

Taxonomic status of sand boas of the genus *Eryx* (Daudin, 1803) (Serpentes: Boidae) in Bahr Al-Najaf depression, Al-Najaf Province, Iraq

Abbas Rhadi F.^{a,b}, Rastegar-Pouyani, N.^a, Karamiani, R.^{a*}, and Ghaleb Mohammed, R.^{a,b}

^a *Department of Biology, Faculty of Science, Razi University, 67149 67346 Kermanshab, Iran*

^b *Al-Qasim Green University, Babylon, Iraq*

(Received: 10 April 2015; Accepted: 30 June 2015)

Five metric and 10 meristic characters were studied in 30 specimens of *Eryx* (Daudin, 1803) in Bahr Al-Najaf depression, Al-Najaf Province – Iraq. According to the results, and considering the principle of priority, we concluded that the populations of *E. jaculus* (Linnaeus, 1758) in the study area should be classified into *E. jaculus jaculus* (Linnaeus, 1758) and *E. jaculus familiaris* Eichwald, 1831. In addition, ten specimens belonging to a population of *Eryx* in the area were found to differ from all other *E. jaculus*. They have second upper labial scale being lower than the third one scale. These specimens, which are tentatively regarded as *Eryx cf. miliaris* (Pallas, 1773), need more comprehensive study to clarify their taxonomic status and phylogenetic relationship using more morphological traits, ecology, and molecular studies.

Key words: *Eryx*, morphological characters, Bahr Al-Najaf depression, Iraq

INTRODUCTION

The family Boidae comprises three subfamilies: Boinae, Ungaliophiinae and Erycinae (Wilcox et al., 2002), as currently defined comprises five subfamilies: Sanziniinae, Chariniinae, Erycinae, Candoiinae, and Boinae (Pyron et al., 2014). The genus *Eryx* (Daudin, 1803) belongs to the subfamily Erycinae and is distributed in southwestern Europe, North and East Africa, Middle East, southwestern Asia to India and Sri Lanka, northward to Caucasia and Afghanistan, and eastward from Turkestan to southern Mongolia and western China (Lanza and Nistri, 2005; Pyron et al., 2014). The Egyptian, Javelin Sand Boa or Spotted Sand Boa *Eryx jaculus* (Linnaeus, 1758) and *E. j. familiaris* Eichwald, 1831 is believed to be the only species and subspecies found in Iraq (Boulenger, 1920; Corkill, 1932; Khalaf, 1959). This subspecies having 9-12 supralabials, feebly keeled scales; brownish-green or grey, with darker blotches, belly white or yellowish, uniform or speckled darker (Khalaf, 1959). The distribution of this species is Algeria, Egypt, Greece, Turkey, Romania, Asia Minor, the Levant, Iraq and Persia. In Iraq specimens have been collected in Basra, Amara, Nasiriyah, Baghdad, Baquba, Mandali, and Sulamainia (Terentyev and Chernov, 1965). In these regions this snake has been referred to as a local inhabitants as “batra” (Corkill, 1932). *Eryx jaculus* (Linnaeus, 1758) can be distinguished by its small eyes and indeterminate neck. The head is covered with small scales. The tail is short and has one row of subcaudal scales. Ventral scales are different from dorsal scales, and are narrower than the width of the body. They feed on lizards, small

mammals, and other snakes. According to Mohammad et al. (2013) *E. jaculus* is the only species reported from Bahr Al-Najaf depression, Al-Najaf Province, Iraq.

The available compilations of snakes occurring in Iraq are that of Corkill (1932), Khalaf (1959), and Leviton et al. (1992) this note refers to specimens collected by the authors and stored in the collection of natural history Museum of the Baghdad University (NHMBU). There is no precise identification key for the species of *Eryx* in Iraq; this leads to misidentification of Iraqi species. As yet, no study has been done on the taxonomic status of *Eryx* in Iraq. The aim of this study is try to determine some diagnostic characters for identification of the species of *Eryx* in southern Iraq.

