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Research Article

A Study on Litter Size in Several Important Medical Scorpions Species (Arachnida: Scorpionida), I.R. Iran

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Abstract

Background and Objective: Scorpions are considered as one of the most important natural hazards and introduced as a dangerous arthropods. Reproduction is the key factor for survival of any species, then interest has increased in knowing the litter size of a female scorpion species. The aim of present study was to determine the litter size and abundance of newborns in the most important of scorpions in laboratory condition. **Materials and Methods:** In this descriptive study, scorpions which represented six medically important species were collected from their natural habitats in two provinces of Khuzestan and Isfahan of Iran. All females gave birth in laboratory condition. The number of juveniles for each species were counted immediately after newborns were detected. Data analyses were conducted using SPSS for window version 16.0. **Results:** The litter size for *Hemiscorpius lepturus* was 15-31, *Odonthobutus doriae* 10-25, *Mesobuthus eupeus* 14-29, *Androctonus crassicauda* 15-45, *Orthochirus scrobiculosus* 12-21 and *Olivierus caucasicus* 19-23. All parturitions were occurred from late August to mid-October in the laboratory. The findings of the present study indicated that in the laboratory conditions, the litter size for *A. crassicauda* was the most whereas this value for *O. scrobiculosus* was less than the other species. **Conclusion:** It can be concluded that perhaps there is a positive correlation between the maternal female size and the litter size.

Key words: Number of juveniles, dangerous arthropods, litter size, gravid scorpions

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Scorpions are arthropods of medical importance, classified in the Class Arachnida. They have known as animal with poisonous and painful sting. They exist up to 52 latitudes of northern hemisphere and 50 latitudes of southern hemisphere. They are more present in the tropical and subtropical areas. More than 2000 species of scorpion have been identified¹⁻³. A limited number of species, about 50-79 are actually responsible for serious or lethal incidents. Most deadly species belong to the family Buthidae; though, species belonging to two other families, Scorpionidae and Hemiscorpiidae, also threaten humans^{3,4}.

Scorpion sting is the main health concern in some African, Middle Eastern, Eastern and Central American countries⁵⁻¹⁴. More than 1.23 million scorpion stings are occur in the world annually, of which resulting to over 0.27% deaths^{15,16}. Scorpions are common arthropods in urban and rural areas of Iran. The Iranian species have been classified in three families of Buthidae, Scorpionidae and Hemiscorpiidae, comprising of 64 species from 19 genera¹⁷. A few known species of these responsible for severe envenoming and considered medically important¹⁸.

Hemiscorpius lepturus, *Androctonus crassicauda* and *Mesobuthus eupeus* are the scorpions of medical importance in Iran. Whereas *Buthotus schach*, *Odonthobutus doriae*, *Buthotus saulcyi*, *Apistobuthus pterygosercus* and *Olivierus caucasicus* are less important species in this country and their stings have happened sporadically¹⁹⁻²³. About 40000-50000 cases of scorpion sting and a number of deaths has been reported annually in Iran^{24,25}.

Scorpions are viviparous². Two different reproductive strategies are found in female scorpions: the female breeds only a single time during its life (Semelparity) and the other one when the female breeds more than a single time during its lifetime (Iteroparity)²⁶.

In spite of the fact that scorpions are a major public health problem, It knowless about scorpions than other arachnids. Without knowledge of the reproductive biology of scorpions, the other aspects of their life cannot be fully achieved. Litter size is one of the important point of scorpion life which is poorly known. Studies have been shown that the larger females usually produce more broods and have a greater reproductive investment. However this subject do not happen for all species even for populations of a species^{26,27}.

Because of the studies on litter size of scorpion in Iran are rare, the present study was conducted to identify and determine the litter size of these arthropods in laboratory condition.

MATERIALS AND METHODS

In this descriptive study, six important scorpion species were collected from their natural habitats in provinces of Khuzestan and Isfahan. This study was conducted in May, July, August and September during 2014-2016 at the entomology lab of Kashan University of Medical Sciences.

Each sample was collected by three collector in 3 h. The collected scorpions were put in glass containers labeled essential information and delivered to the entomology laboratory of Kashan University of Medical Sciences for an accurate identification of the species using diagnostic keys^{28,29}. Males were separated and excluded of the study. Totally 54 females of different species of scorpions were kept in glass containers separately in the laboratory conditions (27-31 °C) and fed them with the German cockroach, to study their litter size. The gravid scorpions were identified by observing their big bellies. All females gave birth in laboratory condition. The number of living and dead juveniles for each species were counted immediately after parturition. Data analyses were conducted using SPSS for window version 16.0.

RESULTS

The result of present study for 54 females representing six species of scorpion summarized in Table 1. According to presented data the mean litter size of each species was as follow: *H. lepturus* (Fig. 1 and 2), 24.54 ± 2.04 (Mean \pm SD) in 13 delivery, *O. doriae*, 19.33 ± 1.98 in 12 delivery, *M. eupeus* (Fig. 3), 20.25 ± 1.75 in 12 delivery, *A. crassicauda* (Fig. 4), 28.87 ± 2.7 in 8 delivery, *O. scrobiculosus* (Fig. 5 and 6), 16.83 ± 4.13 in 6 delivery and *O. caucasicus*, 20.67 ± 1.75 in 3 delivery (Table 1). According to this data, the litter size of *A. crassicauda* was the most whereas this value for *O. scrobiculosus* was the least.

