

Captive reproduction of *Eirenis levantinus* SCHMIDTLER, 1993 with comments on some congeners (Squamata: Serpentes: Colubridae)

Fortpflanzung von *Eirenis levantinus* SCHMIDTLER, 1993 in Gefangenschaft,
nebst Bemerkungen zu einigen Gattungsgenossen
(Squamata: Serpentes: Colubridae)

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KURZFASSUNG

Über die Fortpflanzungsbiologie der *Eirenis*-Arten ist wenig bekannt. Die Autoren berichten von Gefangenschaftsbeobachtungen am Fortpflanzungsgeschehen zweier Pärchen von *Eirenis levantinus* SCHMIDTLER, 1993 vom Südrand der Verbreitung und vergleichen die Ergebnisse mit Daten vom Norden des Verbreitungsgebietes. Die Tiere waren zumindest bis zum neunten Lebensjahr fortpflanzungsfähig. Die Gelege bestanden aus 3-5 Eiern. Die mittlere Eigröße bei der Ablage betrug 20,0 x 4,9 bis 30,0 x 10,0 mm, wobei die Masse etwa 2,2 g ausmachte. Die Eiablage erfolgte zwischen Ende Juni und Mitte Juli. Die Inkubation dauerte je nach Umgebungstemperatur 44-50 Tage. Die Schlüpflinge waren 120-145 mm lang und wogen 1,0-1,25 g. Die Jungtiere häuteten sich erstmalig im Alter von 10-14 Tagen, und ein zweites Mal 34-40 Tage danach. Ein kurzer Überblick über aktuelle Berichte von anderen Arten der Gattung beinhaltet zwei Fälle, in denen *Eirenis rothii* JAN, 1863 Gelege bestehend aus zwei Eiern ablegte, die etwa 25 x 5 mm maßen.

ABSTRACT

The reproductive biology of *Eirenis* species is little known. We report on captive reproduction episodes from two pairs of *Eirenis levantinus* SCHMIDTLER, 1993, from the southern limit of the range, and compare with data from the north of the range. Individuals reproduced at least to the age of nine years. Clutch size was 3-5 eggs. Average egg size at oviposition was between 20 x 4.9 and 30 x 10 mm, with a mass of approx. 2.2 g. Oviposition occurred between late June and mid-July. Incubation lasted, depending on temperature, 44-50 days. Hatchlings measured 120-145 mm, total length, and weighed 1.00-1.25 g. Depending on temperature, juveniles sloughed first at an age of 10-14 days, and a second time 34-40 days later. A partial brief review of recent reports on congeners includes two cases of *Eirenis rothii* JAN, 1863 laying clutches of two eggs measuring approx. 25 x 5 mm.

KEY WORDS

Reptilia: Squamata: Serpentes: Colubridae: Colubrinae: *Eirenis barani*, *Eirenis coronella*, *Eirenis levantinus*, *Eirenis lineomaculatus*, *Eirenis modestus*, *Eirenis rothii*, clutch size, egg size, reproduction, duration of incubation, biology, ecology

INTRODUCTION

In recent decades the systematics of the south-west Asian dwarf-snakes of the genus *Eirenis* JAN, 1863 advanced considerably (SCHMIDTLER & SCHMIDTLER 1978; SCHMIDTLER 1988, 1993, 1997; DOTSSENKO 1989; FRANZEN & SIGG 1989; SCHMIDTLER & LANZA 1990; SCHMIDTLER & EISELT 1991; SIVAN & WERNER 2003; NAGY et al. 2003) but their biology remained little known (SEUFER 2009). This is a little surprising because most of the approximately 18 species of the genus prey mainly on terres-

trial arthropods, eating arachnids, centipedes and insects (SHWAYAT 1998; SHWAYAT et al. 2009; SEUFER 2009), and therefore relatively inexpensive to study in captivity. Indeed there exist some scattered observations in the amateur literature (reviewed by SEUFER 2009). Recently an examination of field-collected specimens, in Jordan, yielded some dietary data (SHWAYAT 1998; SHWAYAT et al. 2009); measurements of museum specimens, in Israel, yielded some data on sexual size dimorphism (WERNER &

VENTURA, in press); and the reproduction of some species in captivity was reported or reviewed (SEUFER 2009).