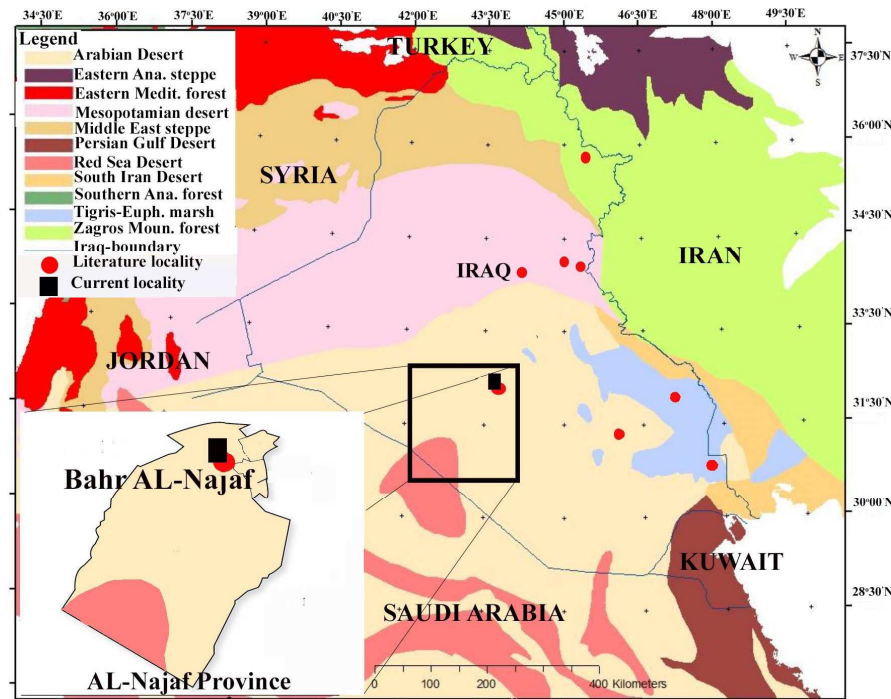


FIGURE 1. Map showing the Known distribution of *Eryx* in Iraq. Indicated as red circle known locations (according to Boulenger, 1920; Corkill, 1932 and Mohammad et al., 2013). The current locality described in the paper is marked with Black Square. Bahr AL-Najaf-Al-Najaf Province-Iraq.

MATERIAL AND METHODS

Bahr Al-Najaf is a wetland depression area extends at northwest-southeast direction of Al-Najaf Province Iraq about 750 Km², of coordinates longitude 43° 40 - 44° 25 E and latitude 31° 40 - 32° 10 N and altitude elevation of about 47 - 11 m a. s. l. (Al-Atia, 2006; Benni and Al-Tawash, 2011). It is composed of a lake or marsh-like area with limited cultivated orchards beyond and surrounded by vast desert or semi desert areas. The area is classified as a part of the Arabian Desert and East Sahero - Arabian xeric shrub lands ecoregion (Bachmann et al., 2011). Thirty specimens including 12 males and 18 females were included in the study. The locality data and habitat features were recorded as well (Fig. 1, Table 1).

Field identification in live: A green brown, or grey snake dorsally with darker blotches, and with a spotted yellowish or white belly; no neck, a stumpy tail, small plates on the head, a vertical pupil, posterior dorsals slightly keeled, ventrals narrow (Corkill, 1932).

Collection of specimens: Samples were obtained either through direct collection by hand or through interviews with hunters and locals by visiting the area five times during the period from 19th

of September 2013 to 13th of May 2014. After collecting, the specimens were placed within a special sack, and transferred to the laboratory for identification and complementary studies.

