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Studying morphological and environmental characteristics of the Plateau Snake Skink *Ophiomorus nuchalis* Nilson and Andrén, 1978 (Sauria: Scincidae) in Central Plateau of Iran

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The nocturnal burrowing skinks of genus *Ophiomorus* is composed of 11 species (Anderson & Leviton, 1966; Nilson & Andrén, 1978; Anderson, 1999; Kazemi et al., 2011) and are distributed from southern Balkans to Sindhian deserts in India (Anderson & Leviton, 1966; Sindaco & Jeremčenko, 2008). Seven species of *Ophiomorus* have been recorded from Iran including *O. blanfordi* (Boulenger, 1887); *O. brevipes* (Blanford, 1874); *O. nuchalis* (Nilson & Andrén, 1978); *O. persicus* (Steindachner, 1867); *O. streeti* (Anderson and Leviton, 1966); *O. tridactylus* (Blyth, 1853); *O. maranjabensis* (Kazemi et al., 2011)(Anderson, 1999; Rastegar-Pouyani et al., 2008; Kazemi et al., 2011; Safaei-Mahroo et al., 2015). According to Greer and Wilson (2001), the scincid lizard is more attractive case to study because of having ancestral characters and limb reduction. In the case, *O. nuchalis* is one of the shink species with having the most primitive limb morphology which has four digits on the manus and three on the pes (Greer & Wilson, 2001; Fig. 4). A comprehensive phylogenetic cladistic analysis on the genus *Ophiomorus* was done by Greer and Wilson (2001). Their analysis confirmed *Ophiomorus* as a monophyletic genus and the eastern species clade as monophyletic. The western group of species was expressed as polyphyletic in origin. The *O. nuchalis* is located is the western group. Another study has been mentioned molecular phylogenetic relationships of *O. punctatissimus* in Aegean trench but phylogenetic relationship among all Iranian *Ophiomorus* still remain unclear (Poulakakis et al., 2008) .

The type locality of *O. nuchalis* is the northern slope of "Siah Kooh" in the center of the Kavir Protected Region, Iran (52°11' E, 34°44' N) (Nilson & Andrén, 1978). So far, distribution range of *O. nuchalis* extended to Qom and Yazd provinces in west and east, respectively (Nilson & Andrén, 1978, Mozaffari et al., 2011, Farhadi Qomi et al., 2011 Hosseinzadeh et al.,Inpress).

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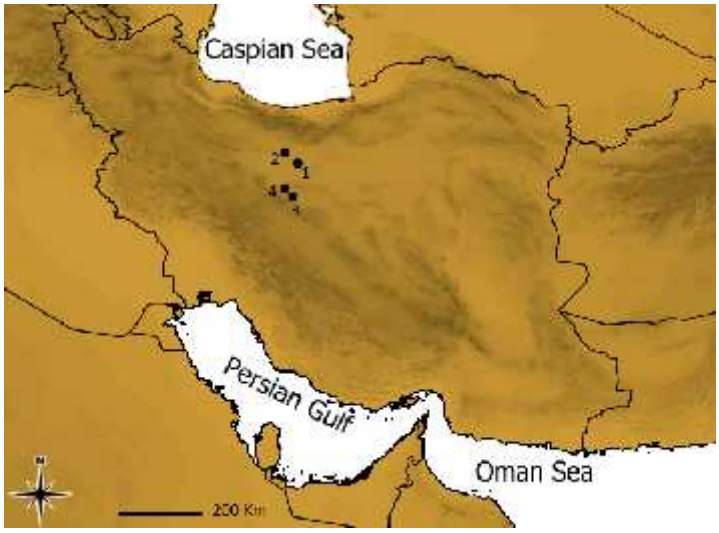

FIGURE 1. Distribution map of *Ophiomorus nuchalis*. 1: Type locality in Cheshmeh Shah, Kavir Protected Region,Teheran (52°11' E , 34°44' N) (Nilson & Andrén, 1978). 2: 5 Km north of Kavir Protected Region entrance (51°46'14" E, 35°6'42" N) (Mozaffari et al., 2011). 3: Arisman village (52°0'11" E, 33°39'27" N). 4: Abouzeid Abad (51°45'30"E, 33°54'52" N), Isfahan Province (Farhadi Qomi et al., 2011).

