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Burrowing activities of *Scorpio maurus towensendi* (Arachnida: Scorpionida: Scorpionidae) in province of Khouzestan sw Iran

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Abstract
However, burrows provide very important facilities for scorpions, a little knowledge has been established so far regarding burrow habitat. The aim of current study was to describe the burrowing biology of *S. maurus towensendi* in some parts of Khouzestan a south west province of Iran, which is a habitat of this species. This research study was carried out through a particular nest sampling procedure in 12 nesting sites of scorpions of Ahvaz and Shoushtar, sw of Iran. No significant difference was recorded in ratios of dimensions of scorpion borrows in the present study. Findings of the current study indicated that *S. maurus* used same engineering method in excavating their tunnels. The comparison among the ratios of width/height using lower and upper limits of nest dimensions showed no significant different in the way of tunnels during making the nests. This fact explained that similar techniques, using the pedipalps, were applied in nest making by this species.

Keywords: *Scorpio maurus towensendi,* Arachnida, Scorpionida, Scorpionidae, Khouzestan sw Iran.

1. Introduction

Scorpions are terrestrial arthropods with non-social and nocturnal habits which have been living in the earth since 360 million years ago [1-4]. Therefore, they have acquired degrees of various adaptations to different ecological conditions during their natural histories [5].

For example, the majority of scorpions are nocturnal, particularly species inhabiting arid desert regions or a majority of scorpion species are able to make some changes in their places and less able to make their nests through burrowing [6, 7, 4, 8]. Consequently, this group of animals have been concerning in the terms of their ecological, physiological and biochemical adaptations to problematic conditions which found in their habitats. One of these adaptations is the burrowing habit which is a basic approach for their survival regarding understanding the ecology and evolution of many scorpion species. However, burrows provide very important facilities for scorpions such as protection against predation, fire accident and hot arid environment (the lower temperature and evapotranspiration and higher relative humidity below the surface), increased availability of food and escaping from the fire ideal microclimate for their lives, a little knowledge has been established so far regarding burrow habitat [7-9].

There are five burrowing scorpion species in Iran including: *Scorpio maurus* (Scorpionida: Scorpionidae), *Odontobuthus bidentatus, O. doriae, O. odonthodorous and Apistobuthus susanae* (Scorpionida: Buthidae). There is little knowledge of their burrowing activities around the word including Iran [10-12].

Scorpio maurus is seen generally in plains close to wheat fields or in deep holes of deserts. Burrow depth approaching 75 cm has been reported for *S. maurus* in the Sahara Desert [13].

This species is officially recorded in different Iranian provinces such as Khouzestan, Kurdistan, Fars, Azarbaijan, Qazvin, Isfahan and Bushehr [10, 11].

Two controversial suggestions regarding burrowing habits of scorpions have been developed During different research studies of scorpions: 1-burrowing habits by chelicera of scorpions such as, *Opisthophthalmus spp*. 2- burrowing habits by pedipalps of scorpions such as *Scorpio spp* [14]. The majority of scorpions use the first method however they make the borrow by first pair of legs too [14].

The aim of current study was to describe the burrowing biology of *S. maurus towensendi* in some parts of Khouzestan a south west province of Iran, which is a habitat of this species.

2. Material and Methods

2.1 Area of Study

To find about the burrowing activities of *S. maurus towensendi* in Khouzestan province (31.3273°N 48.6940°E), the present study was carried out in two fields of Shushtar (32° 2′ 44″ N, 48° 51′ 24″ E) and Ahvaz (31°19′13″N 48°40′09″E), from May 2011 to April 2013.

Shushtar has a hot semi-arid climate (Köppen climate classification *BSh*) with extremely hot summers and mild winters. Rainfall is almost exclusively confined to the period from November to April, though on occasions it can exceed 250 millimetres (9.8 in) per month or 600 millimetres (24 in) per year. In the summers the temperatures regularly at least 50 °C while in winters the minimum temperature could fall around -9 °C. Average soil texture is recognized as loam and Silt in some area of Shushtar countryside [15].

Ahvaz has a desert climate (Köppen climate classification *BWh*) with long, extremely hot summers and mild, short winters. Ahvaz is consistently one of the hottest cities on the planet during the summer, with summer temperatures regularly at least 45 °C, sometimes Exceeding 50 °C with many sandstorms and dust storms common during the

Summer period while in winters the minimum temperature could fall around 5 °C.

