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Observations on the biology of the African Emerald Snake *Gastropyxis smaragdina* (SCHLEGEL, 1837), in southern Nigeria
(Serpentes: Colubridae)

Beobachtungen zur Biologie von *Gastropyxis smaragdina* (SCHLEGEL, 1837) im südlichen Nigeria
(Serpentes: Colubridae)

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KURZFASSUNG

Gastropyxis smaragdina (SCHLEGEL, 1837), eine Colubride des tropischen Afrika, ist durch ihre smaragdgrüne Rückenfärbung, die großen Augen und den extrem langen Schwanz (der über 50% der Kopf-Rumpflänge bzw. über 35% der Gesamtlänge ausmacht) gekennzeichnet. Die Art kommt verbreitet in den Waldbeständen Süd-Nigerias (hauptsächlich östlich des Niger-Flusses) vor, wo sie in zahlreichen Lebensräumen (Trocken- und Sumpfwald, Mangrove, Buschland, landwirtschaftliche Anpflanzungen, Farmen, Vorstädte) beobachtet wurde. Bei Anwendung eines Regressionsmodells erwies sich das Vorkommen von *G. smaragdina* signifikant positiv mit dem Vorhandensein von zwei Biotoptypen korreliert (primärem Trockenwald und sekundärem Sumpfwald), was die Vermutung nahelegt, daß das Mosaik der unterschiedlichen Waldtypen im Niger-Delta eine wesentliche Voraussetzung für die individuenreichen, stabilen Populationen dieser Schlange darstellt. Sowohl in der Trocken- wie in der Regenzeit ist *G. smaragdina* überwiegend tagaktiv. *Gastropyxis smaragdina* wurde häufig in der untersten Kronenschicht der Bäume angetroffen, stieg aber gelegentlich auch auf den Boden herab. Die Länge der Weibchen entsprach etwa der der Männchen, doch hatten erstere kürzere Schwänze. Die Fortpflanzung erfolgte saisonal und weitgehend synchron (Paarungen während der Regenzeit, Eiablage in der Trockenzeit, Reproduktion jährlich). Die Gelegegröße (2-6 Eier) war positiv mit der Größe des Muttertieres korreliert. Beide Geschlechter ernährten sich überwiegend von Echsen (Scincidae, Gekkonidae, Agamidae; über 80% des Nahrungsspektrums), nahmen aber auch Frösche (Hyperoliidae, Ranidae). Sowohl arborikole als auch terrestrische Tiere wurden erbeutet. Die Beutetiergröße war im Vergleich zur Körpergröße der Schlange sehr gering.

ABSTRACT

The African Emerald Snake *Gastropyxis smaragdina* (SCHLEGEL, 1837) is an Afrotropical colubrid snake characterized by emerald-green dorsal coloration, large eyes, and extremely elongated tail (attaining > 50% of snout-vent length, and > 35% of total length). It is widespread in the forested blocks of southern Nigeria (mainly east of the Niger River), where it was observed in a wide variety of habitats (including dry- and swamp-forests, mangroves, shrublands, plantations and farms, and suburbia). Application of a logistic regression model showed that the presence of *G. smaragdina* was significantly positively correlated with the presence of only two macro-environmental parameters (primary dry forest and secondary swamp forest), which suggests that the patchy mosaic of different types of deltaic forest is essential to support stable and abundant populations of this species. Activity was concentrated during the daylight hours, both in the wet and in the dry seasons. *Gastropyxis smaragdina* was frequently observed on the lower strata of forest tree canopies, but descended on the ground on several occasions. Females were approximately as long as males, but had shorter tails. Reproduction was seasonal and synchronous (matings during the wet season, ovipositions during the dry season, and female frequency of reproduction annual). Clutch size (2-6 eggs) was positively correlated to maternal size. Both sexes fed mainly upon lizards (Scincidae, Gekkonidae, Agamidae; > 80% of dietary spectrum), but took also frogs (Hyperoliidae and Ranidae). Prey size was very small in comparison with snake size. Both arboreal and terrestrial animals of prey were taken.

