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Walterinnesia aegyptia LATASTE, 1887 (OPHIDIA: ELAPIDAE) AND THE STATUS OF *Naja morgani* MOCQUARD 1905

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We separate the eastern populations of *Walterinnesia* in Iran, Iraq and eastern Saudi Arabia under the name *Walterinnesia morgani*. This taxon is easily separated from *Walterinnesia aegyptia* in Egypt, Israel, western Saudi Arabia, and Jordan by a significantly lower number of anterior dorsal scale rows. *Walterinnesia morgani* is also having on average a lower number of ventrals, subcaudals, and united subcaudals, as well as a completely different juvenile color pattern, consisting of 25 to 33 reddish crossbars on an otherwise black body. In *Walterinnesia aegyptia* the juvenile dorsal color is black without any pattern.

Keywords: Reptilia, Serpentes Elapidae, Bungarinae, *Walterinnesia aegyptia*, *Walterinnesia morgani*, taxonomy, Iran.

INTRODUCTION

Taxonomic considerations of the different populations of elapids, originally described as *Walterinnesia aegyptia* (Lataste, 1881) from Egypt, or as *Naja morgani* (Mocquard, 1905), or *Atractaspis wilsoni* (Wall, 1908) from Iran have appeared in the literature over times. Although elapid taxonomy and systematics in general are comparatively well settled, relatively little has been archived about this comparatively rare nocturnal desert-dweller.

Occasionally, speculations have focused on variation in juvenile color patterns in eastern specimens and whether a taxonomic separation (subspecies or species) could be justified. Already Haas and Werner (1969) stressed this question. However, problems to get access to enough specimens from the seemingly wide range of this taxon have made this task difficult.

The recent discovery of the species in southern Turkish Anatolia (Uğurtaş et al., 2001) further points to the fact that very little is known of the total distribution and geographical range as well as morphological variation of this nocturnal and to a high extent subterranean elapid. Recently we collected a few remarkable specimens of *Walterinnesia* far outside the known distribution of the species in Iran, which gave us an opportunity to focus on the taxonomy of the species in Iran and west Asia.

One big female was found on the southern slopes of the Elburz Mountains in Iran, about 2 km NW of the Karaj Dam and very close to the Karaj river on a steep gravel slope in a non-forested area with scarce vegetation. A juvenile specimen was collected outside Kermanshah City in the northern section of the Zagros Mountains. Both these records are far outside the known distribution of the species, and the Elburz record is amazing as it is at high altitude (2000 m) and on a mountain range that borders the southern shores of the Caspian Sea.

MATERIAL AND METHODS

29 specimens are included in this study (Table 1). Due to very variable condition of several of the specimens, all characters could not always be investigated. Sex determination could sometimes be difficult. In the cases of information taken from literature, character states such as number of subcaudals could sometimes indicate the sex. Statistical significant levels tested with the two-tailed Mann–Whitney *U*-test.

Museum acronyms for specimens examined of referred to from literature: GNM, Göteborg Natural History Museum, Göteborg, Sweden; BMNH, British Museum of Natural History, London, UK; CNHM, Chicago

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Natural History Museum, Chicago, IL, USA; CAS, California Academy of Sciences, San Francisco, Ca, USA; MNHN, Muséum national d'Histoire naturelle, Paris, France; MZUF, Museo Zoologico de "La Specola," University of Florence, Firenze, Italy.

Anterior scale rows were counted one head length posterior of head, midbody scale rows at midbody and posterior scale rows one head length anterior of anal.

RESULTS

There are clear differences between the eastern and western populations in morphology and this pattern has not been evident until now.

Eastern populations differ from the western ones in having a lower number of united subcaudals, lower number of anterior dorsal scale rows and a lower number of subcaudals in males (Tables 2 and 3). The eastern populations mostly have a completely different juvenile color pattern by having 25 – 33 dorsal, 1 – 3 scale rows wide, pinkish transverse bands on body (Figs. 2 and 3). All banded juveniles measured between 31 and 37 cm in total length. Juveniles in the western populations are completely black (Fig. 1).

