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FEMALE BREEDING FREQUENCY, CLUTCH SIZE AND DIETARY HABITS OF A NIGERIAN POPULATION OF CALABAR GROUND PYTHON, *CALABARIA REINHARDTII*

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The Calabar ground python, *Calabaria/Charina reinhardtii* is an Afrotropical burrowing snake, with an unresolved systematic position (e.g. see Kluge, 1993), and is widespread across the Liberia-Congo rainforest belt (Chippaux, 1999). Due to its nocturnal, elusive, and burrowing habits, this snake has been poorly studied (Lehmann, 1971). In recent years, this situation changed rapidly and detailed studies, including radiotelemetric monitoring, have been published utilizing free-ranging specimens from Nigeria (Luiselli & Akani, 1998; Luiselli, Akani & Capizzi, 1998; Angelici *et al.*,, 2000). However, the knowledge of some crucial aspects of the ecology of this species, such as reproductive and feeding strategies, is still little known.

In this note, we describe female breeding frequency, clutch size, and dietary habits in a population from a forest-plantation mosaic area of south-eastern Nigeria (see also Luiselli *et al.*, 1998; Angelici *et al.*, 2000). The data were collected between January 1998 and December 2001.

The study site (latitude 04°50'N, longitude 07°59'E; elevation 10 m a.s.l.) consisted of about 30 ha of seasonally flooded secondary swamp-forest almost entirely surrounded by wide plantations, busy roads, and houses, situated in the "Eket" Local Government Area (Akwa-Ibom State). Based on radiotracking data, it is known that these surrounding habitats are generally avoided by ground pythons (Angelici *et al.*, 2000). However, the area was not totally isolated (as demonstrated by the relatively high numbers of "new males" each year; Luiselli *et al.*, unpublished observations), being connected to a nearby forest patch (situated approximately 5 km north of our study site) through a corridor of disturbed bush where ground pythons have been seldom observed.

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TABLE 1. Field effort, year-by-year, at the study area. Both the numbers of non-consecutive days spent in the field, and the numbers of yearly consecutive trap-days are indicated.

Year	No. non-consecutive days in the field	No. of consecutive trap-days
1998	41	77
1999	36	89
2000	39	83
2001	43	88

Since ground pythons are specialized burrowers, they can be captured most easily by pitfalls and/or by removing cover objects, whereas they are rarely found active on the ground (Luiselli & Akani, 1998). Thus, during each study year, three lines of pitfalls connected with drift fences were installed. Each line consisted of 15 pitfalls, placed about 60 m apart, and 100 m from the closest pitfall of the adjacent line. The traps were situated in the same places every year, so that the grid was the same year-by-year. Every snake captured was individually marked by ventral scale clipping, and measured to SVL (to the nearest ±0.1 cm) and sexed. For females, eventual reproductive status and litter size were determined by abdominal palpation (precision: ±1 young). Examination of faecal pellets and stomach ingesta allowed us to obtain data on the feeding ecology of the snakes at the study area. The yearly effort in the field, in terms of both number of non-consecutive survey-days in the study area and numbers of days in which traps were placed, is given in Table 1.

All tests, two tailed and with $\alpha = 0.05$, were done using STATISTICA (version 5.0 for Windows) computer package (Statsoft, 1996). When calculating the regression between maternal SVL and number of eggs, to avoid statistical bias due to pseudo-replication of the data (Licht *et al.*, 1966; Hurlbert, 1984), we took body size and clutch size data only once per individual female, i.e. we did not consider further recaptures of the same individual, also if on different years.

In total, we caught 13 adult females and obtained 20 "snake-year" records from females (i.e. counting each female as a separate data point in each year she was collected; Table 2). Reproductive females comprised 11 (=55%) of these records, suggesting an average biennial cycle in individual females. However, this frequency may be biased if reproductive females modify their behaviour (e.g. are active more often above-ground) in such a way that they are easier to find and catch (Bonnet & Naulleau, 1996). So, recapture events of individuals over several consecutive years offer a more reliable indication of female reproductive frequency (Brown, 1991; Capula & Luiselli, 1994; Luiselli, Capula &

TABLE 2. Summary of the longitudinal data collected in the years 1998-2001 from female *Calabaria reinhardtii* at the study area in south-eastern Nigeria. In case of gravid specimens, the number of eggs is presented in parentheses. For the years in which a given specimen was captured, its body size (SVL, cm) is also presented.

Specimen No.	Year 1998	Year 1999	Year 2000	Year 2001
Female 1	81.5 cm (5 eggs)	-	-	-
Female 2	77.5 cm (not gravid)	-	-	-
Female 3	83.1 cm (5 eggs)	83.5 cm (not gravid)	83.5 cm (5 eggs)	-
Female 4	70.2 cm (not gravid)	73.5 cm (not gravid)	-	-
Female 5	78.4 cm (4 eggs)	-	-	-
Female 6	68.8 cm (not gravid)	71.3 cm (not gravid)	-	-
Female 7	-	77.1 cm (3 eggs)	-	-
Female 8	-	88.4 cm (6 eggs)	-	-
Female 9	-	72.7 cm (no gravid)	74.6 cm (3 eggs)	74.7 cm (not gravid)
Female 10	-	-	84.6 cm (6 eggs)	84.6 cm (not gravid)
Female 11	-	-	61.1 cm (no gravid)	63.8 cm (2 eggs)
Female 12	-	-	-	88.6 cm (9 eggs)
Female 13	-	-	-	81.4 cm (5 eggs)

