

Study on Distribution of Scorpions to Provide Prevention and Interventions in Combating Scorpionism in Poldokhtar County, Lorestan Province, Iran

MANSOUR NAZARI¹, HASSAN RASTGAR²

ABSTRACT

Introduction: Scorpions are arthropods of medical importance classified in the class Arachnida, inhabiting hot and dry environments. All scorpions have a venomous sting and several thousand people die each year from scorpion stings, but this mortality is due to the venom of about 25 species located in northern Africa, the Middle East, India, Mexico and parts of South America. Poldokhtar County belongs to one of the southern cities of Lorestan Province, providing suitable habitats for many different species of scorpions due to its specific climatic conditions.

Aim: To examine the fauna of scorpion and its distribution in the Poldokhtar County and to provide appropriate preventive and medical interventions in combating scorpionism.

Materials and Methods: This present study was a descriptive and analytical cross-sectional study. This study was conducted from April 2014 to November 2014 in regions of Poldokhtar County, Lorestan Province, and west of Iran. Cluster sampling methodology was employed in the sampling and scorpion collection procedure. Sampling was undertaken for an eight-month period, in villages and districts, namely, Myankuhe sharqi, Jayedar, Jelogir and Malavi within the county. The Chi-square

test and the Fisher-exact test for homogeneity of proportions were used to compare quantitative variables.

Results: Totally, 393 specimens were captured entailing 193 (49.1%) males and 200 (50.9%) females. There were at least seven species of scorpions belonging to three families; BU= Buthidae, HE = Hemiscorpidae, SCN = Scorpionidae in Poldokhtar. Out of 393 collected scorpions, seven species, *Androctonus crassicauda*, *Hottentotta (Buthotus) saulcyi*, *Compsobuthus matthiesseni*, *Compsobuthus rugosulus*, *Orthochirus scrobiculosus*, *Scorpio maurus* and *Hemiscorpis lepturus* were identified. The overall sex ratio of females to males was 1:1.03.

Conclusion: It is crucial to improve the knowledge of residents in this region regarding preventive methods towards scorpion stinging. All the known dangerous Iranian scorpions having medical importance, including *Hemiscorpis lepturus* and *Androctonus crassicauda* were found in the study area. Additionally, other complementary research detailing the fauna of scorpions and their morphological, ecological and molecular variety in this region is highly recommended to estimate the correlation between particular scorpions' species and ensuring clinical signs and symptoms.

Keywords: Buthidae, Faunistic, Hemiscorpidae

INTRODUCTION

Scorpions are arthropods of medical importance classified in the Class Arachnida, inhabiting hot and dry environments. All scorpions have a venomous sting and several thousand people die each year from scorpion stings, but this mortality is due to the venom of about 25 species located in northern Africa, the Middle East, India, Mexico and parts of South America [1,2].

The dangerous consequences of the scorpion stings comprised the severe and lethal haemolysis, acute renal failure, deep necrotic wound, severe joint inflammation, temporary and permanent psychosis and death. The highest mortality due to scorpion stings are associated with *Hemiscorpis lepturus* (Peters, 1861) in Iran [3].

Scorpions are terrestrial arthropods exhibiting a non-social and nocturnal habit, in which their existence dates back to over 360 million years ago, during the Silurian era [4-6]. As a result, they have acquired various degrees of adaptations to different ecological conditions in the course of their natural histories [6,7]. Scorpions are arthropods of medical importance classified in the Class Arachnida, inhabiting in hot and dry environments [8]. Geographically, scorpion distribution ranges from tropical to temperate regions, including deserts, savannas, tropical forests, mountains exceeding 5500 m high in altitude and the intertidal zone [2,9].

Scorpions normally appear after sunset, are hidden during the day under rocks or within burrows [10]. Number of scorpion have potent venomous stinging characteristics, but do not serve as reservoirs or vector of disease [10,11].