FIGURE 2. Habitat of *O. nuchalis*. A: Abouzeid abad, B: Arisman.

TABLE 1. Locality and the voucher numbers of studied specimens of *O. nuchalis*.

Voucher Number	Locality	Longitude	Latitude	Collector	Date	Type of Habitat
ZMGU.2579	Arisman village	52° 0'	33° 39'	Kazemi	6 June, 2010	cucumber farm
ZMGU.2580	Abouzeid Abad village	51°45'	33°54'	Farhadi Qomi	9 June, 2011	plowed farm near a peach garden
ZMGU.2589	Abouzeid Abad village	51°45'	33°55'	Farhadi Qomi	16 March , 2012	plowed farm
ZHIM 23	Abouzeid Abad village	51°45'	33°55'	Farhadi Qomi	30 April, 2012	plowed farm
ZHIM 24	Abouzeid Abad village	51°45'	33°55'	Farhadi Qomi	13 May, 2012	plowed farm

TABLE 2. Available vegetation in the study areas.

Regions vegetation	Kavir protected regions(Nilson & Andrén, 1978)	Mobarakie (Mozaffari et al., 2011; Farhadi Qomi, 2011)	Abouzedi Abad (Farhadi Qomi et al., 2011)	Arisman (Farhadi Qomi et al., 2011)
Haloxylon		**		
Alhagi		*	*	*
Peganum		*	*	*
Prosopis		*		
Salsola				
Suaeda		*		
Artemisia	**	**		
Prunus persica				
Tamarix		*	*	*
herba-alba	**			
Astragalus				
Shrubs cucumber				*

* : Containing specimens
** : Dominant specimens

TABLE 3. Results of measurement nine metric and eight meristic characters for six specimens of *O. nuchlais*.

Characters	GNM4418	ZMGU.2579	ZMGU.2580	ZMGU.2589	ZHIM 23	ZHIM 24
SVL	84	80	87.9	88.84	52.6	97.10
TL	81	—*	89.3	41.18	—	54.3
HL	6.2	5.5	7.5	6.5	4.52	7.6
SL	4.3	2.9	4.2	3.9	3.1	4.6
HW	—	3.3	6	6.5	4.3	5.45
HH	—	3.1	5	5.4	2.6	5.1
FLL	9	6	8.7	9.1	6.6	9.2
HLL	14	10	15.1	16.7	11.4	16.6
DHF	—	—*	64.4	68.1	40.4	75.1
SPL	7-7	7-7	7-7	7-7	7-7	7-7
IFL	6-6	6-6	6-6	6-6	6-6	6-6
SPO	4-4	4-4	4-4	4-4	4-4	4-4
PTO	2-2	2-2	2-2	2-2	2-2	2-2
PO	1-1	1-1	1-1	1-1	1-1	1-1
LO	1-1	1-1	1-1	1-1	1-1	1-1
SQ	22	22	22	22	22	22
IP-V	116	-	116	116	116	116

* The Arisman specimen has been hurted and we do not have the back of the body.