Here we report captive reproduction of the little-known *Eirenis levantinus*

SCHMIDTLER, 1993, at the southern limit of its range, and compare our data with data from the northern limit of its range (SEUFER 2009). For comparison, we contribute or quote clutch data for some congeners.

MATERIALS AND METHODS

Abbreviations

HUJ-R, Herpetological Collection, the Hebrew University of Jerusalem. PERCRA, percents of rostrum-anus length (WERNER 1971). RA, rostrum-anus length (WERNER 1971). TAU-R, Reptile Collection, Tel Aviv University, Tel Aviv.

The study organism

Eirenis levantinus SCHMIDTLER, 1993, earlier included in *Eirenis modestus* (MARTIN, 1838) (SCHMIDTLER & BARAN 1993), is a small 'aglyphous' colubrine, up to 480 mm in total length. It has 17 rows of dorsals. Within the recent splitting of *Eirenis* into subgenera it belongs to subgenus *Pediophis* FITZINGER, 1843 (NAGY et al. 2003). It is distributed in mesic Mediterranean habitats of the northern Levant, from southern Turkey (around the Bay of Iskenderun) to northernmost Israel (SCHMIDTLER 1993, 1997) and including

Cyprus (SCHMIDTLER et al. 2009). In Israel (*sensu lato*) it is mainly known from the heights of Mt. Hermon, but it was twice collected in one lush wadi in the Upper Galilee (HUJ-R 3,661; TAU-R 12,471). It is terrestrial, diurnal, and mainly encountered under stones.

Our observations derive from two pairs of adult individuals from Mt. Hermon and southern Lebanon. Their data are presented under Results.

Methods

Observations were carried out (by AL) during 1984 in the Department of Zoology, Tel Aviv University (Tel Aviv, Israel). The two pairs were housed separately in two indoor terraria furnished with clay flower-pots for shelter, at room temperature. Eggs were incubated in moist sand. In addition to weighing and measuring them, we calculated their ellipticity, i.e. ratio width to length (WERNER 1972).

RESULTS

Parents

Pair 1: ♂ #EL3 Caught on Mt. Hermon, at an elevation of 1,600 m, on 10 June 1981, by Y. YOM-TOV. After this project, its fate is unknown to the authors. ♀ #EL6 From Lebanon: Baka Valley, 15 km N of Benot-Damaskus Rd., at an elevation of 400 m, on 15 June 1982, coll. Z. SEVER. Died on 2 April 1985, then RA = 290 mm, tail = 80 mm, preserved as TAU-R13048.

Pair 2: ♂ #EL1 From Mt. Hermon, at an elevation of 1,450 m, on June 1978, A. FREIDBERG. Died on approx. 2 March 1986, then RA = 335 mm, tail = 100 mm, preserved as TAU-R13411 (Fig. 1 A). ♀ #EL5

From Mt. Hermon, at an elevation of 1,600 m, on 24 April 1982, A. HEFETZ. Died on 24 January 1985, then RA = 333 mm, tail = 96 mm, preserved as TAU-R 13014.

Oviposition and eggs

The female of pair 1 (#EL6) oviposited three eggs on 15.VII.1984; their sizes on two dates (25.VII and 27.VIII) are summarized in Table 1. During the central month of incubation, the eggs became more elongate, and their average ellipticity dropped from 0.3535 to 0.3129. They hatched during 2-3.IX. 1984, i.e. after 49-50 days: On 2.IX hatchling #EL6-1, on

Table 1: Measures of the eggs ($n = 3$) of ♀ #EL6 (of pair 1) of *Eirenis levantinus* SCHMIDTLER, 1993 on two dates in 1984.Tab: 1: Eimaße ($n = 3$) von ♀ #EL6 (von Pärchen 1) von *Eirenis levantinus* SCHMIDTLER, 1993 an zwei Tagen im Jahr 1984.

