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Short Communication

Reproduction in the brown house snake, *Lamprophis fuliginosus*, from Tanzania

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The brown house snake, *Lamprophis fuliginosus*, is one of the most common and widespread African snakes, ranging from southern Africa up to Senegal in the west and to Eritrea and Sudan in the east (Broadley 1983). Some reproductive data on this species are available in the literature as it readily breeds in captivity. However, these records usually incorporate information obtained for single females from several years or females from various localities (Haagner 1987).

Certain species of snakes have been noted to exhibit significant geographic variation in life history traits such as clutch size and offspring size (e.g., Fitch 1985; Gregory & Larsen 1993, 1996). Regional selection pressures on offspring and adult size appear to be important for snakes, with the interaction with clutch size influenced by local prey availability (Seigel & Ford 2001). It seems likely that a wide-ranging species such as *L. fuliginosus* will also show substantial variation in its reproductive traits, much of which could correlate to adaptation for local conditions. Indeed, in my laboratory, clutch size in this species varies from 2 - 30 and egg size from 1.5 - 14 g. However, this colony was established with animals from different geographical (and often unknown) areas. To understand the nature of this variation, it is important to collect reproductive data from animals from known localities. This is a report on reproduction from 13 animals collected in Arusha, Tanzania.

Variation in clutch size for snakes has been correlated to variation in maternal size, variation in the habitat in which the animals occur, and variation in stochastic events like prey availability based on rainfall (Ford & Seigel 1989b, 1994; Seigel & Ford 2001). The reproduction of *L. fuliginosus* has been documented for three specimens from the Verwoerdburg and Pretoria North areas of South Africa (Haagner 1987). Clutch size varied from 5 - 18 with the mean mass of eggs of one clutch measuring 3.81 g (SD 0.26). Haagner (1987) also presented records for 12 females from the literature, which documented a significant relationship between the female length and clutch size (R^2 = 0.76; $y = 392.78\ x^{0.35}$). The data for this regression were gathered from records of single females from both widespread and unspecified localities.

Reproduction of multiple female *L. fuliginosus* from a single locality has not been previously recorded and variation in characteristics such as clutch size and egg size within and among females has not been documented before. In November of 1999, I obtained 16 female *L. fuliginosus* imported from Arusha, Tanzania. The animals were collected about 15 km southwest of the Kilimanjaro airport in a dry savanna during the rainy season. By 1 March 2000, 13 females had each produced a clutch. Although these animals were commercially imported, the collector indicated that they had been very recently collected (Berraducci, *pers.*

Table 1. Reproductive data from 13 *Lamprophis fuliginosus*, from Arusha, Tanzania. Values are the mean, ± SD (CV). Mass in g; Length in mm; Pp = Postparturition; RCM = Relative Clutch Mass.

ID	Female SVL	Pp Mass	Clutch size	Egg Mass	Egg Length	Egg Width	Total Mass	RCM
1	730	107	7	5.0 ± 0.24 (4.8)	31.2 ± 0.92 (2.9)	15.6 ± 0.44 (2.8)	35.0	33
2	670	88	6	8.1 ± 0.50 (6.1)	49.7 ± 2.38 (5.8)	16.9 ± 0.22 (1.3)	48.8	55
3	650	103	6	7.6 ± 0.41 (5.4)	36.2 ± 2.70 (7.5)	18.2 ± 0.59 (3.2)	45.3	44
4	740	175	6	9.0 ± 0.50 (5.5)	39.2 ± 1.86 (4.8)	18.3 ± 0.38 (2.1)	54.1	31
5	640	90	5	8.3 ± 0.59 (7.0)	41.1 ± 3.12 (7.6)	16.9 ± 0.35 (2.1)	41.7	46
6	680	103	7	6.8 ± 0.36 (5.3)	33.4 ± 1.27 (3.7)	17.2 ± 0.15 (0.9)	47.4	46
7	710	104	8	6.4 ± 0.39 (6.1)	31.8 ± 1.91 (6.0)	17.4 ± 0.12 (0.7)	51.4	49
8	640	96	7	5.7 ± 0.34 (6.0)	35.4 ± 0.97 (2.7)	15.6 ± 0.30 (0.2)	40.2	42
9	710	120	7	8.5 ± 0.45 (5.4)	37.5 ± 1.40 (3.7)	18.7 ± 0.48 (2.6)	59.2	56
10	620	88	5	7.0 ± 0.90 (12.8)	37.0 ± 3.95 (10.7)	1.68 ± 0.31 (1.9)	35.0	40
11	670	85	8	4.9 ± 0.21 (4.2)	31.8 ± 1.72 (5.4)	15.2 ± 0.24 (1.6)	39.3	40
12	710	93	7	5.7 ± 0.41 (7.2)	31.9 ± 1.65 (5.2)	16.5 ± 0.21 (1.2)	40.2	43
13	740	135	7	7.1 ± 0.36 (5.0)	35.0 ± 1.10 (3.1)	17.7 ± 0.22 (1.3)	50.0	37
Mean	685	107	6.6	6.9	36.2	15.8	45.2	43.2
SD	40.7	24.9	0.96	0.37	5.08	4.39	7.41	7.45
CV	5.9	23.3	14.5	19.4	14.0	27.7	16.4	17.2