Fixation, preservation and identification of samples: All the collected specimens were initially fixed with 96% ethanol and later preserved in 75% ethanol. Voucher specimens were stored in Razi University Zoological Museum (RUZM) at Razi University of Kermanshah-Iran, under museum number RUZM-BE 23.1-30. Specimens were identified according to Latifi (1991, 2000), Leviton et al. (1992), and Eskandarzadeh et al. (2013) using morphometric measurements, coloration, and pholidosis features (including the number, structure, and range of scales and plates). The metric and meristic characters used in this study are presented in Table 2.

Sex determination: The sex of snakes in this study determined using two methods for all specimens:

Cloacal probing: Using a blunt probe of appropriate size (Schaefer, 1934). The probe is inserted caudally, at the lateral margins, into the cloacal opening of the animal. In a male snake, the hemipenial pockets will allow the probe to move caudally for some distance; in a female snake, the probe will not be able to move far. Great care must be taken when using this method as the tissues in this region are easily punctured. The hemipenial eversion is shown in Fig. 2 a-b.

Cloacal Popping: By applying pressure to the base of the tail it is often possible to evert the hemipenes of male snakes. This method is preferred for sexing small snakes and neonates (Gregory, 1983) as large males are difficult to evert and excess pressure may cause injury (Fig. 2 c).

Statistical analysis: An independent samples t-test as well as the analysis of variance (ANOVA) was performed using SPSS 20.0 to survey differences among *Eryx* spp.

TABLE 1. Details of the locality and habitat of *Eryx jaculus* and *Eryx* sp. included in study.

Species	Locality			Mean of Elevation	Habitat
<i>Eryx jaculus</i> (N=20)	Iraq - Bahr Al-Najaf it extends at north west-south east direction of an area about 750 Km ²	N	31° 52' 28.5"	19 m	Semi-arid area with bushes and usually at elevations of 19 m. It is composed of a lake or marsh-like area with limited cultivated orchards beyond and surrounded by vast desert or semi desert area.
			31° 58' 57.5"		
<i>Eryx</i> sp. (N=10)	E		44° 15' 52.3"		
			44° 18' 29.4"		

TABLE 2. Description of the most informative metric and meristic characters in *Eryx*.

No.	Definition	Character
1	Distance between posterior edge of eye and corner of mouth	DEM
2	Width of interocular space	WI
3	Number of scales around right eye	RE
4	Number of scales around left eye	LE
5	Number of right supralabial scales	R\ LAB
6	Number of left supralabial scales	L\ LAB
7	Number of scales posterior to internasal	PIN
8	Number of scales between eyes	BE
9	Number of dorsal scales	DS
10	Number of ventral scales	VS
11	Number of subcaudal scales	ScdS
12	Body length	LB
13	Tail length	LT
14	Number of scales between eye and nasal	BEN
15	Second upper labial scale shorter or higher than third one	2 nd LAB



Figure 2. Cloacal probing technique to determine gender : (a) In most male snakes probe inserted a distance spanning 10 subcaudal scales,(b) female snakes have two out pockets that pass a short distance into the base of the tail; In most female snakes the inserted probe can be introduced into these pockets only a very short distance, usually only the distance of 2-5 subcaudal, (c) Cloacal popping technique: By applying pressure to the base of the tail it is often possible to evert the hemipenes of male snakes.

RESULTS

As shown in Table 3 *E. jaculus* (Linnaeus, 1758) and *Eryx* sp. show overlap in 13 morphometric and meristic characters. The only differing character between *E. jaculus* and *Eryx* sp. is the length of second upper labial (2nd LAB) in relation to the third one on the one side, and presence of three or two shields behind the internasals on the other side (Fig. 3 a-e).

The analysis of variance (ANOVA) was performed for meristic and metric characters to show significantly variable characters of *E. jaculus* (Linnaeus, 1758) and *Eryx* sp. The result of the ANOVA shows that the ratio of interocular space width to distance between the posterior edge of eye and corner of mouth (WI/DEM) was significantly different $P \leq 0.05$. Number of scales around right eye (RE), number of scales between eyes (BE), number of ventral scales (VS), number of subcaudal scales (ScdS), number of scales around left eye (LE), number of scales between eye and nasal (BEN), number of dorsal scales (DS), and the ratio of body length to tail length (LB/LT) with $P > 0.05$ were not significantly different.