Shine, 1996). We obtained four records of reproductive status of individual females captured in two consecutive years, and two records of reproductive status of females captured in three consecutive years (Table 2). Two females (nos. 4 and 6 in Table 2) were not gravid for two consecutive years (i.e. suggesting an at least triennial cycle), and two (nos. 10 and 11 in Table 2) exhibited reproduction in alternate years (i.e. a reproductive year followed by a non-reproductive year, or vice-versa). In another case, a female from Calabar (Cross River State), was reproductive in two consecutive years (1999 and 2000), suggesting an annual cycle. However, data relative to this individual are not presented in Table 2 as it came from another locality. For females 3 and 9 (in Table 2) we recorded the reproductive condition for three consecutive years. Female no. 3 appeared to exhibit a biennial reproductive cycle, and female no. 9 appeared to exhibit a more-than-annual (perhaps biennial) reproductive cycle. Hence, these data suggest that breeding frequency is likely to be at least biennial.

The females produced 2-9 eggs in their reproductive year, and there was a positive linear correlation between maternal body length and clutch size (Fig 1).

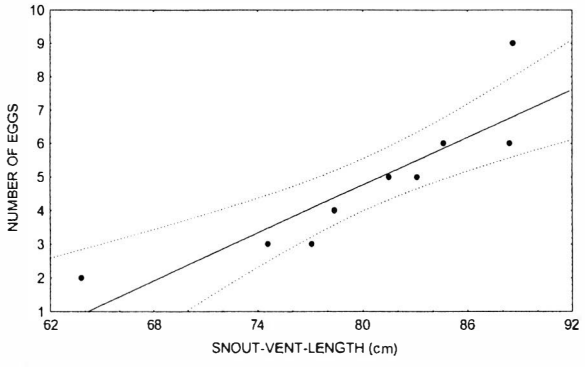

FIG. 1. Relationships between maternal size (cm) and number of eggs in female *Calabaria reinhardtii* from the study area in south-eastern Nigeria. Equation: No. eggs = -14.25 + 0.237 Snout-vent length; $F_{1,8}$= 25.9, P=0.0009.

We examined diet in 44 specimens (16 males, 13 females, and 15 recaptures). We collected faecal pellets from 16 snakes with identifiable prey remains, and obtained stomach ingesta from seven specimens. Regurgitated items were adult *Mus musculoides* in two cases; young *Rattus rattus* in two cases; nestling mice (of unknown species) in two cases; and snake eggs (probably of *Psammophis phillipsi*) found in one specimen. Faecal pellets included exclusively rodents (faeces from 10 specimens: *Rattus* sp. in four; *Mus musculoides* in four; undetermined species in two) and shrews (most probably of the genus *Crocidura,* found in faeces of six specimens). Interestingly, shrews were absent from the diet of all pythons that had consumed rodents. In any case, the diet of *C. reinhardtii* at the study area proved to consist almost only of small mammals, apart from the single case of snake eggs in the stomach.

Although very detailed longitudinal data are available for some species of tropical Booidea (e.g. Madsen & Shine, 1996, 1998, 1999*a*,*b*, 2000; Shine & Madsen, 1997; Shine *et al.*, 1997), we cannot make sound comparisons between our data and those presented in such studies because (1) our sample size is too small compared to Madsen & Shine's studies; (2) *Calabaria* has a still unresolved systematic position; and (3) it has specialized burrowing habits that may have produced very specific life-history adaptations for life underground, at least if compared with typical terrestrial-arboreal boids. So, it would be better to compare our data with those relative to other subterranean boids, such as *Charina bottae* (cf. Hoyer & Stewart, 2000*a*,*b*), which has been considered a species phylogenetically closely related to *Calabaria* (Kluge, 1993). However, it must be stressed that our study area in tropical Africa is climatically very different from temperate North-America, where *C. bottae* is living, so that these comparisons may also have considerable biases due to inter-climatic differences. However, after having taken into account these potential biases, it should be stressed that both the main reproduc-

tive characteristics and the diets of Calabar ground pythons were similar to that of *C. bottae*. Indeed, Hoyer & Stewart (2000*a*) reported a biennial reproductive frequency and an average litter size of 2-5 in *C. bottae* from California, which is similar to our population of *C. reinhardtii*. In addition, small mammals were also found to be the major prey items in *C. bottae* (Hoyer & Stewart, 2000*b*), although this latter preyed frequently upon reptile eggs (lizards and snakes), which were consumed only occasionally in our *Calabaria* population. This difference is noteworthy and probably reflects true ecological differences between species, as at least four species of oviparous snakes (*Python regius, Naja nigricollis, Psammophis phillipsi,* and *Lamprophis lineatus*) and one species of appropriately sized lizard (*Agama agama*) are common in the study area, and may provide an abundant food resource for *Calabaria* specimens. In any case, the data presented here, together with those already presented by Luiselli *et al.* (1998) and by Luiselli & Akani (1998), confirm that *C. reinhardtii* is primarily a small mammal-eater, and does not feed upon earthworms (as observed in captive specimens, cf. Trutnau, 1981). One *Mabuya* skink was, however, found in the stomach of another Nigerian individual (Luiselli & Akani, 1998).

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