KEY WORDS

Reptilia, Serpentes, Colubridae; *Gastropyxis smaragdina*, biology, ecology, activity, reproduction, body size, sexual dimorphism, diet, habitat, arboreal habits, distribution in Nigeria, rainforest

INTRODUCTION

Arboreal snakes are keystone species for studies of rainforest decline due to their specialized habits and habitat requirements (POLITANO 1997), and, thus, merit special attention by the applied ecologist working in global environmental impact assessment

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programs. During our long-term ecological research on forest snakes from southern Nigeria (e.g., LUISELLI et al. 1998 a; LUISELLI & ANGELICI 2000), special attention has been devoted to study the life-history traits of the arboreal species (POLITANO 1997), and some papers on *Boiga* (*Toxicodryas*) *blandingii* HALLOWELL, 1844 (LUISELLI et al. 1998b), *Rhamnophis aethiopissa* GÜNTHER, 1862, and *Dendroaspis jamesoni* (TRAILL, 1843) (LUISELLI et al. 2000a) have already been published.

In the present paper we focus our attention on another arboreal forest snake, the African Emerald Snake, *Gastropyxis smaragdina* (SCHLEGEL, 1837), which is widespread inside the forested blocks of southern Nigeria (BUTLER & REID 1986, 1990; AKANI et al. 1999; LUISELLI & AKANI 1999). *Gastropyxis smaragdina*, sometimes assigned to the genus *Hapsidophrys* (e.g., BUTLER & REID 1986), is a very slender, agile, fast-moving snake, characterized by emerald-green dorsal coloration, a conspicuously long tail and large eyes (VILLIERS 1975). Ecological information on *G. smaragdina* is still scarce (e.g., SCHMIDT 1923; PITMAN, 1938; VILLIERS 1975). Concerning Nigerian populations, field data on food habits (LUISELLI et al. 1998a) and habitat (BUTLER & REID 1986; AKANI et al. 1999; LUISELLI & AKANI 1999) have been reported only briefly. In this paper we provide detailed data on body size, diet composition, reproductive biology, activity pattern, habitat preferences, and local distribution of *G. smaragdina* in the rainforests of southern Nigeria.

MATERIALS AND METHODS

Study areas

The field study was carried out from early September 1996 to early October 1999 (with some data recorded ~~even~~ earlier), in several localities of southern Nigeria. These localities - situated between Lekki Lagoon in the west and the border to Cameroon in the east (fig. 1) - included areas situated in Lagos State, Ogun State, Delta State, Edo State, Anambra State, Bayelsa State, Rivers State, Abia State, Akwa-Ibom State, Imo State, and Cross River State. In particular, our researches were conducted in the central and eastern parts of the Niger Delta (Anambra, Bayelsa, and Rivers States), in the surroundings of Aba (Abia State), Eket and Ikot-Ekpene (Akwa-Ibom State), and Calabar, Itu, and Akampka (Cross River State).

These territories are densely populated, with patches of rainforest interspersed among wide plantations (yam, cassava, cocoa, pineapple, banana, plantain, oil palm, etc). The forest patches may have dry soil, or may be permanently or seasonally inundated swamp-forests. Vast mangrove formations (*Avicennia marina*, *Rhizophora racemosa*) are found in the brackish water tracts. Along the rivers Bonny, New Calabar, and Cross, the mangroves are under serious threat because of the expansion of the introduced *Nypa* palm (SINGH et al. 1995; POLITANO 1997; DORE without date). A more detailed description of the study areas, their environmental characteristics, and climate conditions is given elsewhere (POLITANO 1997; AKANI et al. 1999).

Data collection

Field trips were conducted under all weather conditions. Daily field research lasted approximately from 8 a.m. to 6 p.m. Night searches were done rarely, because of security constraints related to the unstable social situation prevailing, with groups of criminals operating in the region. Random routes for locating snakes were followed through the various macrohabitat types present in each study area. Snakes were captured by hand, pitfall traps with drift fences, and by placing flat objects on the ground and checking what was hiding below them each day. The captured snake specimens were sexed and measured for snout-vent length (SVL, to the nearest cm) and tail length (tL). Meteorological conditions, time (Lagos time), type of activity exhibited by the snakes, and habitat at each capture site were recorded. For snakes which were found climbing on trees, perch height was measured to the nearest +/- 10 cm. To the observer in the field, the mor-

