Journal of Animal and Veterinary Advances 14 (9): 263-267, 2015
ISSN: 1680-5593

Morphometric Study on Two Different Borrowing Species of Buthidae Scorpions from Khoozestan Province, Iran

[1]M. Ghassemi, [2]A. Dalimi and [3]S.H. Navidpour
[1]Abadan School of Medical Sciences, Abadan, Iran
[2]Department of Parasitology, Faculty of Medical Sciences,
Tarbiat Modares University, Tehran, Iran
[3]Razi Reference Laboratory of Scorpion Research (RRLS),
Razi Vaccine and Serum Research Institute, Karaj, Iran

Abstract: Considering the climate of Iran, the country is so rich with respect to the diversity of scorpions. The highest prevalence of scorpion bite and mortality resulted from it occurs in Khoozestan across the country. The samples of scorpions for this research (*Apistobuthus susanae* and *Odontobuthus bidentatus*) have been collected from different parts of Khoozestan Province (Southwest of Iran) using UV Method. The desired morphological characters were measured with a digital caliper. The data were analyzed using SPSS software (Version 14) with ANOVA and t-test. The result shows significant differences between male and female scorpions in intra-species comparison and between same sexes in inter-species comparison.

Key words: Morphometric, *Apistobuthus susanae*, *Odontobuthus bidentatus*, buthidae, Iran scorpions

INTRODUCTION

Scorpions, scorpionism and human envenomation cases are common in Khoozestan due to its geographical location and climate. This province is located in the Southwest of Iran and borders five other provinces: Lorestan, Ilam, Chahar Mahal and Bakhtiyari, Kohkiloye and Boyer Ahmad, Bushehr and it is limited by the Persian Gulf in the South. Khoozestan is one of the largest provinces of Iran, with 63.236 km^2 of land area. Humidity varies from 10-90% and temperature from 60°C in the deserts during summers to 0°C in eastern mountain areas during winters (Navidpour *et al*., 2008).

According to studies carried out in Khoozestan, the scorpions living in the province belong to three families of Buthidae, Scorpionidae and Hemiscorpiidae. The diversity of scorpions in the province is notable and 19 species of scorpion live in this area, among which one belongs to Scorpionidae, another belongs to Hemiscorpiidae and 17 species are of the Buthidae family (Soleglad and Fet, 2015; Navidpour *et al*., 2008).

Although, scorpions are most diverse in deserts, they also occur in all other terrestrial habitats with the exception of tundra, high-latitude taiga and some high-elevation mountaintops.

Scorpions are not distributed randomly within a habitat. Rather, particular species are normally found in specific microhabitats. Scorpions can be roughly divided into a group that lives on or in the ground and a group that lives in vegetation.

Scorpions that live on plants may hide under bark in tree holes at the base of large leaves and branches or in epiphytes that grow on trees. Some of these species are the “bark scorpions” which may also be associated with dead vegetation, fallen loge and human dwellings.

Ground-dwelling scorpions often build burrows. They also live in crevices and under rocks, logs and other surface debris including vegetation litter. They often improve the quality of these natural retreats by digging scrapes or small chambers beneath them. Some may live in burrows made by other animals.

Some scorpions called burrowing scorpions dig tunnels underground to make their nests. These tunnels protect the scorpion against predators and unfavorable environmental conditions. This is an adaptive behavior, developed in many arthropods living in deserts. The mechanism protects them against warmth and dryness, moderates the effect of climate changes and saves the organism in the unfavorable environmental condition (Pyke, 1984).

Since, the habitat condition is the most significant factor in the geographical distribution of scorpions (Prendini, 2001), so, the scorpions are categorized into the following main groups according to their dwelling

Corresponding Author: M. Ghassemi, Abadan School of Medical Sciences, Abadan, Iran

behaviors: Psammophilous or sand-dwelling scorpions; Pelophilous; Lithophilous; Corticolous and Lapidicolous (Hadley, 1974; Polis 1990; Fet *et al*., 1998, 2001; Prendini 2001).

The main objective of the present research to study morphometric characters of two different borrowings species of Buthidae scorpions from Khoozestan Province. Many different characteristics can be evaluated in morphometric studies. Therefore, considering the objectives and limitations of the study, we studied the characteristics that are useful in determining the similarities and differences of the scorpion species evaluated in the study.

MATERIALS AND METHODS

In the present study, two burrowing species of Buthidae scorpions living in Khoozestan province, namely *Apistobuthus susanae* and *Odontobuthus bidentatus* were collected using UV light at night.