Significantly, numerous studies have described the persistent severity of scorpion envenomation, predominantly in the Central and Southern America, North Africa, the Middle East and Southwestern Asia [11,12]. Remarkably, over 2000 scorpion species have been described and identified [13].

Primarily, scorpion fauna in Iran was first explored by Olivier and he identified the black scorpion, *Androctonus crassicauda*, in Kashan [8]. Following this, other profound investigators, including a Russian zoologist, Alexei Andreevich Bialynitskii-Birulya, have published a vast number of reports detailing the presence of scorpions in Iran [14-16]. According to well-established scientific reports, there are a minimum of 51 species of scorpions in Iran, belonging to 18 genera and 4 families namely Diplocentridae, Scorpionidae, Hemiscorpidae and Buthidae [15-17].

Annually, it is estimated that nearly 40000-50000 people are stung by different species of scorpions in Iran [18,19]. The three main species of scorpions with economic importance as a result of their severe envenomation include *M. eupeus*, *A. crassicauda* and *Hemiscorpis lepturus*. However, other species of

secondary importance encompass *Hottentota (Buthotus) saulcyi*, *Odontobuthus doriae*, *Olivierus (Mesobuthus) caucasicus* and *Apistobuthus pterygosercus* [20].

Clinical symptoms designating scorpion sting cases include, but not limited to, tachypnea, tachycardia, hemolysis, pulmonary edema, agitation, intensive local pain, necrosis and sweating [21]. Children are the most vulnerable group of people in situations of severe scorpion envenomation and this has given rise to a greater number of deaths in this age group [22].

The absence of epidemiological data on scorpion fauna and scorpionism has led to the failure of most control strategies for different species of scorpion, because habitat of scorpions is different such as digger scorpions, half-digger scorpions and non-digger scorpions.

Poldokhtar County belongs to one of the southern cities of Lorestan Province, providing suitable habitats for many different species of scorpions due to its specific climatic conditions and there are many reports of scorpion stings in this area [17]. In spite of this, no general and extensive study regarding scorpions has been conducted so far within the city.

This present study aimed to examine the fauna of scorpion and its distribution in the Poldokhtar County. In effect, this has a long term strategic plan for the reduction and elimination of scorpion sting cases among the susceptible residents of these regions.

MATERIALS AND METHODS

Study Area

This present study was a descriptive and analytical cross-sectional study conducted from April to November 2014 in regions of Poldokhtar County, Lorestan Province, and Western Iran. Poldokhtar County belongs to geographic coordinates of 33°10' North and 48°00' East [Table/Fig-1]. Poldokhtar has been designated as the capital city of the county. As at 2014 population census, Poldokhtar County has accommodated closely 86,693 inhabitants, including 20,508 families. The county is subdivided into two districts and two cities; the Central District, with its city of Poldokhtar, and the Mamulan district enclosing the Mamulan city.

Sampling and Scorpion Collection

Cluster sampling methodology was employed in the sampling and scorpion collection procedure. Scorpions were collected by researchers and indigenous people. Sampling was undertaken for an eight-month period, in villages and districts, namely, Myankuhe sharqi, Jayedar, Jelogir and Malavi within the county.

Collection of scorpions was done at night and examined using the Ultra Violet (UV) light [Table/Fig-2], holding it at an interval of about 20 cm from the ground, on brick walls or muddy walls. Meanwhile, during the day, scorpions were collected via digging, rock-rolling, searching of gaps in backyard gardens near houses, pouring water in holes, searching lower sections of tree trunks and pulling down ancient walls. Scorpions were eventually gathered by using the forceps, and then transferred to the laboratory in separate glass containers containing 70% alcohol [Table/Fig-3]. Necessary data concerning the scorpions, which include the place of abode and date of collection, were recorded.