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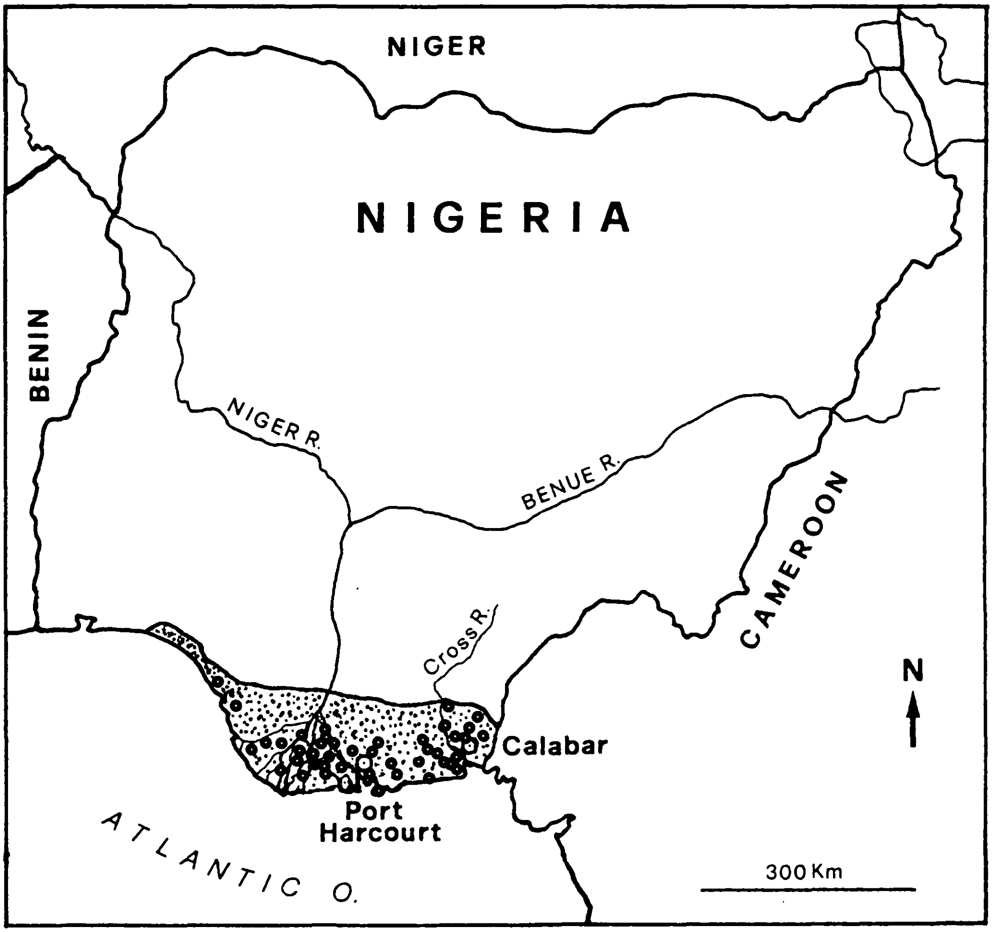

Fig. 1: Map of Nigeria, showing the study region and the sites where the presence of *Gastropyxis smaragdina* was ascertained. Though preliminary, our records suggest that this species is less common west than east of the Niger Delta.

Abb. 1: Karte von Nigeria mit dem Untersuchungsgebiet und den Nachweisen von *Gastropyxis smaragdina*. Nach gegenwärtigem Wissensstand scheint die Art westlich des Niger Deltas seltener zu sein als östlich davon.

phological similarity of *G. smaragdina* with other sympatric arboreal species [e.g., *Dispholidus typus* (SMITH, 1829), *Rhamnophis aethiopissa*, and *Philothamnus* spp. (AKANI et al. 1999)] is high (see SPAWLS & BRANCH 1997) when sighted only shortly before escaping. For all analyses we therefore retained only data of specimens which were captured and clearly identified to species level.

Specimens found dead (roadkilled or macheted by farmers), including those which were too damaged for any reliable body size measurement, were dissected to get data on diet and reproductive condition. In addition, the snake specimens stored in several Nigerian institutions (hospitals, university departments, and biological labs of high school colleges; for a complete list see LUISELLI & ANGELICI 2000; LUISELLI et al. 2000a) were examined for the presence of *G. smaragdina*, and dissected. All snake specimens captured alive were palpated in the abdominal region until regurgitation of the ingested food or defaecation occurred. The prey items were identified to the lowest taxon possible. Sizes of relatively undigested prey (lengths and masses) were de-

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termined by weighing them with an electronic balance. Vouchers of the snake species are deposited in the herpetological collection of two authors (L.L. and F.M.A., collections both in Rome and in Ikot-Ekpene, Nigeria; specimens labelled but catalogue numbers not yet assigned), and in the Department of Biological Sciences, Rivers State University of Science & Technology, Port Harcourt.