The samples were kept in alcohol 70% and were transferred to the Razi Reference Laboratory of Scorpion Research.

The characteristics selected in the present work were chosen according to Stahnke (1970) and were measured by a 15 cm digital caliper with an accuracy of 0.2 mm (±0.02) and a stereomicroscope equipped with a scaled optical lens (W10×0.25).

Pocock statistical method was used to determine the sample size. Pectin length was chosen as the reference characteristic, using the data reported by Ozkan. The variance and mean values of 1.05 and 8.63 for the first population and 1.26 and 7.5 for the second population were respectively obtained with $\alpha = 0.05$ and $\beta = 0.5$. Based on these estimations, the sample size determined to be 8.2 for each group.

Choosing the appropriate statistical test is dependent on the number of groups under study and normality or abnormality of the data. In order to investigate the data normality, the KS test of SPSS software was used and according to the test, all data were found normal. Since, all variables were normally distributed, parametric methods (one-way ANOVA and t-test) have utilized. Level of significance was considered to be 0.005 and the null Hypothesis (H_0) for each characteristic was defined significantly.

RESULTS AND DISCUSSION

Table 1 and 2 demonstrate the results of measurements, with regard to sex and species. According to the results, the two scorpion species under study were significantly different in the body length and telson length. It should be noted that the species under study were also significantly different with regard to femur length-width ratio and patella length-width ratio. Some of the descriptions were found slightly different from what was reported by different observers (Fig. 1-4).

Apistobuthus susanae can be easily diagnosed by their disc-shaped second metasoma. The body is light yellow ochre, pedipalps and legs are light yellow, denticles of chelicerae, pedipalps fingers, telson and sometimes the interocular triangle are brown. These scorpions are Psammophilous and make their nests in sandy deserts.

Table 1: Different parameter measurements of male and female of *Apistobuthus susanae* Collected from Khoozestan

Apistobuthus susanae	♀			♂		
Parameters	N	X	±SD	N	X	±SD
Total length	10	90.8520000	8.926700	10	84.230000	6.120000
Chelicerae length/width	10	5.33/2.950	0.49/0.30	10	5.28/2.55	1.06/0.19
Carapace length	10	9.9880000	1.051900	10	9.264000	0.821000
Carapace anterior/posterior width	10	6.29/11.29	0.65/1.19	10	5.55/9.94	0.50/0.95
Distance between median eyes and the anterior margin of the Carapace	10	4.5440000	0.520500	10	4.162000	0.402020
Trochanter length/width	10	5.23/3.38	0.62/0.38	10	4.82/2.96	0.49/0.39
Femur length/width	10	10.18/2.56	1.05/0.32	10	9.33/2.40	0.86/0.38
Patella length/width	10	11.22/2.93	1.09/0.32	10	10.36/2.66	1.00/0.24
Chela length/width	10	20.53/4.12	2.11/0.56	10	18.89/3.86	1.87/0.49
Manus length	10	7.090000	0.760000	10	6.540000	0.840000
Moveable finger length	10	15.730000	1.600000	10	14.355000	1.380000
Metasomal Seg. I length/width	10	7.17/7.18	0.68/0.85	10	6.77/6.86	0.70/0.92
Metasomal Seg. II length/width	10	8.79/9.65	83/1.080000	10	8.10/9.07	0.88/1.14
Metasomal Seg. III length/width	10	8.64/6.07	0.83/0.80	10	8.14/5.94	0.79/0.82
Metasomal Seg. IV length/width	10	9.38/4.43	0.93/0.52	10	8.87/4.20	0.93/0.53
Metasomal Seg. V length/width	10	11.01/4.36	1.09/0.35	10	10.36/4.10	0.95/0.51
Telson length/width	10	9.93/4.06	0.97/0.47	10	9.10/3.82	0.84/0.47
Pectin length	10	8.310000	1.070000	10	11.680000	2.200000

Table 2: Different parameter measurements of male and female of *Odontobuthus bidentatus* collected from Khoozestan