Scorpion Species Identification

Morphological identification was finalized following observation under a stereo microscope using specific diagnostic keys. The Iranian scorpion species were identified by conforming to the Farzanpay's key of identification [8,17]. The basis of identification in these keys are the comparison between the morphological features of scorpions, such as the number of eyes, the sternum figure, tongs forms, the number and pattern of granules on the body, color and

etc. The genera of scorpions were identified by the position of shoulder taps and the number of teeth.

STATISTICAL ANALYSIS

The Chi-square test and the Fisher-exact test for homogeneity of proportions were used to compare quantitative variables. Confidence intervals (CI) of 95% for prevalence were determined. The statistical analysis was conducted with SPSS (ver. 20) statistical software. The p-values of 0.05 or less were considered statistically significant.

RESULTS

Totally, 393 specimens were captured entailing 193 (49.1%) males and 200 (50.9%) females. There were at least seven species of scorpions belonging to three families; BU=Buthidae, HE=Hemiscorpiidae, SCN=Scorpionidae in Poldokhtar. Out of 393 collected scorpions, seven species, *Androctonus crassicauda*, *Hottentotta (Buthotus) saulcyi*, *Compsobuthus matthiessen*, *Compsobuthus rugosulus*, *Orthochirus scrobiculosus*, *Scorpio maurus* and *Hemiscorpius lepturus* were identified [Table/Fig-4,5] [23].

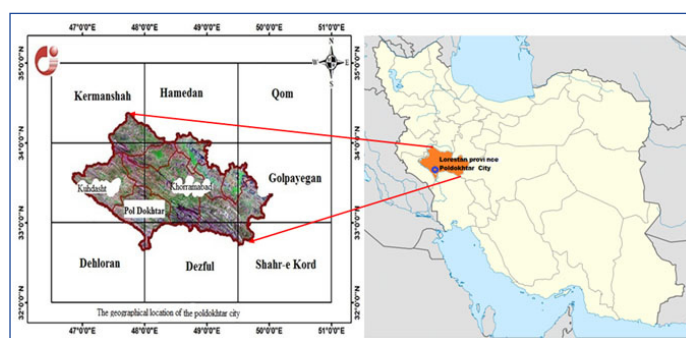
Buthotus saulcyi, consisting of 143 (36.4%) scorpions, was the most frequently recorded and dominant species. In contrast, *Compsobuthus matthiessen*, involving 3 (0.8%) scorpions, had the least frequency ($p < 0.01$, $\chi^2 = 368$, 11, df=6). The overall sex ratio of females to males was 1:1.03.

Sixty nine hunted scorpions (17.5%) recorded from the Sarab Hamam area had the highest frequency, and records from the Sarab Abdolali with 13 hunted scorpions (3.3%) had the lowest frequency [Table/Fig-6]. The frequencies of captured scorpions were in the villages of Sarab Hamam (69, 17.5%), Valiasr (19, 4.8%), Chalkal (27, 6.9%), Chamgaz (24, 6.1%), Absard (20, 5.1%), Dadagolab (14, 3.5%), Sarab Abdolali (13, 3.3%), Dareh Shoor (40, 10.2%), Bagh Golgol (53, 13.5%), Golgol (29, 7.4%), Chamgardeleh (51, 13%), and Meidan (34, 8.7%), respectively. The variation between the absolute and relative frequencies of captured scorpions in Poldokhtar in terms of species richness in the regions under study in 2014 was statistically significant ($p < 0.01$, $\chi^2 = 375$, 55, df=66).