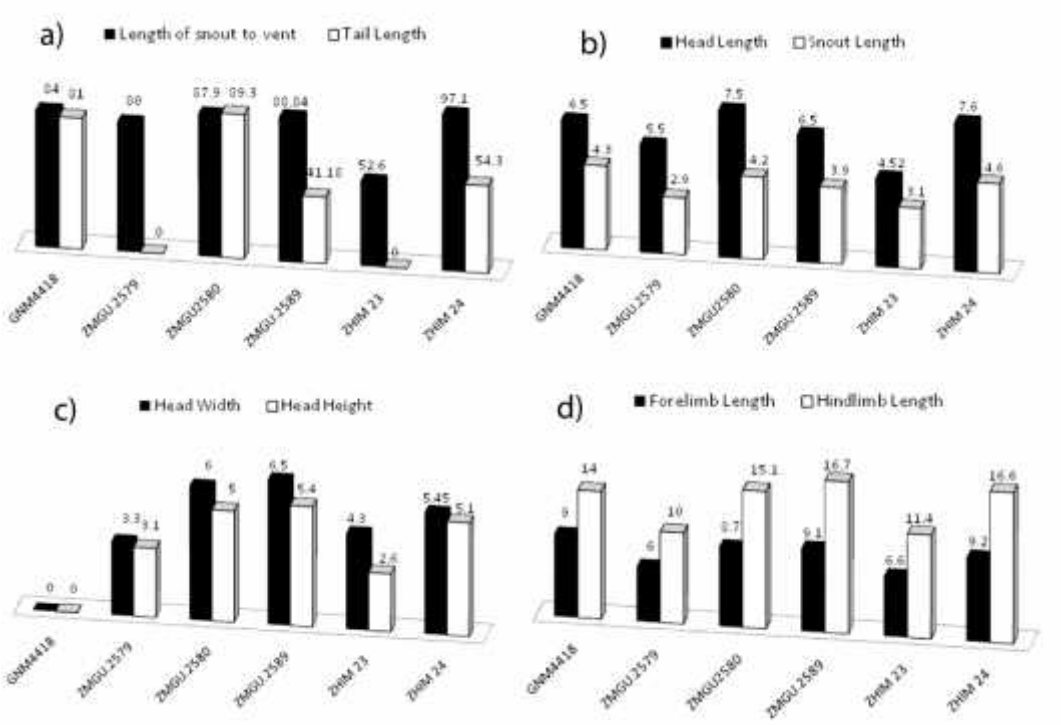

FIGURE 3. Graphs of measurement values and comparisons of 8 metric characters for six specimens of *O. nuchalis*. a) length of snout to vent and tail length, b) head length and snout length, c)head width and head height and d) forelimb length and hindlimb length

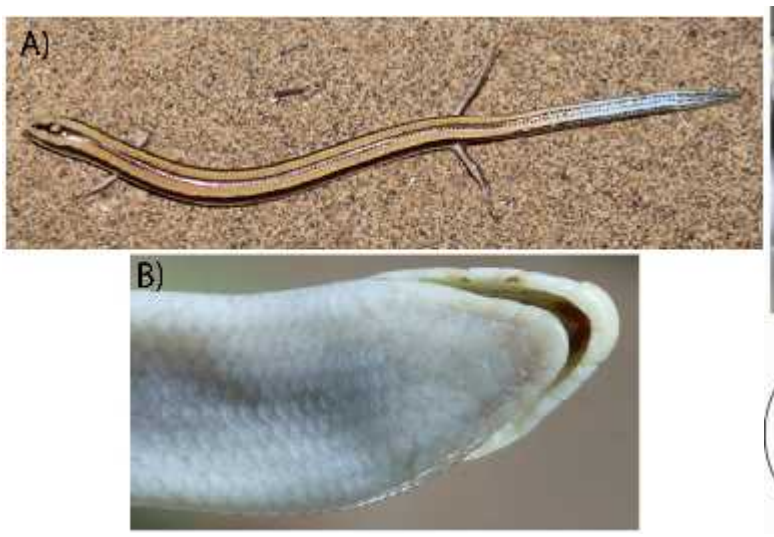

FIGURE 4. A) Dorsal view of *O. nuchalis* (ZHIM 23), B) Ventral view of head *O. nuchalis* (ZMGU.2580).

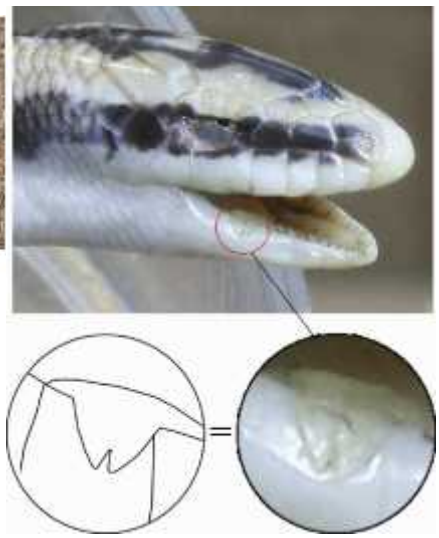

FIGURE 5. View of tongue *O. nuchalis*, and small scale between eye and preocular (ZMGU.2580).