The results of the independent samples t-test showed that the number of dorsal scales (DS), the ratio of body length to tail length (LB/LT) and ratio of interocular space width to distance between the posterior edge of eye and corner of mouth (WI/DEM) were significantly different between males of *E. jaculus* and *Eryx* sp. $P \leq 0.05$. Ratio of interocular space width to distance between the posterior edge of eye and corner of mouth (WI/DEM) was significantly different between females of *E. jaculus* and *Eryx* sp. $P \leq 0.05$. The other studied morphometric and meristic characters with

TABLE 3. Descriptive table including minimum, maximum, mean and standard error in 13 morphometric and meristic characters and ANOVA of all morphometric and meristic characters morphometric and meristic characters in *Eryx jaculus* and *Eryx sp.* included in this study. Significant values ($P < 0.05$) are shown in bold.

Characters	Male							Female						
	<i>Eryx jaculus</i> (N=9)			<i>Eryx sp</i> (N=3)				<i>Eryx jaculus</i> (N = 11)			<i>Eryx sp</i> (N = 7)			
	Range	Mean	Std. Error	Range	Mean	Std. Error	<i>P value</i>	Range	Mean	Std. Error	Range	Mean	Std. Error	<i>P value</i>
R\E	8-11	9.4	0.3	10-10	10	0.0	0.380	9-10	9.5	0.2	8-11	9.6	0.4	0.942
L\E	9-11	9.6	0.2	9-10	9.3	0.3	0.644	8-11	9.6	0.4	8-10	9.6	0.3	0.902
R\ LAB	10-11	10.7	0.2	10-11	10.7	0.3	1.000	10-12	10.6	0.2	10-12	10.9	0.3	0.512
L\ LAB	10-11	10.7	0.2	10-11	10.3	0.3	0.356	10-11	10.5	0.2	10-11	10.7	0.2	0.503
BE	5-8	6.2	0.4	6-7	6.7	0.3	0.525	5-7	6.2	0.3	6-7	6.9	0.1	0.104
PIN	2-2	2	0.0	2-3	2.3	0.3	0.082	2-3	2.1	0.1	2-3	2.4	0.2	0.307
BEN	3-3	3	0.0	3-3	3	0.0		3-3	3	0.0	3-3	3	0.0	
DS	47-53	48.8	0.6	51-53	51.7	0.7	0.036	45-53	49.7	0.8	47-50	48.9	0.4	0.446
VS	187-204	191.7	1.8	187-189	188	0.6	0.274	188-201	195.5	1.4	185-202	193.4	2.4	0.440
ScdS	25-35	31.3	1.2	29-32	30.7	0.9	0.774	21-28	24.6	0.7	22-28	24.7	0.8	0.919
LB/LT	6.7-11.4	9	0.5	6.5-6.7	6.6	0.1	0.005	9.8-26.6	13.3	1.4	9.3-15.0	10.9	0.8	0.205
WI/DE M	1-1.4	1.3	0.0	1-1	1	0.0	0.013	1-2	1.1	0.0	0.9-1	0.98	0.01	0.001
SVL	42.2-65.5	52.1	2.5	35.6-50.7	43.5	4.4	0.087	51.1-74.6	59.6	2.0	42-70.5	54.3	3.5	0.176
2 nd LAB	Higher than third one	-	-	Lower than third one	-	-		Higher than third one	-	-	Lower than third one			

$P > 0.05$ were not significantly different. Descriptive characters and descriptive statistics of the studied species are shown in Tables 3.