Odontobuthus bidentatus	♀			♂		
Parameters	N	X	±SD	N	X	±SD
Total length	10	77.13	5.08	10	70.42	2.41
Chelicerae length/width	10	5.08/2.81	0.29/0.11	10	4.59/2.41	0.30/0.16
Carapace length	10	9.42	0.43	10	8.48	0.41
Carapace anterior/posterior width	10	5.69/10.40	0.23/0.43	10	4.95/9.00	0.20/0.38
Distance between median eyes and the anterior margin of the Carapace	10	4.26	0.20	10	3.71	0.22
Trochanter length/width	10	4.79/3.06	0.27/0.08	10	4.25/2.66	0.20/0.17 10
Femur length/width	10	7.79/2.39	0.34/0.16	10	7.19/2.02	0.73/0.26
Patella length/width	10	8.79/2.94	0.33/0.16	10	7.92/2.50	0.63/0.22
Chela length/width	10	16.72/3.90	0.56/0.26	10	14.75/3.46	0.85/0.37
Manus length	10	6.90	0.46	10	6.38	0.57
Moveable finger length	10	11.84	0.46	10	10.30	0.61
Metasomal Seg. I length/width	10	5.77/5.92	0.28/0.29	10	5.20/5.23	0.55/0.32
Metasomal Seg. II length/width	10	6.54/5.32	0.42/0.26	10	5.95/4.74	0.56/0.34
Metasomal Seg. III length/width	10	6.76/4.91	0.32/0.38	10	6.28/4.32	0.55/0.28
Metasomal Seg. IV length/width	10	8.34/4.53	0.44/0.19	10	7.69/4.01	0.78/0.17
Metasomal Seg. V length/width	10	9.64/5.03	0.57/0.30	10	8.83/4.03	0.71/0.35
Telson length/width	10	8.94/4.37	0.53/0.20	10	7.86/3.75	0.41/0.22
Pectin length	10	7.98	0.43	10	8.12	0.86

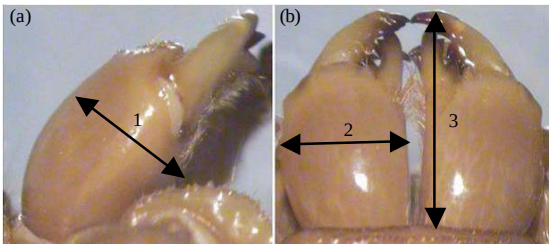

Fig. 1: Chelicerae (*Apistobuthus susanae*); a) lateral view; b) Dorsal view; 1) Height; 2) Width; 3) Length

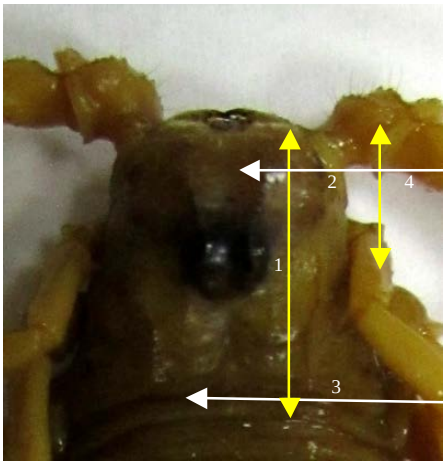

Fig. 2: Carapace (*Apistobuthus susanae*): 1) Length; 2) Anterior width; 3) Posterior width; 4) Distance between median eyes and anterior margin of the carapace

In its adult form, *Odontobuthus bidentatus* is not longer than 5 cm. It is of dark yellow, its ocular tubercle

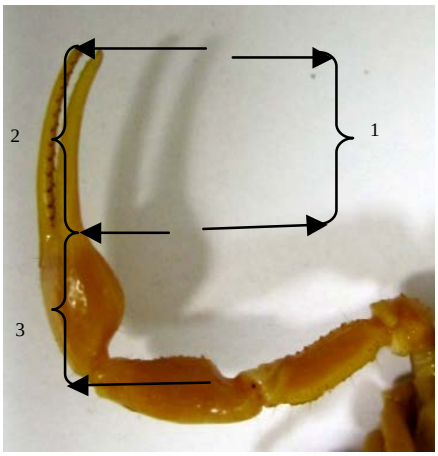

Fig. 3: Pedipalp (*Odontobuthus bidentatus*): 1) Fixed finger length; 2) Movable finger length; 3) Manus length

and the end of its telson is dark and its legs are light yellow. The species is also Psammophilous but makes its nests on substrates harder than that used by *Apistobuthus susanae*.

In the two species, all significantly different characteristics could be morphologically useful in the differentiation of the species. Nevertheless, when our goal is to differentiate the male and female of the species, carapace dorsal width and trochanter width are important; since male and female of the two species were significantly different in these two characteristics and also the two species were significantly different in these respects. In this regard, chela length-width ratio has the least significance; since, although there is a significant

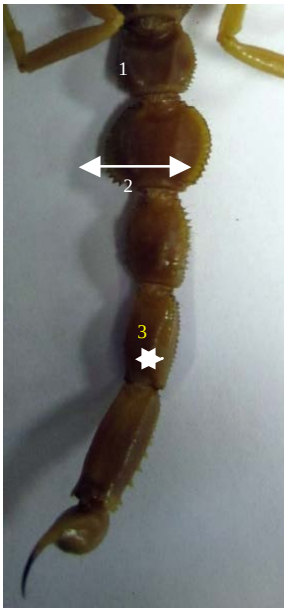

Fig. 4: Metasom (*Apistobuthus susanae*): 1) Length; 2) Width; 3) Height

difference between the two species in this characteristic, male and female of the species were not significantly different in this respect.