In the eastern and western sample the number of anterior dorsal scale rows are completely separated within the sexes (Table 2). Also taken all specimens pooled the distance is distinguished between eastern and western samples, with no real overlap (Table 3). The difference

TABLE 1. Morphology of Key Characters in the Investigated Specimens of *Walterinnesia*

Specimen	Sex	Locality	Ant-sq	Midbody-sq	Post-sq	Subcaudals	United subcaudals	Ventr
		Eastern populations						
GNM Re.Ex. 6093	Female	Iran, Karadj-Chalus	23	23	17	44	0	197
CAS N220647	Female	Gaziantep, Turkey	23	21	17	43	4	186
MZUF 25588	Female?	Saudi Arabia		21		40	2	200
CNHM 74500	Female	Iraq, Kirkuk		23		40	2	192
GNM Re.Ex. 6125	Female	Iran, Souleman	21	23	17	41	3	189
Wall 1908:805	Female?	Iran	23	23	19	41	2	197
Haas and Werner 1969:366	Female	Iran		23		44		193
BMNH 1947.4143	Female	Saudi Arabia, 30 km N. Riyadh	22	23	17	42	0	199
BMNH 1951.1.2.8	Female? Juv.	Naft Khaneh, borders Iran/Iraq	21	23	17	44	8	192
BMNH 1931.12.1.1	Female	10 miles N Ahwaz, Persia	22	21	17	39	1	196
BMNH 1923.6.2.26.2	Female	Bagubab, W. Bagdad, Iraq	21	21	17	42	0	196
BMNH 1951.1.1.30	Female	Nasjid-j-Sulaiman, Khuzistan	23	23	17	40	2	189
GNM Re.Ex. 5754	Male	Iran, Kermanshah	21	23		47	7	181
Wall 1908:805	Male?	Iran	21	23	19	47	11	180
BMNH 1951.1.1.29	Male	Nasjid-j-Sulaiman, Khuzistan	22	23	17	47	9	189
BMNH 1935.2.1.33	Male	Saudi Arabia, Qaiiya (Qauya)	23	23	17	47	7	186
BMNH 1980.333	Male?	Saudi Arabia	21	23	17	46	8	183
		Western populations						
GNM Re.Ex. 5997	Female	Israel	24	23	(16)17	44	6	
Lataste 1887:412	Female	Egypt	27	23	17	46	8	198
BMNH 1930.12.1.7	Female	Egypt	25	23	17	45	2	195
BMNH JG70870	Male?	Saudi Arabia		23		43	13	192
CNHM 68810	Male	Egypt, Suez	27	23	17	53	9	189
Mertens 1929:41	Male	Egypt	27	23		46	7	191
CNHM 69240	Male	Egypt, 20 miles E. Cairo	27	23	17	51	13	186
Anderson 1898:325	Male	Egypt	25	23		48	8	189
Flower 1933, 829	Male	Egypt				48	3	
Flower 1923, 1083	Male	Egypt	29	23	17	51	6	190
BMNH-TYPE 1946.1.21.42	Male?	Egypt	23	23	17	45	4	194
BMNH-P-TYPE 92.6.28.1	Male	Egypt	26	23	17	48	9	186

Note. Eastern populations from Iran, Iraq, Turkey and east and south Saudi Arabia; western populations from north-west Saudi Arabia, Israel, Egypt.

is statistically significant ($p < 0.002$). Specimens of the western populations have in general 24 to 29 anterior dorsal scale rows while the eastern ones have between 21 and 23 scale rows. The only exception in the western series is the holotype (BMNH 1946.1. 21.42) from Cairo area, and which has only 23 anterior dorsal scale rows.

Also in number of ventrals the western ones have in average a higher number for both sexes. Also western females have a higher number of united subcaudals (Table 2).

In general the eastern ones seems to be more homogenous in body constitution while the western ones are more gradually diminishing in body diameter backwards as seen from scale reduction figures.

DISCUSSION

The population east of the Tigris is known to have a different juvenile color pattern with transverse narrow pinkish-brown cross-bands along the body (Anderson, 1963; Haas and Werner, 1969). This has led to speculations of a possible subspecific division (e.g., Joger, 1984; Gasperetti, 1988). With additional material from Iran we got the possibility to examine whether a morphological and historical separation between eastern and western populations could be postulated.