Analyses

The effects of the major macro-environmental parameters on the presence or absence of *G. smaragdina* in the study region were assessed by using a logistic regression model (forward stepwise conditional procedure) for discrete values (HOSMER & LEMESHOW 1989). For this analysis, we used data on the presence/absence of this species in 52 study sites which were accurately surveyed during previous environmental work (POLITANO 1997). Each site was approximately 50 ha in size and was separated from the closest surveyed site by at least 10 km of linear distance. Eight macro-environmental parameters were identified during these large-scale environmental studies (see POLITANO 1997), and we checked for the presence of any of them in each of the 52 surveyed sites. The designed macro-environmental parameters were as follows: (1) primary dry forest (PDF); (2) secondary dry forest (SDF); (3) shrub-land (SHL); (4) primary swamp-forest (PSF); (5) secondary swamp-forest (SSF); (6) mangrove (MGR); (7) farmland and plantations (FPL); (8) large water body (main river tract or wide lake, PWB). The place-names, the geographic coordinates, and the macro-environmental parameters of each of the 52 study areas are omitted in this paper to save space, but are fully available in LUISELLI et al. (2000b). In the logistic regression model, the study areas were the cases (total n = 52), the presence/absence of *G. smaragdina* was the dependent variable, and the environmental parameters were the covariates (total n = 8).

All data were statistically processed by means of an SPSS® personal computer package (ver. 4.5 for Windows®), with all tests being two-tailed and with α set at 5%.

RESULTS

Local distribution and habitat preferences

Gastropyxis smaragdina is doubtlessly one of the most common snakes of southern Nigeria (AKANI et al. 1999). Its presence has been ascertained in a lot of localities east of the Niger River. The snake appeared to be very common in the eastern Niger Delta (Bayelsa State and Rivers State), in the surroundings of Eket and in Stubbs Creek Reserve (Akwa-Ibom State), and in the surroundings of Calabar and Akampka (Cross River State) (fig. 1). *Gastropyxis smaragdina* was by far the most common arboreal snake in the pristine forests of Kwale Natural Park (western Niger Delta), Taylors Creek Forest Reserve (central Niger Delta), Upper Orashi Forest Reserve (eastern Niger Delta), and Stubbs Creek Reserve (Akwa-Ibom State) (POLITANO 1997; AKANI et al., unpublished data). The snake appeared much more widespread and abundant in the forested blocks east rather than west of the Niger River, although a few records exist also for the remnant coastal forests and the derived savannas of the Lagos region (BUTLER & REID 1990; fig. 1).

Application of the logistic regression model showed that the presence of *G. smaragdina* was significantly positively correlated with the presence of PDF (r = 0.321, P = 0.006) and SSF (r = 0.181, P = 0.02), but not with any other macro-environmental parameters. This result indicates that the patchy mosaic of dryland forest and deltaic freshwater swamp-forest is essential to support stable and abundant populations of this species, although records of its presence fell also in localities with as different habitats as mangroves, shrub-lands, plantations and farms, derived savannas, and suburbia (see also BUTLER & REID 1986; AKANI et al. 1999; LUISELLI & AKANI 1999). In any case, *G. smaragdina* appeared much less common in the extensively deforested zones of Lagos State,

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Ogun State, and Abia State, than in the rainforest blocks of the Niger Delta and eastern Nigeria, thus showing that it may be subject to decline in places of habitat loss by deforestation.

Microhabitats used, height of perch sites

When a snake was captured in the wild (n = 133), it was often found climbing in a tree (n = 88, 66.2%), thus confirming that this species is mainly, although not exclusively, arboreal. Perch height averaged 1.87 m (SD = 3.72 m), and was not significantly different between sexes (χ^2= 1.87, df= 1, P > 0.1).

With regard to the specimens encountered in the forest patches (n = 88), most of them were observed at the borders of the small paths and trails connecting the various forest-villages (n = 43, 48.9%), and also in sites with closed canopy and extended shadow (n = 27, 30.7%), and much more rarely in open canopy sites (with oil palms prevailing), swamp sites (with *Raphia* plants prevailing), or along the banks of rivers and creeks. In suburbia (n = 11), *G. smaragdina* was found in areas characterized by compound gardens with ornamental shrubs, small groups of mango trees, plantains, and also in grassy sites. In mangrove areas, *G. smaragdina* was observed mainly in bushy sites with sandy soil that tend to develop from the pristine formation (SINGH et al. 1995). In practice, *G. smaragdina* seems to be a species that could benefit from this alteration of mangrove formations, in that the snake might penetrate into previously unsuited areas (POLITANO 1997).