The first molt, in offsprings for all studied species was observed in the first 10 days after birth while juveniles were carrying by their mother. *Hemiscorpius lepturus* species showed cannibalistic behavior in the laboratory condition. Fifty percent of samples of *H. lepturus* females fed their own juveniles. This phenomenon was not observed among other scorpion species.

Table 1: Litter size of six scorpions of medical importance in Iran

Delivery No.	Litter size of scorpion species					
	<i>Hemiscorpius lepturus</i>	<i>O. doriae</i>	<i>M. eupeus</i>	<i>A. crassicauda</i>	<i>O. scrobiculosus</i>	<i>O. caucasicus</i>
1	23	19	20	26	12	19
2	24	10	23	32	15	23
3	18	21	25	45	18	20
4	27	22	14	15	19	-
5	29	19	29	21	21	-
6	25	25	18	30	16	-
7	15	20	15	27	-	-
8	31	24	17	35	-	-
9	26	23	21	-	-	-
10	19	14	19	-	-	-
11	21	12	22	-	-	-
12	30	23	20	-	-	-
13	31	-	-	-	-	-
Total delivery	13	12	12	8	6	3
Total juveniles	319	232	243	231	101	62
Mean	24.54	19.33	20.25	28.87	16.83	20.67
SD	2.04	1.98	1.75	2.7	4.13	1.75



Fig. 1: Gravid female of *Hemiscorpius lepturus*



Fig. 3: *Mesobuthus eupeus* carrying first instar juveniles



Fig. 2: *Hemiscorpius lepturus* carrying first instar juveniles



Fig. 4: Gravid female of *Androctonus crassicauda*



Fig. 5: Gravid female of *Orthochirus scrobiculosus*



Fig. 6: *Orthochirus scrobiculosus* carrying first instar juveniles

DISCUSSION

The results of the present study indicated that the litter size for different species of scorpions was varied in the laboratory condition. The findings revealed that the litter size for six important scorpion species in the laboratory condition varies from 10-45. While other researcher reported that this value was vary³⁰⁻³² from 6-91. It reported the litter size for different species of scorpions from 6-90 and 20-60 respectively^{28,33}. Studies have been shown that the litter size for different species of scorpion is variable²⁷. The number of larvae born by *A. crassicauda* species was the most whereas this number for *O. scrobiculosus* species was less than the other species. It can be concluded that there is a direct correlation between the female body size of scorpions and increase the litter size.

The significant positive correlation between litter size and female size has been reported in some studies^{30,34}, while Outeda-Jorge *et al.*²⁷ reported that the non-significant correlation between these two variables for *Tityus serelatus* species. However it was observed that bigger females tended to born larger litter but it do not always happen. It may be associated with environmental condition and physiological

structure of female scorpion. Litter size can be decrease in any female scorpion species in the end of their age, because of decrease of their follicles^{35,36}.

In this study all deliveries were occurred from late August to mid-October. It shown that majority of births occurred during warm seasons in south America, (September-April). Most of scorpions give birth during December-March (Summer)²⁷. Opportunistic and *Synantropic scorpions*, are able to deliver their brood throughout the year, thus can increase their population and threaten the human health^{32,37}.

Among the species studied in the present study, only *H. lepturus* showed cannibalistic behavior and fed on their own larvae. Cannibalism can be observed among scorpions. This behavior may be resulting of the laboratory conditions^{26,38}. It can be varied among specific species due to their physical and physiological structures and various environmental condition. It was reported that about 16% of the adults total diet was provided by newborn mortality. Most newborn mortality happen within the first 90 days of their life³⁹. It was observed that a few *Tityus bahiensis* juveniles cannibalized by the female during delivery⁴⁰. Likewise results of a study revealed that 80% of female *Rhopalurus rochai* Borelli, 1910 showed cannibalistic behavior during delivery⁴¹.

For each species, the reproductive rate and the number of newborns should be studied under laboratory conditions. Also, as scorpion nesting behavior is an essential issue in scorpionology, the nesting behaviors of scorpions should be examined. Meanwhile, it is suggested to identify the habitats of scorpions in each region in order to optimize prevention.

CONCLUSION

In small species, the number of newborns per birth was lower in compared with big species. The birth of scorpion newborns in laboratory conditions may not be the same as normal conditions. Therefore, at the same time, the number of newborns in both natural and laboratory conditions should be investigated. Level of knowledge of important aspects of scorpion reproduction is still elementary. For better understanding the scorpion reproduction, doing more experiments for any species are recommended.

SIGNIFICANCE STATEMENT

This study discovered the numbers of newborn of some medical important of scorpions that can be beneficial for future studies. This study will help the researchers to uncover the critical areas of biology of scorpions that many researchers were not able to explore. Thus a new theory on breeding of scorpions may be arrived at.

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