Our new material from Iran includes a couple of juvenile specimens with marked cross-banded pattern (Figs. 2 – 3). The border of distributions between this morph and the uniformly black juvenile morph is not

Fig. 1. *Walterinnesia aegyptia*. Juvenile specimen, 34 cm total length, from Israel. GNM Re.Ex. 5997.

Fig. 2. *Walterinnesia morgani*. Juvenile specimen, 37 cm total length, from Kermanshah province, Iran. GNM Re.Ex. 5754.

Fig. 3. *Walterinnesia morgani*. Juvenile specimen, 31 cm total length, from Khuzistan province, Iran. GNM Re.Ex. 6125.

TABLE 2. Comparison of Key Characters between Males and Females in Western and Eastern Specimens of *Walterinnesia*

	Anterior-sq			Subcaudals			United subcaudals			Ventrals		
	N	range	mean ± S.D.	*N*	range	mean ± S.D.	*N*	range	mean	*N*	range	mean ± S.D.
Males, east	5	21 – 23	21.6 ± 0.9*	5	46 – 47	46.8 ± 0.4	5	7 – 11	8.40 ± 1.7	4	180 – 189	184.5 ± 3.9
Males, west	7	23 – 29	26.3 ± 1.9*	9	43 – 53	48.1 ± 3.2	9	3 – 13	8.00 ± 3.5	8	186 – 194	189.6 ± 2.8
Females, east	9	21 – 23	22.1 ± 0.9**	12	39 – 44	41.7 ± 1.8	12	0 – 8	2.50 ± 2.9	12	186 – 200	193.8 ± 4.4
Females west	3	24 – 27	25.3 ± 1.3**	3	44 – 46	45.0 ± 1.0	3	2 – 8	5.33 ± 3.1	2	195 – 198	196.5 ± 2.1

*$p = 0.003$; **$p = 0.02$.

TABLE 3. Comparison between Two Main Morphological Differences in Eastern and Western Specimens of *Walterinnesia*

	United subcaudals			Anterior sq		
	N	mean ± S.D.	range	*N*	mean ± S.D.	range
East	16	4.13 ± 3.6	0 – 11	14	21.9 ± 0.9*	21 – 23
West	12	7.33 ± 3.5	2 – 13	10	26.0 ± 2.6*	23 – 29

*$p < 0.002$. Males and females are pooled together.

clear. The river Tigris has been stated as a western limit for this color pattern and three juvenile specimens from Saudi Arabia, examined by Gasperetti (1988), were all uniformly black. However, it is not stated from which part of Saudi Arabia the Gasperetti material originated. One juvenile specimen of 28 cm total length (BMNH 1980.333) from Wadi Qatan in southwestern Saudi Arabia, examined by us, was uniformly black. However, when comparing scalation characters most of the Saudi Arabian material examined agrees with the Iran/Iraq specimens. Only the north west Saudi Arabian specimens agree in pholidosis with Egyptian/Israeli specimens (Fig. 7).

Walterinnesia is known to avoid sandy deserts (Leviton et al., 1992) and is absent from most of the sand desert regions of Saudi Arabia and neighboring northern countries (Amr and Amr, 1983; Gasperetti, 1988; Disi et al., 2001). In Saudi Arabia the regions with Eolian sand dunes seem to be an efficient dispersal barrier. The sandy deserts in the Middle East are certainly an effective separation area of the western and eastern populations in the same way as it is for *Pseudocerastes*, which is divided in a western (*fieldi*) and an eastern (*persicus*) taxon. Also *Echis* is divided in a similar fashion.

The Turkish population (see Uğurtaş et al., 2001) is geographically closest to the Mosul population (see Reed and Marx, 1959) in Iraqi Kurdistan, and this would suggest that also the Turkish population belongs to the *morgani* lineage. The Turkish female specimen (CAS N220647) is also the single record from the vast area between the rivers Euphrates and Tigris. All other eastern samples from north Iraq and Kurdistan, as well as all Iranian samples, are east of the river of Tigris and east of Mesopotamia. The Turkish site seems to have a past shared fauna with other eastern populations, as at the same site also the gekkonid *Eublepharis angramainyu* was discovered recently (Orlov, personal communication). Of the western populations (the *aegyptia* lineage) the geographical closest populations seem to be in Jordan (Disi et al., 2001). In the number of anterior dorsal scale rows and number of subcaudals the Turkish specimen agrees with *morgani*.