Date / Datum	Mass / Masse (g)		Length / Länge (mm)		Width / Breite (mm)	
	25.VII	27.VIII	25.VII	27.VIII	25.VII	27.VIII
Mean / Mittelwert	2.12	2.40	29.7	31.2	10.5	10.7
Minimum	2.08	2.10	29.3	30.0	10.0	10.3
Maximum	2.19	2.58	30.0	32.7	11.0	11.3

3.IX #EL6-2. The third embryo died while hatching.

The partners of pair 2 were kept separately since capture until 27.IV.1984, when the male was placed into the female's terrarium, after almost six years and respectively, two years of solitude. Their terrarium was furnished with two flowerpots for shelter. Occasionally the snakes were observed sheltering separately, each in its flowerpot. However, on 29.IV they were part of the day together under one flowerpot; later the same day they again dispersed to the two pots. On 1.VII the female laid 5 eggs, 65 d after being joined and 63 d after being known to have sheltered together. The measures of these eggs on three dates are summarized in Table 2.

Initially the eggs' mean ellipticity had been 0.2379. Then the eggs grew particularly in width and by 25.VII ellipticity reached 0.5336. By 10.VIII ellipticity dropped to 0.3944.

During 18-19.VIII.1984 two eggs hatched, the masses of the hatchlings were 0.96 g (#EL5-1) and 0.89 g (#EL5-2). The empty eggshells weighed 2.05 and 1.28 g. These materials together amounted to 5.18 g. The difference from the expected 5.46 g for two whole average eggs may be due to

variation in the sample, or loss of egg-white and water, including evaporation from the shells during the hour that elapsed between hatching and weighing.

At this time (19.VIII), the two remaining eggs measured, 2.63 g (30.8 x 12.4 mm); and 2.67 g (29.3 x 12.1 mm). Within the next few days both collapsed, then spoiled. There is no information about the fifth egg.

Offspring

Hatchling #EL6-1 (TAU-R 13010) that hatched during 2.IX.1984, was kept on a mixture of dry sterilized sand and moist peat, a 1:1 mixture. On 2.IX it weighed 1.27 g, on 13.IX it underwent its first slough, and on 17.IX it ate its first cricket. On 11.XI, weighing 1.2 g, it stopped eating. On 24.II.1985 it died with concave abdomen, measuring RA = 116 mm, tail = 29 mm (25.0 PERCRA).

Hatchling #EL6-2 (TAU-R 13104) that hatched during 3.IX.1984, on 3.IX weighed 1.02 g, and was moved to a container with dry sterilized sand. On 15.X, now on moist sand mixed with peat, it started to slough, had difficulty, so was assisted. Thereupon it weighed 0.87 g, refused food, and on 31.X died in poor condition, measur-

Table 2: Measures of the eggs ($n = 5$ but on 10.VIII, $n = 4$) of ♀ #EL5 (of pair 2) of *Eirenis levantinus* SCHMIDTLER, 1993 on three dates in 1984.Tab: 2: Eimaße ($n = 5$, aber am 10.VIII, $n = 4$) von ♀ #EL5 (von Pärchen 2) von *Eirenis levantinus* SCHMIDTLER, 1993 an drei Tagen im Jahr 1984.

Date / Datum	Mass / Masse (g)			Length / Länge (mm)			Width / Breite (mm)		
	2.VII	25.VII	10.VIII	2.VII	25.VII	10.VIII	2.VII	25.VII	10.VIII
Mean / Mittelwert	2.1	2.81	2.73	20.6	23.8	30.1	4.9	12.7	12.2
Minimum	1.24	2.73	2.17	19.4	27.7	27	4.6	11.8	11.8
Maximum	3.07	2.85	3.03	22.7	31.8	32.2	5.1	13	12.7

ing RA = 101 mm, tail = 22 mm (21.8 PER-CRA).

Hatchling #EL5-1 (TAU-R 13011) (Fig. 1 B) that hatched during 18-19.VIII.1984 and on 19.VIII weighed 0.96 g, ate its first cricket on 21.VIII and first sloughed on 2.IX.

On 10.IX it weighed 1.08 g. Thereafter it gradually declined and despite sloughing on 12.X, it died, thin, on 4.XII.1984, measuring RA = 101 mm, tail = 30 mm (29.7 PER-CRA). Its litter-mate #EL5-2 was attacked and eaten by ants during its first night.