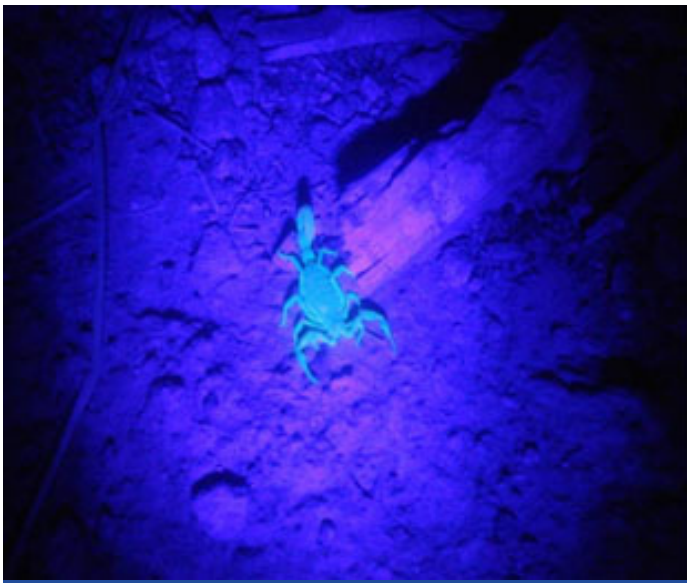
The highest and the lowest frequencies of the hunted scorpions were 87 (22.1%) in August and 14 (3.5%) in November, respectively [Table/Fig-7]. There was statistically significant difference between months of scorpion collection in Poldokhtar in 2014, ($p < 0.01$, $\chi^2 = 73$, 13, df=42).

DISCUSSION

Scorpion envenomation commonly occurs in the tropical and sub-tropical regions, as a challenging medical situation in Iran [12,24]. Scorpionism remains a serious health problem in several southern parts of Iran. Iran, with nearly 10 venomous scorpion species, has the largest number of scorpions among other Middle Eastern countries [10,13,15]. This research demonstrated a wide diversity of scorpion species in the Poldokhtar County, consisting of three families of



[Table/Fig-1]: Location of study area in Poldokhtar County, Lorestan Province, western Iran [1].
<https://www.alltravels.com/iran/lorestan/pol-dokhtar/maps>



[Table/Fig-2]: Hunted scorpions under ultraviolet light (by Rastgar H.).



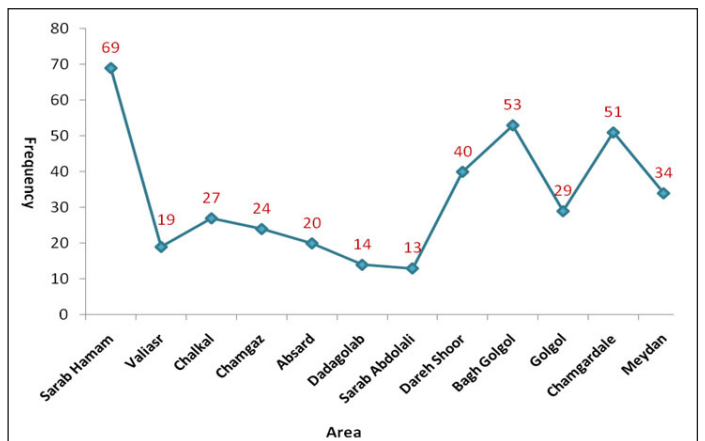
[Table/Fig-3]: Glass storage collected of scorpions.

Family	Species	Sex No. (%)		Total No. (%)
		Male No. (%)	Female No. (%)	
Buthidae (C.L. Koch, 1837)	<i>H. saulcyi</i>	69 (48.3)	74 (51.7)	143 (36.4)
	<i>A. crassicauda</i>	27 (48.2)	29 (51.8)	56 (14.2)
	<i>O. scrobiculosus</i>	8 (57.1)	6 (42.9)	14 (3.6)
	<i>C. matthiesseni</i>	2 (66.7)	1 (33.3)	3 (0.8)
	<i>C. rugulosus</i>	7 (43.8)	9 (56.2)	16 (4.1)
Scorpionidae (Latreille, 1802)	<i>S. maurus</i>	65 (48.5)	69 (51.5)	134 (34.1)
Hemiscorpiidae (Pocock, 1893)	<i>H. lepturus</i>	15 (55.6)	12 (44.4)	27 (6.9)
Total		193 (49.1)	200 (50.9)	393 (100)