The southernmost examined specimen (BMNH 1980.333 (70972)) from Wadi Quatan, Saudi Arabia (18°06′ N 44°07′ E) is geographically somewhat closer to the western series albeit morphologically it agrees totally with the eastern sample. It is a male with only 21 anterior dorsal scale rows and 183 ventrals. The low number of ventrals is below the range for all groups except eastern males (Table 2). From morphological points of view it agrees with *morgani*.

The division of the *Walterinnesia* populations into eastern and western taxa reflects to some extent a vicariant event, with species-pair — like *Pseudocerastes persicus — P. fieldii* and *Cerastes gasperetti — C. cerastes* showing a similar division.

TAXONOMIC ACCOUNT

The separation of *Walterinnesia aegyptia* into two taxa seems reasonable to us based on external morphological characters. In herpetology for long times there is a tradition to divide species into subspecies. However, subspecies are actually incipient species and "subspecies" with an allopatric distribution and acting as species in the nature could just as well be treated as full species.

Walterinnesia aegyptia Lataste, 1887

Walterinnesia aegyptia Lataste, 1887; *La Naturliste*, **1887**:411.

Terra typica. al-Qahira (surroundings of Cairo), Egypt.

Holotype. Natural History Museum, London, No. 1946.1.21.42. Leg. Walter Innes.

Diagnosis. Black juvenile color (Fig. 1) and a significantly higher and non-overlapping number of anterior dorsal scale rows in both sexes. Further, higher number of subcaudals and ventrals in both sexes, higher number of united subcaudals in females.

Distribution. Its main distribution is restricted to southern Israel, north western Saudi Arabia, western half of Jordan, the Sinai peninsula and Egypt to the east of the Nile (Fig. 7).

Material examined ($N = 12$; see Table 1). **Egypt:** BMNH 1946.1. 21.42 (holotype — *aegyptia* — according to the catalogue in BMNH and label); BMNH 92.6. 28.1 (paratype?; but according to the scale count (see Table 1) this is the specimen that is listed as "type" in Boulenger Catalogue of Snakes in the British Museum 1896); BMNH 1930.12.1.7. **Israel:** GNM Re.Ex. 5997l. **Literature specimens:** Egypt: Marx 1953 — CNHM No. 68810; CNHM No. 69240. Including detailed data in Gasperetti (1988), Wall (1908), Haas and Werner (1969), Lataste (1887), Mertens (1929), Anderson (1898), and Flower (1923, 1933).

Walterinnesia morgani (Mocquard, 1905), new combination

Naja morgani Mocquard, 1905; *Bull. Mus. Hist. Nat. Paris*, **11**:78.

Terra typica. Khuzestan (Arabistan), Iran. *Naja morgani* was described on the basis of five syntypes collected by Morgan with the collect data information "Perse." Their collection numbers are MNHN 1904.562 to 1904.566.

Atractaspis wilsoni Wall, 1908; *J. Bombay Nat. Hist. Soc.*, **18**:804.

Terra typica. Maidan Mihaftan, Iran

Diagnosis. Juvenile pattern with 25 to 33 reddish crossbars on a black body (Figs. 2 – 3) and a significantly lower and non-overlapping number of anterior dorsal scale rows in both sexes. Further, lower number

of subcaudals and ventrals in both sexes, lower number of united subcaudals in females.

Comment. The remote Elburz female (Fig. 4: GNM Re.Ex. 6093) is special by having all subcaudals divided. The presence of few to many united subcaudal scales is often stated as characteristic for *Walterinnesia*. In *W. morgani* three specimens were found with all subcaudals divided (Figs. 5 – 6).