Winters in Ahvaz have no snow. The average annual rainfall, high °C and low °C are 230 mm, 84 32.79 and 17.07, respectively [15]. Average Soil texture is recognized as loam, Sicl-Silt and Sicl in some area of Ahvaz countryside [16].

2.2 Sampling and Trapping

This research study was carried out through a particular nest sampling procedure in 12 nesting sites of scorpions of Ahvaz and Shoushtar.

Firstly, 68 burrows were selected (5-6 burrows per nesting site). Then they were detected to distinguish the active burrows from inactive burrows. Active burrows were clean in contrast to inactive burrows which were covered with fallen leaves and debris.

A molage method using masonry plaster was applied to compute and draw the dimensions of the Nest tunnels. The liquid plaster was poured into the nest through the large opening until it was

Filled.

After 24 h these nests were carefully excavated and their scorpion/s were collected (figure 1) and were transported to the entomology lab of Razi Reference Laboratory of Scorpion Research (RRLS), Dep. of Venomous Animals and Antivenin Production, Razi Vaccine & Serum Research Institute, Karaj, Iran.

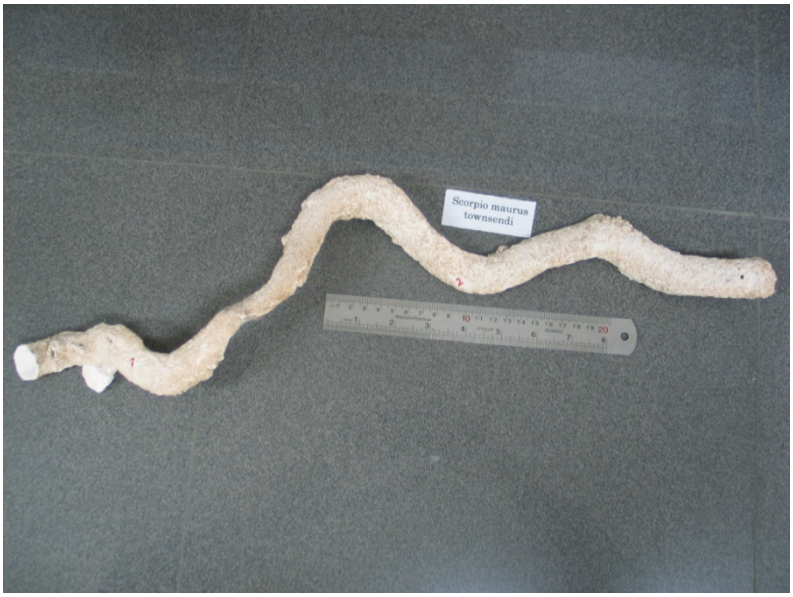

Fig 1: Side view of an elongate (59 cm) helical burrow cast of *Scorpio maurus townsendi.*

(RRLS), Dep. of Venomous Animals and Antivenin Production, Razi Vaccine & Serum Research Institute, Karaj, Iran.

Total burrow length was sum of the length of all of the shafts, tunnels, and chambers. The cross sectional width to height ratio was determined from an average of three tunnel cross sections.

Maximum depth to the bottom of a burrow was measured from a surface opening 103 to the base of the deepest tunnel; for those burrows that reached the base of the enclosure, this value was used as a minimum estimate. Dimensions of the burrows were classified into four parts as computed 4 ratios of width/heigh in the way of tunnels. If the interval limit ratios of each part did not overlap, the different dimensions of the compared parts would be considered significant

3. Results

3.1 Description of Burrow

A total of 20 nests were dissected and dimensions of their characters were recorded. All burrows were remarkably similar to each other.

Scorpio maurus burrow had an oval and round-like entrance. The current study showed that their nests were simple tunnels with a series of turns including more or less sharp slopes in the Way. These tunnels were not constructed with side tunnels or other entrances. The tunnels ended to a straight chamber which were included a scorpion at the peach bottom.

