. crassicauda*, *H. lepturus*, *M. phillipsii*, *C. matthiesseni*, *O. iranus*, *A. susanae*, *R. zarudnyi*, *B. macrocentrus,* and *S. maurus*, respectively, by relative frequency. Despite the low surface of the county, such various species display a rich scorpion fauna that reveals suitable habitats of scorpions. In our study, *A. crassicauda* and *H. lepturus* two venomous scorpions were collected with the most frequency and regarded as the most deadly important scorpion species in this area. Meanwhile,

M. eupeus is medically significant and is one of the six most significant scorpion species in Iran, which manufactures antivenom versus its venom for the treatment of scorpion envenomation. The Nejati *et al*.'s study, seven scorpion species, were collected from Iranian central desert, including *M. eupeus*, *A. crassicauda*, *O. doriae* (Thorell 1876), *Odontobuthus odontobotus*, *Hottentotta* (*Buthotus*) *saulcyi* (Simon, 1828), *Orthochirus scrobiculosus* (Grube, 1873), and *C. matthiesseni*. *M. eupeus* had the most frequency (62%), followed by *A. crassicauda* (36%).[16] In Sharifinia *et al*.'s study in Ilam Province (southwestern Iran), out of the 391 collected scorpions, 11 species were identified as follows: *H. saulcyi*, *M. eupeus*, *C. matthiesseni*, *R. zarudnyi*, *H. lepturus*, *A. crassicauda*, *O. iranus*, *Odontobuthus bidentatus* (Lourenço and Pézier, 2002), *B. macrocentrus*, *S. maurus*, and *Polisius persicus* (Fet, Capes, and Sissom, 2001). The most abundant species were *H. saulcyi* (25.09%), *M. eupeus* (23.29%), and *C. matthiesseni* (16.18%).[6] In Mansouri *et al*.'s study in Ahvaz city, Khuzestan Province, which is located in the North of Bavi County at a distance of 10 kilometers, 237 scorpions were collected and identified including, *M. eupeus* (65%), *H. lepturus* (23.2%), *A. crassicauda* (3.8%), *Compsobuthus rugosulus* (Pocock, 1900) (3.4%), *Orthochirus zagrosensis* (Kovařík, 2004) (2.5%), *A. susanae* (1.7%), and *B. macrocentrus* (0.4%).[17] In the mentioned study, they could not collect *O. iranus*, *R. zarudnyi,* and *S. maurus*. On the other hand, in our study, we could not capture *O. zagrosensis* and *C. rugosulus*. *A. crassicauda* and *H. lepturus* are the most deadly scorpions, especially in Khuzestan Province. These species are captured in the Southwest and South of Iran plenty, and their stings cause many injuries greatly in children.[7,18] *A. crassicauda* is responsible for 41% stings in Khuzestan Province.[19] In Dehghani *et al*.'s study in Khuzestan Province (Southwestern Iran), six different species were collected *H. lepturus* (60.4%), *M. phillipsi* (21.5%), *A. crassicauda* (8.2%), *C. matthiesseni* (4.8%), *O. iranus* (3.6%), and *S. maurus* (1.5%), respectively.[20] They could not capture *A. susanae*, *R. zarudnyi,* and *B. macrocentrus*. In Zakho Province of Northern Iraq, *S. maurus* (55%), *H. saulcyi* (33%), and *A. crassicauda* (12%) were collected and identified.[21] The cause for this disagreement might be for the reason weather-related and ecological factors.

This study showed that females of captured scorpions were more prevalent than males. Female and male scorpions comprised 55.5% and 44.5%, respectively. In Nejati *et al*.'s study, most of the collected specimens were female (60.77%) than male (39.23%).[16] The result of the present study was the same as other studies.[7,8,22,23] Because pregnant female scorpions need more food to feed their offspring, as a result, they are more active and more hunted. Opposite finding was revealed in the study by Mogaddam *et al*., where the majority of scorpions caught were male (53.3%).[24]

A study on the monthly activity of scorpions displayed that their maximum activity was in September and August, respectively. The results in various regions revealed that the activity of scorpions starts s in March and gets its peak mobility in September and inchmeal from October, their mobility steps down. The maximum of the scorpion activity was observed in the summer. The highest and lowest abundance of scorpions in Darmian County (Eastern Iran) was in May (13.9%) and January (2.8%), and also, the beginning of the activity of scorpions was from April.[24] In Kassiri *et al*.'s study, the largest of specimens was collected in the summer season (43.3%). In addition, scorpions had their most duration of movement in July (15.9%), August (15.9%), and May (12.7%), respectively.[7] The correlation between environmental conditions and scorpion activity was one of the important findings of this study. Low temperatures in the cold season reduce the activity of scorpions, but as the weather warms, the activity of scorpions gradually increases.

In this study, most of the captured specimens belonged to animal husbandry (20%) and abandoned sites (19.2%). In Kassiri *et al*.'s study, the frequency distribution of the collected scorpions by the environment type showed that 79.1%, 10.8%, 9.5%, 6.7%, 1.5%, and 0.4% were captured in low land, mountain, around the building, abandoned place, inside house, and dooryard, respectively.[7] In Nejati *et al*.'s study, maximum of the captured specimens belonged to indoors, yards, around the houses, and warehouses.[16]

In the current study, most of the specimens were collected through UV lamp (50.3%), pouring water into the ground pits (20.1%), rock rolling (18.3%), and ordinary flashlight (11.3%), respectively. In Dehghani *et al*.'s study, different scorpion species were hunted using various methods: rock rolling (53.7%), destruction of dry mud wall on the edge of channels (19.7%), old mud walls destruction (13.6%), blacklight (11.5%), and scorpion nest digging (1.5%).[20] In Shahi *et al*.'s study, collecting of scorpions was performed during night with UV light and during the daytime from under the rocks and branches of dry trees.[25] In Mansouri *et al*.'s investigation, scorpion sampling was done by various methods, such as UV light, pitfall trap, and wet bags, and a total of 237 specimens were collected.[17]

The limitations and strengths of this study were

The relatively small number of collected samples and the impossibility of collecting samples from all areas of the county were the limitations of this study. The strengths of the research included sampling in all seasons and by four methods. The highlight of this study was the rich fauna of scorpions in the area.

Conclusion

Despite the small size of the region, a diverse and rich fauna was seen, compared to other different counties of Iran. Such a geographical spread may be influenced by their habitat, global warming, and climate changes. A survey for assessment of peoples' knowledge on prevention methods of scorpion sting and the determination of effective factors on reducing the length of time spent between scorpion stings and taking medical care is recommended.

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Conflicts of interest

There are no conflicts of interest.

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