DISCUSSION

In their treatment Corkill (1932) and Khalaf (1959) considered *E. j. familiaris* as to be the only subspecies found in Iraq. Leviton et al. (1992) mentioned *E. j. jaculus* (Linnaeus, 1758) and *E. j. familiaris* Eichwald, 1831 from Iraq. According to the results, and considering the principle of priority, the populations of *E. jaculus* included in this study (20 specimens) are regarded as *E. j. jaculus*

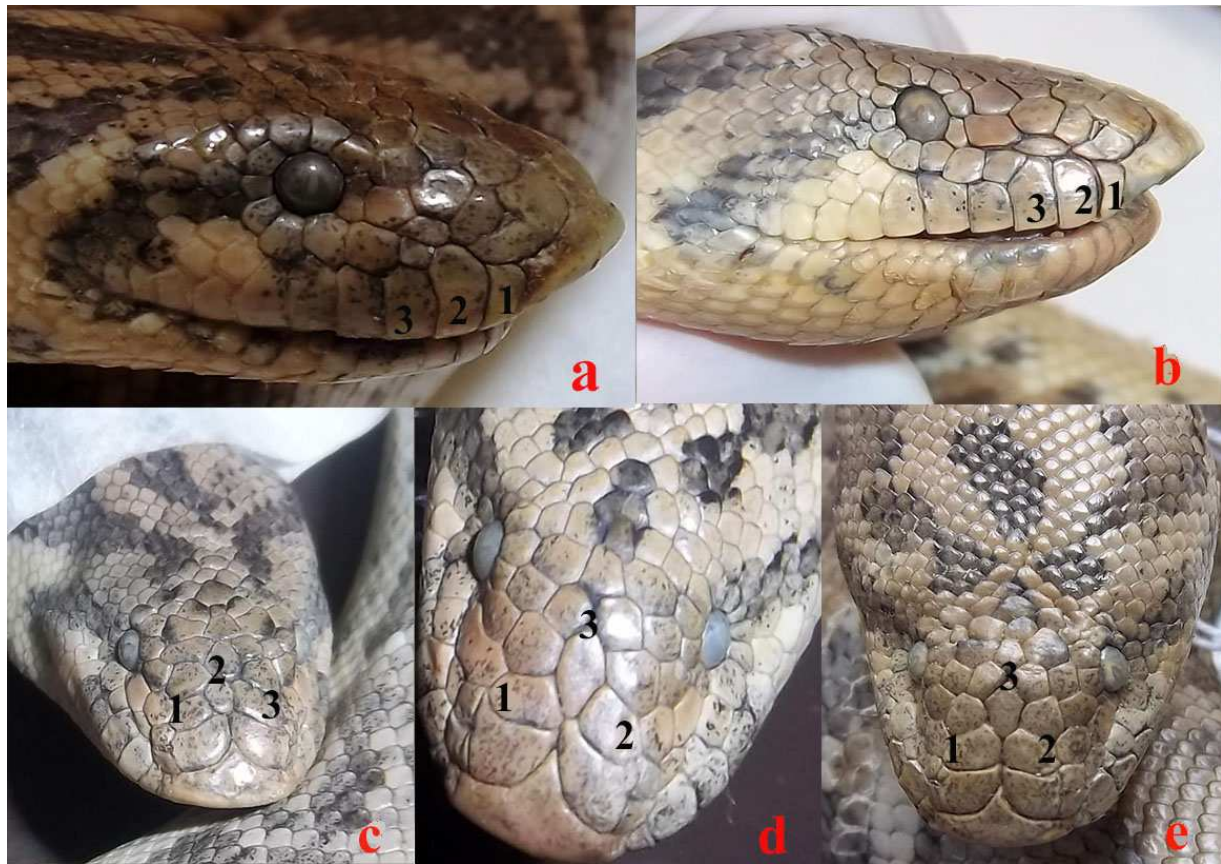


FIGURE 3. The topography of the head in *Eryx*. (a) the second upper labial higher than the third one in *E. jaculus*. (b) the second upper labial lower than the third one in *Eryx* sp. (c) three scales behind internasals in *Eryx* sp. (d) three scales behind internasals, the middle shield inserted between the other two and in contact with internasals in *E. j. jaculus*. (e) two large shields behind internasals, a third large median shield may insert itself between the other two but does not contact internasals in *E. j. familiaris*.