DISCUSSION

Sexual size dimorphism is unclear in *E. levantinus*. Herein, in pair 1 the male's data are lost, and in pair 2 the sexes were practically equally large (the male's tail was a little longer). In a small museum sample from the southern limit of the distribution the male is approximately 10% longer (RA) than the female, as in the similar but larger *E. decemlineatus* (DUMÉRIL, BIBRON & DUMÉRIL, 1854) (WERNER & VENTURA, in press) although according to NAGY et al. (2003) these two are not closely related. In the other, small, species of *Eirenis* in Israel, *E. coronella* (SCHLEGEL, 1837), *E. lineomaculatus* SCHMIDT, 1939 and *E. rothii* JAN, 1863, the female is the larger sex (WERNER & VENTURA, in press). This accords with Rensch's rule, that across species within a lineage, size dimorphism will increase with increasing body size when the male is the larger sex, and decrease with increasing body size when the female is the larger sex (reviewed in ABOUHEIF & FAIRBAIRN 1997).

SEUFER (2009) provided the only available report of reproduction in this species, based on a captive pair from 25 km N of Tarsus, Turkey (elevation 600 m) – approximately 400 km north of the area of origin of our individuals. He emphasized the scarcity of reproductive data for the genus. His project, like ours, included two reproduction episodes, and involved individuals that had already been maintained in captivity for six to nine years. He provides a rare report of copulation by his *E. levantinus*: At 11:30 h the male bit the female approximately 10 cm behind her head but by 12:00 h the hold was advanced to the head, where it was maintained throughout the copulation that lasted from 12:10 to 13:15. The holding bite is apparently not uniform for the genus. The duration of pregnancy (from mating to oviposition) remains unclear. In our case it was maxi-

mally 65, probably only 63 days but could have been shorter. SEUFER's (2009) mating report does not state the date but his table indicates a pregnancy of 44 days.

Eirenis clutches appear to comprise relatively few but relatively large eggs. Our observation of three and five eggs resembles that of SEUFER (2009), four and five eggs. Our egg size data, between 20.0 x 4.9 and 30.0 x 10.0 mm, with ellipticity of 0.2379-0.3535 seem to resemble SEUFER's for his freshly laid clutch of four, 27.25 (24-31) x 11 (10-12) mm, with average ellipticity 0.4037. This similarity of our data and SEUFER's (2009) (keeping in mind the tiny sample sizes) is of interest in view of a widespread trend for northern hemisphere reptile clutches to be larger in the north (FITCH 1985).

The dates of oviposition, 1.VII and 15.VII.1984, were somewhat later than in SEUFER's (2009) snakes – 24.VI and 2.VII. This seems surprising in view of the geographical situation, and perhaps was affected by maintenance conditions (partly unspecified).

The duration of incubation was in both our clutches 49-50 days, thus a little longer than in the 44 days of the clutch reported by SEUFER (2009). Assuming an equal developmental stage at the time of oviposition (always an unknown variable), this too indicates a possibly higher maintenance temperature of SEUFER (2009).

Our monitoring of average egg size during incubation (in lieu of marking individual eggs) raises the possibility that towards hatching some shrinkage of eggs may have occurred. However, pliable-shelled eggs of squamates may shrink a little at the end of incubation, depending on hydric conditions, without jeopardizing normal hatching (BUSTARD 1966; GUTZKE & PACKARD 1987).