The depths and lengths of *S. maurus* nests were measured as 32.33-47.89 cm and 46.50-64.00 cm

Respectively. No significant difference was recorded in ratios of dimensions of scorpion borrows in the present study. The details of nest dimensions are presented in the table. Field

observations in the current study showd that *S. maurus* scorpions used their peipalps as the major appendages to excavate and make the burrows (figures 1-4).

Table 1: Some measurements (in cm.) of 20 specimens of *Scorpio maurus towensendi* burrows from Khouzestan province, Iran

Architecture	N	Mean	Std.Deviation	Std.Error	Minimum	Maximum
Maximum dept	20	39.65	6.0631	3.3420	32.33	47.89
Total length	20	52.70	7.0852	3.1686	46.50	64.00
Width of surface opening	20	2.3460	0.114	0.051	2.225	2.528
Height of surface opening	20	1.426	0.074	0.033	1.332	1.521
Ratio of W to H of S.O	20	0.164	0.008	0.003	0.180	0.229
Width of first part	20	2.389	0.446	0.199	1.905	3.028
Height of first part	20	1.285	0.232	0.104	1.080	1.647
Ratio of W to H of first part	20	0.185	0.009	0.004	0.017	0.197
Width of second part	20	2.996	0.265	0.118	2.594	3.241
Height of 2nd part	20	1.575	0.140	0.062	1.413	1.788
Ratio of W to H of 2nd part	20	0.190	0.010	0.004	0.178	0.203
Width of third part	20	2.742	0.811	0.363	1.307	3.262
Height of third part	20	1.673	0.146	0.065	1.473	1.840
Ratio of W to H of third part	20	0.164	0.050	0.022	0.102	0.227

Fig 2: Ttypical burrow entrance (about 2.8 cm wide) of *Scorpio maurus townsendi*. (Shushtar locality, Khouzestan-Iran)

Fig 3: section of a burrow (about 45 cm deep) of *Scorpio maurus townsendi*.

Fig 4: Helical burrow cast of *Scorpio maurus townsendi* (about 43 cm deep).

4. Discussion and Conclusion

The burrow is the location for almost all normal activities of burrowing scorpions: birth maternal care, molting, feeding, and even mating. Scorpion burrow construction has been described by numerous researchers [17-26].

Different species use a combination of chelae, chelicerae, legs, and even the tail to loosen and remove soil and to compact burrow walls. *Scorpio maurus* is recognised as a pedipalpal burrowing scorpion and our knowledge is very less regarding this fact. Therefore this study was conducted to open more windows in the terms of this scorpion in Khouzestan province of Iran.

Vazirianzadeh and Tirgari (1989) [27] indicated that Iranian Scorpions are classified into 3 categories of non-burrowing (*Hemiscorpius lepturus*), semi-burrowing (*Mesobuthus eupeus* and *Androctonus crassicauda*) and burrowing scorpions (*S. maurus*, *O. bidentatos* and *O. doriae*) according to the pattern of their nest building habits. This range is referred to anatomical structure of the scorpions and hardness of scorpion soil texture nesting sites [27, 14].

The type of soil texture in the area of this study has been determined as a light class of loam. This is consistent with Rutin study (1996), which explained that the high density of nests was related to the lightness of soil texture [28].

The mean depths of *S. maurus* nests were measured as 39.65 cm in the current study. However, Cloudsley-Thompson (1965); Abdel-Nabi *et al*. (2004); Colak and Karatas (2013), were recorded this measure as 20 cm in Turkey, 20 - 80 cm in Egypt and 75 cm in Sahra, respectively [13, 29, 30].

Findings of the current study indicated that *S. maurus* used same engineering method in excavating their tunnels. The comparison among the ratios of width/height using lower and Upper limits of nest dimensions showed no significant different in the way of tunnels during making the nests. This fact explained that similar techniques, using the pedipaps, were applied in nest making by this species.

Finally, results of present study indicated that *S. maurus* should be an obligate digger scorpion, consequently, because of vast variation of seasonal temperature and relative humidity in Khouzestan province. Humidity varies from 10 to 90% and from 60 °C in deserts during summers to 0 °C in eastern mountainous areas during winters in Khouzestan. Therefore, digging burrow is an important in biological activity of *S. maurus* in Khoozestan as the nests protect this species from adverse effects of climatic variation and so from their predators.

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