Activity patterns

Gastropyxis smaragdina was found active only during the daylight hours (08:00 to 16:30), with a peak between 09:00 and 12:30. The foraging activity seemed to be concentrated at the period between 09:00 and 14:30, because we observed several *G. smaragdina* specimens while attacking and sometimes capturing their prey (lizards and frogs, see below) at this time. The highest movement rates were also concentrated at this period of the day (AKANI et al. unpublished radiotracking data).

Specimens were active both during the wet and the dry season, but were more easily encountered during the dry season or in the interphases between dry and wet seasons (end of September to mid October, and April).

Body size and sexual dimorphism

Excluding young specimens shorter than 37 cm SVL (n = 23) from the analysis, average SVL was almost the same in females and males (males: $\bar{x}$ = 53.1 cm, SD = 7 cm, range = 39.8 - 66.2 cm. n = 50; females: $\bar{x}$ = 55.1 cm, SD = 6.4 cm, range: 40.5 - 66.3 cm, n = 42; intersexual comparison: unpaired t = 2.53, df = 99, P = 0.131).

Males and females differed significantly in terms of body proportions: at identical SVL, males had longer tails than females (single-factor analysis of covariance, with sex as the factor, and tail length as the covariate: heterogeneity of slopes, P < 0.0001). This result was also clearly received when analyzing the ratio tL / SVL, in which the mean value was also higher in males ($\bar{x}$ = 0.603, SD = 0.026, n = 50) than in females ($\bar{x}$ = 0.587, SD = 0.019, n = 42) (unpaired t = 3.32, df = 90, P = 0.0013;) The frequency distribution of this ratio in the two sexes (fig. 2) indicates that, despite males attained the highest values, however there was a wide intersexual overlap, so that this ratio cannot always be considered a good parameter to discriminate between males and females. As expected, SVL and tL were positively correlated both in males (r = 0.953, n = 50; P < 0.00001; equation: tL = -0.0482 + 0.606 * SVL) and females (r = 0.963, n = 42; P < 0.00001; equation: tL = -0.1577 + 0.584 * SVL; fig. 3). SVL did not influence the body proportions (expressed as tl / SVL ratio) neither in males (r = 0.044, n = 50, P > 0.7) nor in females (r = -0.012, n = 42, P > 0.6). Moreover, tL was about 0.35 - 0.39 of the total length (SVL + tL), values very similar to that already reported for this species (SCHMIDT 1923; VILLIERS 1950).

Reproductive biology

Mating in *G. smaragdina* and combats between males were never observed in the field. However, associations of two or