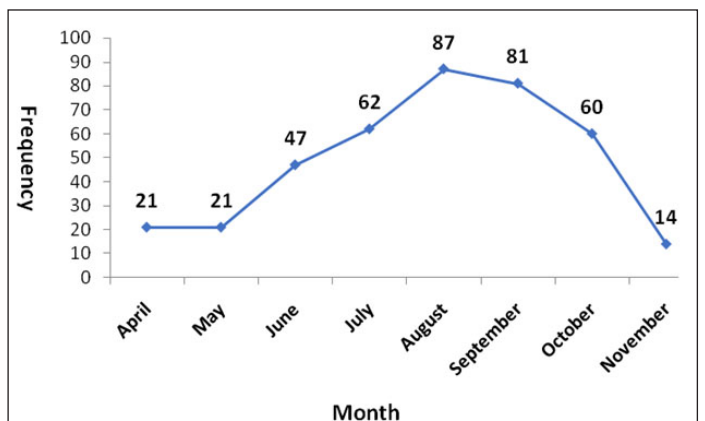
[Table/Fig-4]: The abundance of captured scorpions according to family, species and sex in Poldokhtar County, western Iran (2014). Family and species same as mentioned by Kassiri et al [23].



[Table/Fig-5]: Morphological characters of scorpions (dorsal view) captured in Poldokhtar County, western Iran (2014): (A) *Hottentota* (Buthotus) *saulcyi*; (B) *Androctonus crassicauda*; (C) *Orthochirus scrobiculosus*; (D) *Compsobuthus matthiesseni*; (E) *Compsobuthus rugulosus*; (F) *Scorpio maurus*; (G) *Hemiscorpius lepturus*; (Original photos by H. Rastgar).



[Table/Fig-6]: Distribution of scorpion species in different major areas of Poldokhtar County, western Iran 2014.



[Table/Fig-7]: Monthly fluctuation of the scorpions found in Poldokhtar County, western Iran (2014).

scorpions, namely, BU, HE, SCN with at least seven species and subspecies. According to current study, *Androctonus crassicauda* (Olivier, 1807), *Hottentotta saulcyi* (Simon, 1880), *Compsobuthus matthiesseni* (Birula, 1905), *Compsobuthus rugulosus* (Pocock, 1900), *Orthochirus scrobiculosus* (Grube, 1873), *Scorpio maurus* (Pocock, 1900) and *Hemiscorpius lepturus* (Peters, 1861) have been reported from Poldokhtar County [8].

Survey of Nazari et al., showed that in Hamadan 4 species of scorpion named *Mesobuthus eupeus* (89.7%), *Androctonus*

crassicauda (4.08%), *Odontobuthus doriae* (5.1%) and *Razianus zarudnyi* (1.02%) (Family: Buthidae), were identified [24]. Also, Nazari and Hajizadeh were captured 4 species of scorpion from different

areas of Bam belonged to the Buthidea family, namely *Mesobuthus eupeus* (73.1%), *Orthochirus zagrosensis* (23.8%), *Androctonus crassicauda* (1.8%) and *Compsobuthus kaftani* (1.3%) [19].

In the study of Navidpour et al., 18 species of scorpions belonging to three families from the Fars Province of Iran have reported as follows: *Androctonus crassicauda*, *Compsobuthus persicus*, *C. matthiesseni*, *Compsobuthus petrioli*, *Hottentotta saulcyi*, *Hottentotta schach*, *Hottentotta zagrosensis*, *Iranobuthus krali*, *Mesobuthus eupeus persicus*, *Mesobuthus phillipsii*, *Odontobuthus bidentatus*, *O. doriae*, *Orthochirus farzanpayi*, *Orthochirus zagrosensis*, *Razianus zarudnyi*, *S. maurus townsendi*, *H. lepturus* and *Hemiscorpius* sp [25].