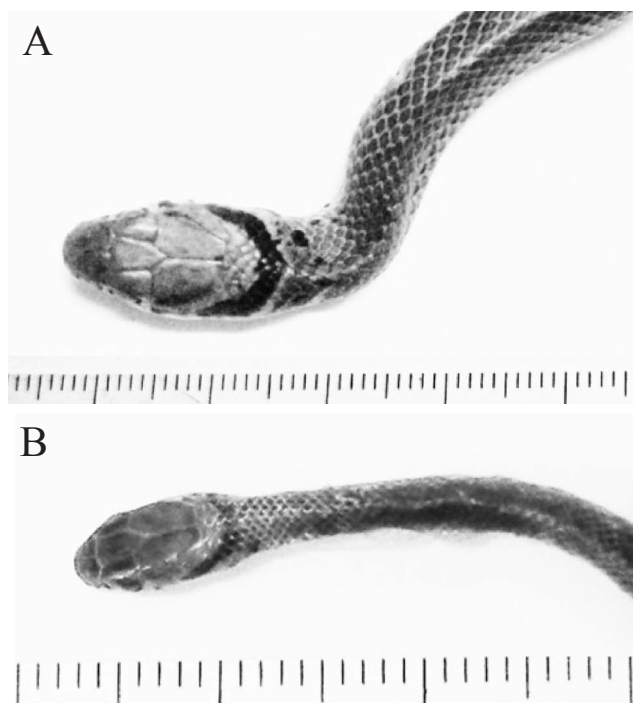


Fig. 1: *Eirenis levantinus* SCHMIDTLER, 1993 from Mt. Hermon.
A - The male of pair 2 (#EL1; TAU-R13411); B - Its offspring, hatchling #EL5-1 (TAU-R 13011).
Note the difference in head shape, due to allometric elongation of the snout with growth.
The rulers show cm and mm.

Abb. 1: *Eirenis levantinus* SCHMIDTLER, 1993 vom Hermon Gebirge.
A – Männchen von Paar 2 (#EL1; TAU-R13411). B – Sein Nachkomme, Schlüpfling #EL5-1 (TAU-R 13011).
Man beachte die unterschiedliche Kopfform aufgrund allometrischer Verlängerung
der Schnauze während des Wachstums. Die Maßstäbe zeigen cm und mm.

A difference between our and SEUFER's (2009) data occurred also in the timing of the first slough: at the age of 11-14 days in our experience, 10 days in SEUFER's. By the same token, our snakes experienced an interval of 40 days till the second slough, and SEUFER's (2009) – 34 days.

The failure, in both projects, to hatch some of the eggs, and in ours, to raise the hatchlings, shows that the maintenance conditions for this species need to be learned. But the similarity of the results is reassuring, that some robust biological data have been obtained.

Additionally, some data regarding congeners are relevant. SEUFER (2009) reports captive reproduction in *E. modestus*

laying a clutch of five eggs, and *E. barani* SCHMIDTLER, 1988 laying in three successive years clutches of three, four and three eggs each; one egg measured 25 x 8 mm (ellipticity 0.32).

There are two records of oviposition in captivity by wild-caught female *E. rothii* from Israel. On 12.VII.1956 a female laid two elongate eggs of approx. 25 x 5 mm (ellipticity 0.2), and on 1.VII.1995 another female laid two eggs of 25 x 6 mm (ellipticity 0.24) (WERNER, in prep). Reports from Jordan include an *E. coronella* that on dissection contained a clutch of five (DISI et al. 2001), another *E. coronella* [but this might also have been *E. coronelloides* (JAN, 1862)] that in captivity laid five eggs aver-

aging 22 x 6 mm (ellipticity 0.273), and clutches of *E. lineomaculatus* comprising 3-8 eggs [but for the last a multi-female aggregate is conceivable] (DISI 2002).

Thus, in summary, by now there are some clutch-size reports for six small

species of *Eirenis*, comprising 2-5 (perhaps up to 8) eggs. Despite the scarcity of observations, some consistent specific clutch sizes appear to be indicated, such as *E. rothii* 2; *E. barani* 3-4 and *E. levantinus* 3-5.

CONCLUSIONS

1. In captivity, individuals of *Eirenis levantinus* can engage in reproduction at least to the age of nine years.
2. Clutch size is 3-5 eggs.
3. Average egg size at oviposition ranges between 20 x 4.9 and 30 x 10 mm with a mass of approx. 2.2 g.
4. The season of oviposition is from late June to mid-July.

5. The duration of incubation, depending on temperature, ranges 44-50 days.
6. Hatchlings measure 120-145 mm, total length, and weigh 1.0-1.25 g.
7. Depending on temperature, the juveniles slough first at the age of 10-14 days, and a second time 34-40 days later.
8. The optimal rearing conditions remain to be studied.

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