comm.). In addition, because food intake can influence the reproductive traits of captive snakes (Ford & Seigel 1989a), I restricted their diet prior to their reproduction. Snakes were therefore fed approximately 10% their body mass in mice per week. I assumed that, because the animals had not been in captivity for long, the reproductive characteristics would be similar to in the wild state (Gregory & Larsen 1996). Snakes were maintained in individual cages under a 14:10 light/dark cycle at 28 °C and paired with a male at least once a week. Prior to oviposition, females were given a nest box with moist sphagnum that was checked daily for eggs. The snout-vent length (SVL, nearest 10 mm) and mass (nearest g) of the female were taken after the eggs were laid. Each egg was separated, and length and width measured with callipers to the nearest 0.1 mm and weighed to the nearest 0.01 g. Some individual eggs that were in contact with wet sphagnum were obviously swollen and were not measured. Clutch size was considered to be all fertile eggs. Mean, standard deviation (SD) and coefficient of variation (CV) of egg mass, length, and width were calculated for each clutch. Clutch mass for each female was calculated by multiplying the mean mass of fertile eggs (not including swollen eggs) by the clutch size. Relative clutch mass was calculated by dividing the clutch mass by the female's post-partum mass (Ford & Seigel 1994). Correlations of clutch size, mean egg mass and clutch mass were made with female SVL and linear regressions of these factors were conducted with Statview (SAS Institute Inc. 1999).

The characteristics of each clutch and the means for the females are given in Table 1. Clutch size and clutch mass were weakly correlated to female SVL ($R^2 = 0.24$, $P = 0.09$ and $R^2 = 0.26$, $P = 0.08$ respectively) (Figs. 1 - 2). These factors are typically correlated to female size in oviparous colubrids (Seigel & Ford 1987; Ford & Seigel 1989b). However, all the snakes in this study were similar in length (CV = 5.9%) and so clutch size varied only from 5 - 8 (CV = 14.5%, Table 1). If larger females had been included with much larger clutches, then the relationship between these variables might have been stronger. Nonetheless, the sizes of my females were typical for the locality and the clutch sizes are thus likely to be representative for the area. Haagner (1987) indicated several

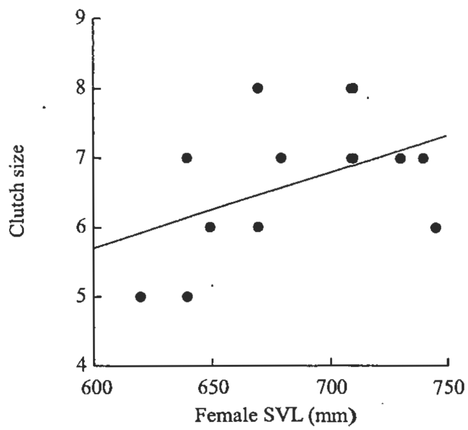

Figure 1. Clutch size relative to female SVL in 13 *Lamprophis fuliginosus*, from Arusha, Tanzania. R^2 = 0.24, P = 0.09, N = 13, y = 0.109x - 0.876.