In general, due to biological reasons and the way they nurture their babies, female scorpions have wider carapace compared with males. This is also reported by Booncham in a study of the sexual dimorphism in *Heterometrus laoticus* (Booncham *et al*., 2007). Regardless of the scorpion sex, wider carapace is considered normal in burrowing scorpions and the scorpions excavating harder beds, owing to the larger chelicerae muscles (Prendini, 2001). In these species, the ratio of posterior to anterior carapace width is lower than that in the scorpions with other habitats. Moreover, because of the above-mentioned reasons, the middle eyes on the carapace are in a more posterior position than in other scorpions.

Based on the results, the species with a lower ratio of posterior to anterior carapace width live in habitats with harder beds. Chela height is an appropriate factor to estimate its power. In this regard, Van der Meijden *et al*. (2010) proposed two hypotheses:

- The scorpions with bigger chela have less dangerous venom for man and the vertebrates
- For the scorpions with long and capsulated chela, speed is more important than power during hunting

Regarding the investigations, we could not find any relationship between the longest or the thickest chela and the level of toxicity of the scorpions. It should be noted that the longest and the thickest chela observed in *Apistobuthus susanae*. Indeed, the role of diet should be considered in the size and volume of chela and chelicerae.

CONCLUSION

Investigation of metasoma indicates that there is no obvious pattern in the length of metasoma in male and female ones and the pattern varies in different species. In *Apistobuthus susanae*, shape modification in the second metasoma which seems to play a role in the identification of the burrowing site is observed in both males and females. Ultimately, according to our observations and also the previous reports, males usually have longer pectines.

ACKNOWLEDGEMENTS

The present research is part of MSc thesis supported financially by Tarbiat Modares University. Researchers thank the staff of Department of Venomous Animals and Antivenome Production of Razi Vaccine and Sera Research Institute for their help and cooperation.

REFERENCES

Booncham, U., D. Sitthicharoenchai, A.O. Pradatsundarasar, S. Prasarnpun, and K. Thirakhupt, 2007. Sexual dimorphism in the Asian giant forest scorpion, *Heterometrus Laoticus* Couzijn 1981. NU. Sci. J., 4: 42-52.

Fet, V., E. Michelle Capes and W.D. Sissom, 2001. A New Genus and Species of Psammophilic Scorpion from Esthern Iran (Scorpiones: Buthidae). In: Scorpions 2001: In Memoriam Gary A. Polis, Fet, V. and P.A. Selden (Eds.). British Arachnological Society, UK., ISBN: 0 9500093 3 4, pp: 183-189.

Fet, V., G.A. Polis and W.D. Sissom, 1998. Life in sandy deserts: The scorpion model. J. Arid Environ., 39: 609-622.

Hadley, N.F., 1974. Adaptational biology of desert scorpions. J. Arachnol., 2: 11-23.

Navidpour, S., F. Kovarik, M.E. Soleglad and V. Fet, 2008. Scorpions of Iran (Arachnida, Scorpiones). Part I. Khoozestan Province. Euscorpius, 65: 1-41.

Polis, G.A., 1990. The Biology of Scorpions. 1st Edn., Stanford University Press, Stanford, CA., ISBN: 0804712492, pp: 587.

Prendini, L., 2001. Substratum Specialization and Speciation in Southern African Scorpions: The Effect Hypothesis Revisite In: In: Memoriam Gary A. Polis. Fet, V. and P.A. Selden (Eds.). Scorpions Publishing, Burnham, UK., pp: 113-138.

Pyke, G.H., 1984. Optimal foraging theory: A critical review. Annu. Rev. Entomol., 15: 523-575.

Soleglad, M.E. and V. Fet, 2015. High-level systematics and phylogeny of the extant scorpions (Scorpiones: Orthosterni). Euscorpius, 11: 1-56.

Stahnke, H.L., 1970. Scorpion nomenclature and mensuration. Entomol. News, 81: 297-316.

Van der Meijden, A., A. Herrel and A. Summers, 2010. Comparison of chale size and pincer force in scorpions; Getting a first grip. J. Zool., 280: 319-325.