Distribution. In Iran the actual distribution is restricted to the western parts of the country (Fig. 7). The main occurrence is in Khuzistan and Fars provinces at the foothills of the Zagros mountains. Our new material extends the range much to the north and northeast. The record from the Elburz mountains (GNM Re.Ex. 6093) is remarkable as it goes up into a high (2000 m) and dry rocky steppe region of the southern slopes of the Elburz mountains. By this, it approaches the Caspian Sea. Also the Kermanshah record (GNM Re.Ex. 5754) is far outside the previously known range and at the foothills of the Zagros mountains in Kurdistan. The habitat is agriculture (wheat and peas cultivations) and *Artemisia* steppe. To some extent it resembles the Jarmo and Mosul records from northern Iraq, which also are outside the traditionally supposed suitable desert habitat. The Jarmo habitat is a steppe habitat (Reed and Marx, 1959; Leviton et al., 1992) and thereby similar to the Kermanshah habitat,

Except the Mosul and Jarmo records in the north, the main distribution in Iraq seems to be in the south towards Iran, Kuwait and Saudi Arabia (Gasperetti, 1988) although Corkill (1932) stated that "*Naja morgani* is apparently uniformly distributed throughout Iraq." The range continues along the coastal regions along the Persian Gulf on the Saudi Arabian side down to United Arab Emirates and inland in the surroundings of Riyadh and down to Wadi Qatan in the south west of Saudi Arabia. In the north it enters Turkey in the province Urfa (Fig. 7).

Material examined ($N = 17$; see Table 1). **Iran:** GNM Re.Ex. 5754; GNM Re.Ex. 6093; GNM Re.Ex. 6125; BMNH 1931.12.1; BMNH 1951.1.1.29; BMNH 1951.1.1.30. **Iraq:** BMNH 1919.7.18.29; BMNH 1951.1.2.8; BMNH 1923.6.2.26.2. **Saudi Arabia:** BMNH 1935.2.1.33; BMNH 1947.4143; BMNH 1980.333. **Literature specimens:** Iraq: Reed and Marx 1959 — CNHM No. 74500; Turkey: Uğurtaş et al., 2001

Fig. 4. *Walterinnesia morgani*. Adult specimen, 100 cm total length, from Elburz mountains, Tehran province, Iran. GNM Re.Ex. 6093.

Fig. 5. *Walterinnesia morgani*. Tail with all subcaudals divided. GNM Re.Ex. 6093 from Elburz, Iran.

Fig. 6. *Walterinnesia morgani*. Tail with seven out of 47 subcaudals undivided. GNM Re.Ex. 5754 from Kermanshah, Iran.

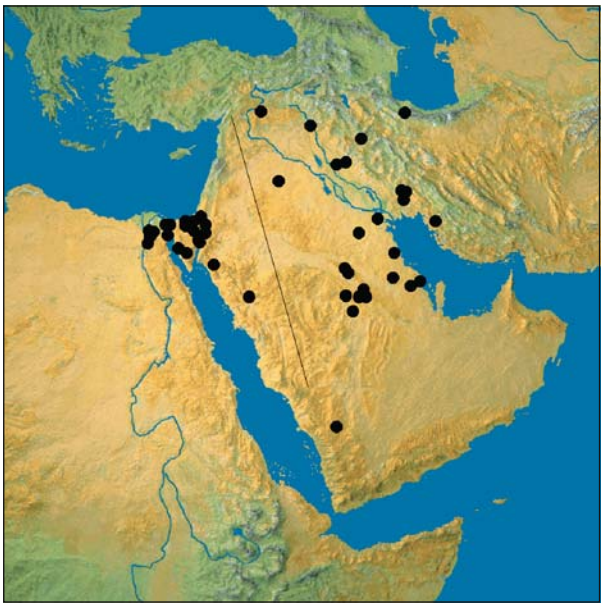

Fig. 7. Distribution of the two taxa of *Walterinnesia*, with *aegyptia* to the west (links) and *morgani* to the east (right) of the dotted line. Localities based on literature and examined museum specimens.

— CAS N220647. Including detailed data in Gasperetti (1988), Wall (1908), Haas and Werner (1969), Lataste (1887), Mertens (1929), Anderson (1898), and Flower (1923; 1933).

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