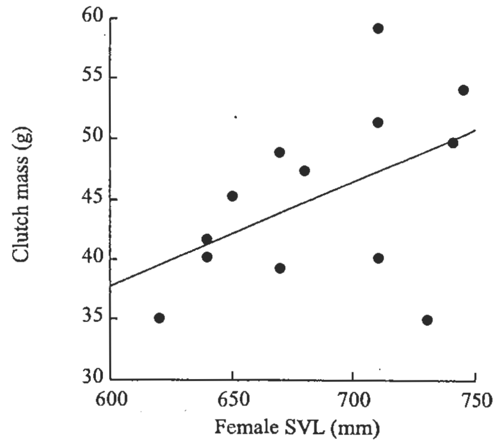

Figure 2. Clutch mass relative to female SVL in 13 *Lamprophis fuliginosus*, from Arusha, Tanzania. R^2 = 0.26, P = 0.08, N = 13, y = 0.866x - 14.208.

records of clutch size of 12 or more in his literature review for the species and he reported a strong relationship between clutch size and female SVL. However, it is important to be aware that early studies on reproduction in snakes often included data from exceptionally large animals that were collected specifically because they were likely to have large clutches. Knowing the normal or average clutch size for a species in a locality is important for development of life tables that can predict population trends.

Mean egg mass among clutches ranged from 4.9 - 9.0 g and egg length from 31.2 - 49.7 mm with widths of 15.2 - 18.7 mm (CVs of 19.4%, 14.0% and 27.7% respectively, Table 1). The CV for egg mass within clutches averaged 6.2% and that for length and width even lower. This means that although there was about 20% variation among females in egg mass, within a female, very little variation occurred in the size of individual eggs. This among-female variation was not related to female size since egg mass was not correlated to female SVL (R^2 = 0.00, P = 0.91). Indeed, although the clutch sizes of female house snakes in my lab increase in subsequent clutches as the females grow, the mean egg mass for a female shows little change (*unpubl. data*). Egg sizes in snakes have rarely been examined, but most studies show increased offspring size with an increase in female length (Ford & Seigel 1989b). Haagner (1987) suggested from the limited data that he examined, that this relationship did occur in *L. fuliginosus*. My study does not support this finding, probably because my records are all for snakes from one locality. It is likely that selection pressures that produce larger adult females in some areas might also give rise to larger eggs and vice versa. A regression of a sample of animals gathered from different localities would then produce a significant regression of mean egg mass and female SVL. Whether a female's egg sizes increase as she grows is a different question and one that has not been addressed in any snake species.

Egg mass was also not correlated to clutch size (R^2 = -0.47, P = 0.10). Although the trade-off between offspring size and number has been the subject of much research and debate, for reptiles it has often not been evident (Ford and Seigel 1989b). Unlike the case for clutch size, these studies typically evaluated data for females from one locality. If information from multiple localities were available, it is more likely that a negative relationship would be apparent. Where larger offspring are selected for, it is intuitive that it would result in a reduction in the number of offspring that females can produce. However, within a locality, as in the current report, the selection for an optimal neonate size might restrict flexibility in clutch size for an individual female. If she obtains more food she may be able to add an additional egg, but that should not occur at the expense of the size of the other eggs. If this were the case, a trade-off between clutch size and egg mass would not be evident.

Knowledge of reproductive characteristics of species from distinct localities are important, both for understanding the dynamics of that population, and for understanding the geographical variations that might occur for the species. Surprisingly, such data are minimal for even common species like *L. fuliginosus*. This is primarily because few researchers keep multiple pairs of snakes in captivity. There is also the concern that animals kept in captivity do not necessarily have the same reproductive characteristics as animals in the wild. For example, it is well documented that clutch size for snakes is influenced by food intake in captivity (Seigel *et al.* 2000; Seigel & Ford 2001). However, these same studies suggest offspring size is less affected by prey availability. Therefore, although the clutch size of captive animals may not be useful data, the egg masses in snakes from specific localities may be reflective of local selection pressures. For example, one might expect the size of locally available prey for hatchlings to influence egg size. Egg mass is, however, the least reported reproductive character in the literature on snakes. Thus, even limited data on offspring size are useful to report.

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