We attempted to investigate morphology variation and environmental condition, to give more information of biological aspects of *O. nuchalis* in Iran**.** The six studied specimens were deposited in Göteborg Natural History Museum (GNM), Zoological Museum Gorgan University (ZMGU) and Zagros Herpetological Institute Museum (ZHIM). In addition, Data were taken from literature (Nilson & Andrén, 1978; Mozaffari et al., 2011). A list of studied specimens and their localities with voucher numbers are given in Table 1, Figure 1. The morphology of used materials was examined using 9 metric and 8 mersitic characters as follow: SVL= including Length of snout to vent (from tip of snout to anterior edge of cloaca), TL= Tail Length (from posterior edge of cloaca to tip of tail), HL= Head Length (from end of snout to angle of jaw), SL= Snout Length (from tip of snout to anterior corner of eye), HW= Head Width (widest point of head), HH= Head Height, FLL= Forelimb Length, HLL= Hindlimb Length, DHF= Distance between hindlimbs and forelimbs, PTO= Postocular, PO=Preocular, LO= Loreal, SQ= Scales round the middle of the body, IP-V= Scales between interparietal at the level of vent, SPL= Supralabials, IFL= Infralabials, SPO= Supraoculars**.**

ENVIRONMENTAL DATA

The average annual precipitation of Kavir Protected Region is 100 mm at the nearest meteorological station in Varamin city, about 30 km to the northwest. During the hot summer months the temperature may reach 50 °C and the minimum temperature reaches -15 °C in winter. In the case, the maximum and minimum temperatures of Abouzeid abad, Arisman regions reach to 46.2 °C and -12.5 °C, respectively (Fig. 2). The average rainfall is 170 mm. The species found in low hills with stony or rocky ground, near dry river with clay topsoil, agricultural farms and sand dunes (Nilson & Andrén, 1978; Mozaffari et al., 2011; Farhadi Qomi , 2011; Hosseinzadeh et al., Inpress). Type of vegetation has been examined in four area of catching the species (Table 2). According to Mozaffari et al. (2011), dominant habitat vegetation contained *Tamarix, Prosopis, Alhagi* and *Artemisia* (Table 2). *Artemisia herba-alba* constitutes the dominating species in the plant community on the low hills (Nilson and Andrén, 1978). In total, *Artemisia* and *Tamarix* are dominant in habitat of the species. With regard to environmental findings and previous researches, it seems the species is adapted to live in arid climatic condition and widely distributed in the central Iranian plateau including Semnan, Tehran, Qom, Isfahan, Yazd provinces (Nilson & Andrén, 1978; Mozaffari et al., 2011; Farhadi Qomi et al., 2011; Hosseinzadeh et al., Inpress) **.**

MORPHOLOGICAL DATA

Results of comparison morphology of six specimens of *O. nuchalis* showed some variation as follow. The tip of the tongue of *O. nuchalis* from Abouzeid abad, Kashan (ZMGU.2580) has dichotomy style (Fig. 5). The style of tongue has not been mentioned in the species by comparing with other specimens from Abouzeid abad, Arisman, Kavir protected area (holotype). According to Nilson and Andrén (1978), the holotype has two postmentals, which the first in contact with first and second pairs of sublabials but our data showed a specimen has one postmental which is in contact with the first scale of sublabials (ZMGU.2580; Fig. 5; Fig. 4B). In the holotype, there is a single preocular; but we have found a small scale before preocular, between eye and preocular (Fig. 5). The holotype has four supraocular that second and third scales are divided longitudinally and the lower part isone third of the top part but in the specimen of Abouzeid abad (ZMGU.2580), the situation is just right for left eye. The study mentions that the length of the hindlimb is slightly larger than one fourth distance of axilla to groin in the holotype but the measurement value in our adat is 15.1 mm which is smaller than one fourth of the distance of axilla to groin (ZMGU.2580, Fig. 3). In holotype specimen, the hand length is about two third of length of leg but in our specimen the forelimb

lenght is less than two third of the length of hindlimb (ZMGU.2580, Fig. 3). Therefore, further sampling is needed to shed more light of morphological variation and habitat insights of *O. nuchalis*.

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