Reproduction in the Beerr Sheva fringe-fingered lizard, *Acanthodactylus beershebensis* (Squamata: Lacertidae) from Israel

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The ground-dwelling lacertid lizards, *Acanthodactylus*, are found in the Old World where they occur in sandy areas from south-east Turkey to southern Arabia and from the Mediterranean and Red Sea to Pakistan and north-west India (Harris & Arnold, 2000). There are currently 42 recognized species of *Acanthodactylus* (Uetz & Hosek, 2014). The Beerr Sheva Fringe-fingered Lizard, *Acanthodactylus beershebensis* Moravec, El Din, Seligmann, Sivan & Werner, 1999 is found in Israel, Gaza and the West Bank where it inhabits loess flatlands in the Negev and the southern Judean Desert (Sindaco & Jeremcenko, 2008; Bar & Haimovitch, 2011). All lizards utilized in this study were taxonomically identified as *A. beershebensis*. Frankenberg & Werner (1992) reported a mean clutch size of 4.8. range = 3-7 for 25 *A. beershebensis* (as *A. pardalis*). The purpose of this paper is to supply additional information on the reproductive cycle of *A. beershebensis* from a histological examination of museum specimens from Israel as part of an ongoing series of studies on the timing of events in the reproductive cycle of Middle-Eastern lizards. In view of the difficulty in obtaining collecting permits for large monthly samples of reptiles, utilizations of existing collections in museums has become increasingly important.

A sample of 53 *A. beershebensis* consisting of 25 mature males (mean snout-vent length, SVL = 65.3 mm ± 6.0 SD, range = 54-75 mm), 27 mature females (mean SVL = 63.0 mm ± 5.9 SD, range = 55-72 mm) and one subadult female (SVL = 53 mm) collected in Israel between 1941–2008 and deposited in the Zoological Museum of Tel Aviv University (TAUM), Tel Aviv, Israel was examined by (region): Central Negev: 996–998, 1628, 1629, 2505–2209, 3645; Northern Negev: 905, 906, 940, 941, 1039, 1041, 1046, 1047, 1049, 1050, 1052, 1586, 2105, 2106, 2110, 2804, 2805, 2911, 2917–2921, 2923–2927, 3854, 4248, 4869, 5165, 5167, 15845, 15846; Yehuda Desert: 892, 916, 922, 923, 958, 960, 1734.

A small slit was made in the left side of the abdomen and the left testis was removed from males and the left ovary was removed from females for histological examination. Enlarged ovarian follicles (> 4 mm) or oviductal eggs were counted in situ. No histology was performed on them. There was a high probability that follicles of > 4 mm size would have completed yolk deposition and ovulated. Removed gonads were embedded in paraffin, sections were cut at 5 μm and stained by Harris' hematoxylin followed by eosin counterstain (Presnell & Schreibman, 1997). Slides of the testes were categorized as to the stage of the testicular cycle. Epididymides were examined for the presence of sperm. Slides of ovaries were examined for yolk deposition or corpora lutea. Histology slides were deposited in the National Collections of Natural History at Tel-Aviv University. Mean body sizes (SVL) of male and female *A. beershebensis* were compared using an unpaired t-test; the relation between female body size (SVL) and clutch size was examined by linear regression analysis (Instat vers 3.0b, Graphpad Software, San Diego, CA).

There was no significant size difference in mean SVL length between adult male and female samples of *A. beershebensis* (unpaired t–test, t = 0.1, p = 0.16). Two stages were noted in the testicular cycle: (1): spermiogenesis (seminiferous tubules lined by clusters of sperm and/or metamorphosing spermatids; (2) recrudescence = renewal (proliferations of germ cells for the next period of spermiogenesis). Primary spermatocytes predominated. Males undergoing spermiogenesis by month were: February (N = 2), March (N = 4), April (N = 12), July (N = 1), October (N = 3), November (N = 2). Epididymides of all spermiogenic males contained sperm. The one September male examined (TAUM 1586) exhibited recrudescence. The epididymides was empty. In the present study *A. beershebensis* males from August were not examined so it is not known if the September male in recrudescence was preceded by a summer period of regression which is common in temperate zone lizards (Goldberg 1974; 1975). The smallest reproductively active male (spermiogenesis) measured 54 mm SVL (TAUM 2505) and was collected in March.

Four stages were present in the ovarian cycle (Table 1); (1) quiescent, no yolk deposition; (2) yolk deposition, basophilic yolk granules in the ooplasm; (3) enlarged ovarian follicles > 4 mm; (4) oviductal eggs. The female reproductive period encompassed February to April. Three females from February with follicles > 4 mm but no oviductal eggs suggests February is close to the start of female reproduction. It is not known when female reproductive activity ceased as no samples from May or June were examined. Mean clutch size (N = 22) was 4.9 ± 1.2.SD, range = 3-7. Linear regression analysis revealed a significant positive relation between female body size (SVL) and clutch size (N = 22): Y = -4.36 + 0.143X, r = 0.62, p = 0.002. Three females with oviductal eggs and concurrent yolk deposition from March indicate *A. beershebeensis* may produce multiple clutches in the same reproductive season. The smallest reproductively active females, both from February, measured 55 mm SVL (TAUM 2209, yolk deposition; (TAUM1050, 3 follicles > 4 mm). One slightly

smaller female (SVL = 53 mm) with quiescent ovaries from August (TAUM 15846) was considered to be a subadult.

The mean clutch size of 4.9 ± 1.2 SD, range is almost identical to that of Frankenberg & Werner (1992) for *A. beershebensis* (as *A. pardalis*). Production of multiple clutches has been reported for other species of *Acanthodactylus*: *A. erythrurus* in Spain (Carretero & Llorente, 1995) and *A. schmidti* in Saudi Arabia (Al-Johnay & Spellerberg, 1988). Perry & Dmi'el (1994) reported the congener *A. scutellatus* from Israel deposited 1-4 clutches in captivity between May and June. However, adverse weather conditions may reduce production of multiple clutches by females of *Acanthodactylus* (Castlla et al., 1992). As has been reported for other lizards from Israel (Goldberg, 2011; 2012; 2013), *A. beershebensis* commences spermiogenesis in autumn. Examination of other lizards from the Middle East are needed to ascertain whether fall spermiogenesis is typical for lizards from this region.

	N	Quiescent	Yolk deposition	Enlarged follicles >4	Oviductal eggs
February	3	0	0	3	0
March	12	0	0	6	6***
April	8	0	1	4	3
September	2	2	0	0	0
November	2	2	0	0	0

Table 1. Monthly stages in the ovarian cycle of 27 Acanthodactylus beershebensis from Israel; * indicates a female with oviductal eggs and concurrent yolk deposition for a subsequent clutch.

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