The *Scorpio maurus* was the first identified and reported species in the city. Previously, some studies, conducted in the Kerman Province, *Androctonus crassicauda* have been discovered and identified, together with other species of *Compsobuthus* and *Orthochirus* [16].

The *Hemiscorpius lepturus*, which is the most dangerous scorpion in southern Iran. Dispersion of this species affected by the type of soil and its humidity, topographic condition and climate. The victim of scorpion sting was stung by *H. lepturus*, while a few were stung by *A. crassicauda*, but in over half of the cases the species was not known in southern and southwestern parts of Iran [3]. In this study, the prevalence of *Hemiscorpius lepturus* was 6.9%. The prevalence of *H. lepturus* in Khuzestan, Kerman, Hormozgan and Ilam provinces were 24.9%, 0.9%, 21.6% and 5.56%, respectively [26-28]. Other studies revealed that *H. lepturus* was responsible for 90% of deaths in the southern provinces of Iran [27,28]. *H. lepturus* also is dangerous species in Iraq, Pakistan and Yemen [29,30].

It must be emphasized that *Buthotus sulcyi*, consisting of 143 (36.4%) scorpions, was considered as the dominant species in the city. These species are more prominent in this area because of its suitable climatic conditions [15,29]. However, *Campsobuthus matthiesseni* (3, 0.8%) was the least recorded species in the county, probably due to their inability to adapt to the climatic conditions of Poldokhtar County.

Females were frequently recorded than their counterpart males with a sex ratio of 1:1.03. Perhaps, males were more obscure and could not be traced and caught during the collection procedure.

Varying records among the different species of scorpions were statistically significant considering the months of the study period, with a noticeable peak in July, and a decline in October. Differences in monthly records of the species were due to seasonal variations. In summer, when the weather is relatively warm, many species of scorpions are active and normally emerge at night in search of food and victims. These results are consistent with the results of other studies performed in Turkey [11] and Saudi Arabia [31], where the highest number of scorpions was recorded in the warmer summer.

Preventive and Medical Interventions in Combating Scorpionism

The control of scorpion must focus on preventing the contact between humans and scorpions and the reduction of the number of scorpions. These can be done through: active search and collect or killing of the scorpions, the use of chemicals, introduction of natural predators, environmental-architectonic measures or, depending the situation, through combinations of the former [32].

The appropriate treatment of scorpion envenoming is argumentative. Some authors do recommend the use of the scorpion antivenom [33-36], while other authors consider that the use of specific antivenom unnecessary [37-40]. However, in a recent study it was demonstrated that the use of antivenom is more effective than the pharmacological treatment alone to treat the envenomation by *Centruroides* [41].

Most of the scorpions in Iran and other parts of the world have

neurotoxic poisons; therefore unrestrained knowledge of Avicenna could be useful for the researchers and physicians in tropical and semitropical areas. According to another study, each patient is treated individually in traditional medicine because their temperament is a mixture of four humors and the balance is different from one person to another [12].

CONCLUSION

It is crucial to improve the knowledge of residents in this region regarding preventive methods towards scorpion stinging. All the known dangerous Iranian scorpions having medical importance, including *H. lepturus* and *Androctonus crassicauda* were found in the study area. Additionally, other complementary research detailing the fauna of scorpions and their morphological, ecological and molecular variety in this region is highly recommended to estimate the correlation between particular scorpions' species and ensuing clinical signs and symptoms. Poldokhtar County, with its tropical and subtropical climate is an endemic foci of scorpionism. Also, this area is relatively undiscovered in terms of scorpion species composition. This research presents novel formal data illustrating scorpion fauna in this vulnerable region.

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PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Medical Entomology, Hamadan University of Medical Sciences, Hamadan, Iran.
2. Student, Department of Medical Entomology, Hamadan University of Medical Sciences, Hamadan, Iran.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Mansour Nazari,
Associate Professor, Department of Medical Entomology, Hamadan University of Medical Sciences, Hamadan, Iran.
E-mail: ynazari@yahoo.com

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