(one specimen) and *E. j. familiaris* (19 specimens). The characters of *E. j. jaculus* based on the studied specimens are as follows: the second supralabial is higher than the third; width of interocular space is more than 1.2 times than distance between posterior edge of eye and corner of mouth; eyes directed sideways; three scales between eye and nasal area; the ventral surface is cream-colored with black spots more or less interconnected; in some cases they are seen as linear lines; the undersurface of the head has scattered spots, some spots are seen on the lateral surfaces; dorsal surface olive-brown, with scattered black or brown spots meeting as transverse and diagonal lines in most samples. 187-201 ventrals; three large shields behind internasals, the middle shield inserted between the other two and in contact with internasals; this character is the most diagnostic character for *E. j. jaculus*, since *E. j. familiaris* has only two large shields behind internasals, a third large median shield may insert itself between the other two but does not contact internasals; dorsal scales, vary from 40 to 55 rows at midbody; the ventral scales number from 180 to 205 and the subcaudals range from 20 – 30. The scale count for the specimens in Iraq having a higher average than those from Europe and Africa (Corkill, 1932; Khalaf, 1959).

In addition, in ten specimens of *Eryx* sp. the second supralabial is lower than the third one. Two or three scales located posterior to the internasal. Width of interocular space is equal or smaller than

distance between posterior edge of eye and corner of mouth, and eye directed sideways. Three scales are present between eyes and nasal. The lower surface of head has a few black spots in comparison with *E. jaculus*, the morphological features generally agree with published data (Latifi, 1991, 2000; Eskandarzadeh et al., 2013), being very close to *Eryx miliaris* (Pallas, 1773). So, we tentatively regard this snake as *Eryx cf. miliaris*. This snake has not already been reported from Iraq. It is found in north coast of the Caspian Sea, east through Kazakhstan to western Inner Mongolia, Iran, south to Turkmenia, Afghanistan, and China (Kluge, 1993; Latifi, 2000).

The characters of this new population in Iraq are generally similar to *E. miliaris*, a more comprehensive study is needed using morphology, ecology and molecular data to clarify the real taxonomic status of this taxon. In this study we determined some diagnostic characters for identification of the species of *Eryx* in southern Iraq and our findings show that taxonomy and distribution of snakes in Iraq need more attention and deserve further studies.

Key to the species of *Eryx* in the study area

- 1a. Second supralabial longer than third2
 1b. Second supralabial shorter than third3
 2a. Two large shields behind internasals, a third median shield may insert itself between the other two but does not contact internasalsventrals*Eryx jaculus familiaris*
 2b. Three large shield behind internasals, the third median shield inserted between the other two and in contact with internasals *Eryx jaculus jaculus*
 3a. Two or three scales posterior internasals *Eryx cf. miliaris*
 3b. Four scales posterior internasals *Eryx miliaris*

Acknowledgments

We are grateful to the Iraqi Ministry of Higher Education and Scientific Research for their kind collaboration. Also, we thank the authorities of Razi University (Kermanshah-Iran) for their support during field work. We also thank the Department of the Environment in Al-Najaf Province, Iraq for providing facilities and for their efforts in collecting specimens.

LITERATURE CITED

- Afrasiab, S. R., Al-Ganabi, M. I. and Al-Fartosi, K. 2012. Snake species new or rare to the herpetofauna of Iraq. *Herpetozoa*; 24 (3/4): 179 – 181
- Al-Atia, M. J. 2006. The Najaf Land: History, geological heritage and natural wealth. 1st edition. *Al-Nibras Foundation for Printing, publication and Distribution. Al-Najaf*.
- Bachmann, A., Chappell, B., Elliott, N. and Matti, N. 2011. Key Biodiversity Survey of Iraq, 2010 Site Review. *Nature Iraq Report* No. 0311-01P. 100 pp.
- Benni, T. J. and Al-Tawash, B. S. 2011. Palynological evidences on Paleoclimate and Paleoenvironmental changes during Late Quaternary of Bahr Al-Najaf Depression, Central Iraq. *Iraqi Bulletin of Geology and Mining* (2): 1-28. (in Arabic).
- Boulenger, G. A. 1920.** A List of Snakes from Mesopotamia. Collected By Members of The Mesopotamian Expeditionary Force, 1915 To 1919. *Journal of the Bombay Natural History Society*.

- Corkill, N.L. 1932. Snakes and snake bite in Iraq: A Handbook for medical office. Published for The Royal College of Medicine of Iraq: by *Bailliere, Tindall and Cox 7&8, Henrietta Street. London. W.C.2.* ix, +51 pp.
- Eskandarzadeh, N., Darvish, J., Rastegar-Pouyani, E. and Ghassemzadeh, F. 2013. Reevaluation of the taxonomic status of sand boas of the genus *Eryx* (Daudin, 1803) (Serpentes: Boidae) in northeastern Iran. *Turkish Journal of Zoology*. 37: 348-356.
- Gregory, P.T. 1983. Identification of sex of small snakes in the field. *Herpetological Review*. 14: 42- 43.
- Hatt, K. T. 1959. The Mammals of Iraq: Cranbrook Institute of science, Museum of Zoology, University of Michigan, 113 pp.
- Khalaf, K.T. 1959. Reptiles of Iraq with some notes on the amphibians. *Ar- Rabitta Press, Baghdad*. 96 pp.
- Kluge, A.G. 1993. Calabaria and the phylogeny of erycine snakes. *Zoological journal of the linnean society*. 107:293-351
- Lanza, B. and Nistri, A. 2005. Somali Boidae (genus *Eryx* Daudin 1803) and Pythonidae (genus *Python* Daudin 1803) (Reptilia Serpentes). *Tropical Zoology*. 18: 67–137.
- Latifi, M. 1991. The snakes of Iran. *Society for the Study of Amphibians and Reptiles. Contributions to Herpetology*. 7.VIII, + 159 pp.
- Latifi, M. 2000. Snakes of Iran. *Department of the Environment, Tebran*. 478 pp.
- Leviton, A.E., Anderson, S.C., Adler, K. A. and Minton, S.A. 1992. Handbook to Middle East Amphibians and Reptiles. *Oxford, Ohio*. VII, + 252 pp.
- Matar A.R. 2013. Estimating Water Requirement and Irrigation Scheduling for Rice (*Oryza sativa*) in Mashkhab, Iraq.- MSc. Thesis, Università Degli Studi Di Firenze, Florence – Italy, IX + 42 pp.
- Mohammad, M.K., Ali, H.H., Ali, B.A. and Hadi, A.M. 2013. The Biodiversity of Bahr Al-Najaf Depression, Al-Najaf Al-Ashraf Province. *Bulletin of the Iraqi natural history Museum, Baghdad*. 12: 21-30.
- Pyron, R.A., Renolds, R.G. and Burbrink, F.T. 2014. A Taxonomic Revision of Boas (Serpentes: Boidae). *Zootaxa*. 2: 249-260.
- Schaefer, W.H. 1934. Diagnosis of sex in snakes. *Copeia*, 1934, 181.
- Terentyev, P.V. and Chernov, S.A. 1965. Key to Amphibians and Reptiles. Soviet Sciences Publishing, Moscow.
- Wilcox, T.P., Zwickl, D.J., Heath, T.A. and Hillis, D.M. 2002. Phylogenetic relationships of the dwarf boas and a comparison of Bayesian and bootstrap measures of phylogenetic support. *Molecular Phylogenetics and Evolution*. 25: 361–371.