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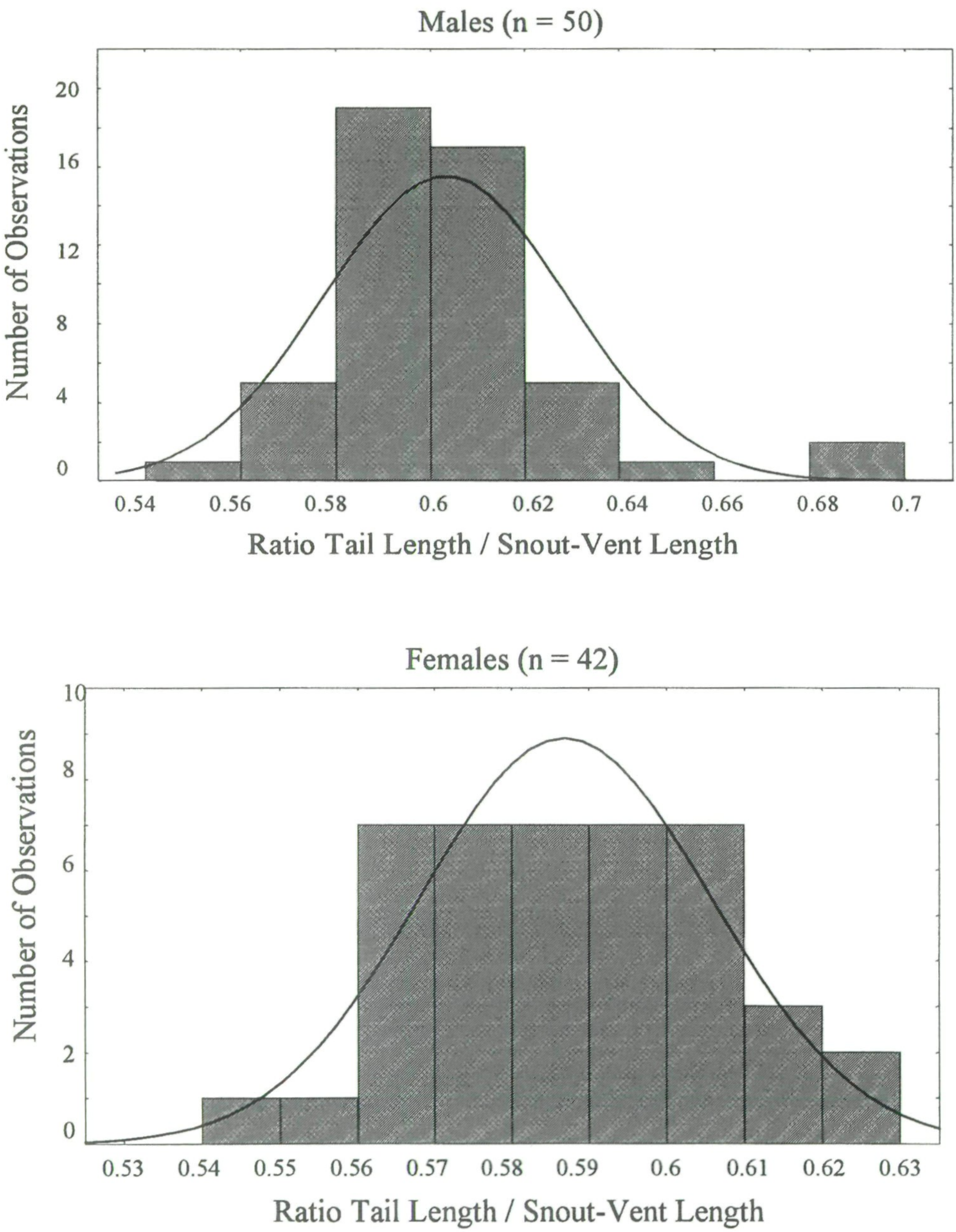

Fig. 2: Frequency distribution of the ratio (tL / SVL) in 50 male (top) and 42 female (bottom) *Gastropyxis smaragdina* from southern Nigeria.

Abb. 2: Häufigkeitsverteilung des Quotienten (tL / SVL) [= Schwanzlänge / Kopf-Rumpflänge] bei 50 männlichen (oben) und 42 weiblichen (unten) *Gastropyxis smaragdina* aus dem südlichen Nigeria.

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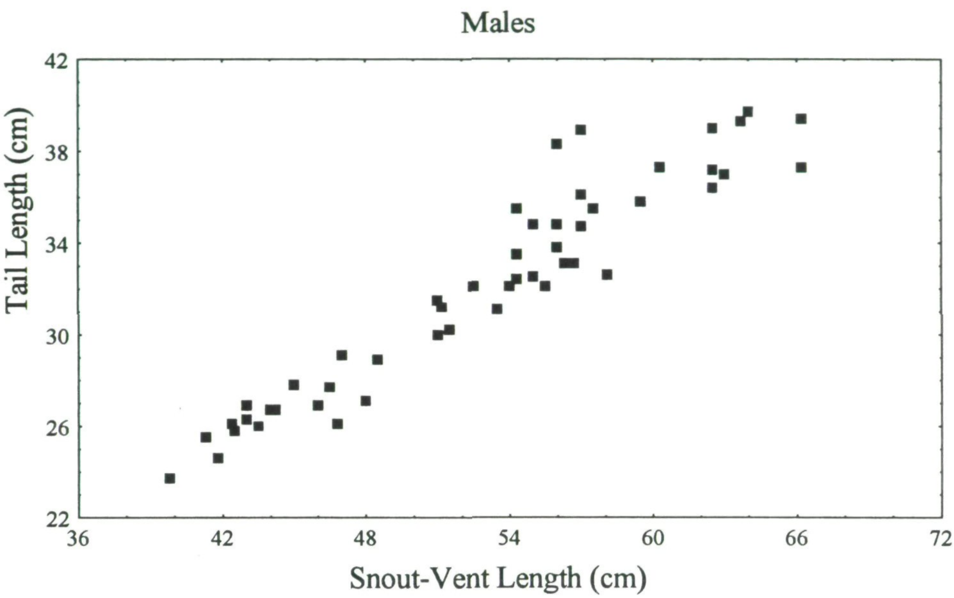

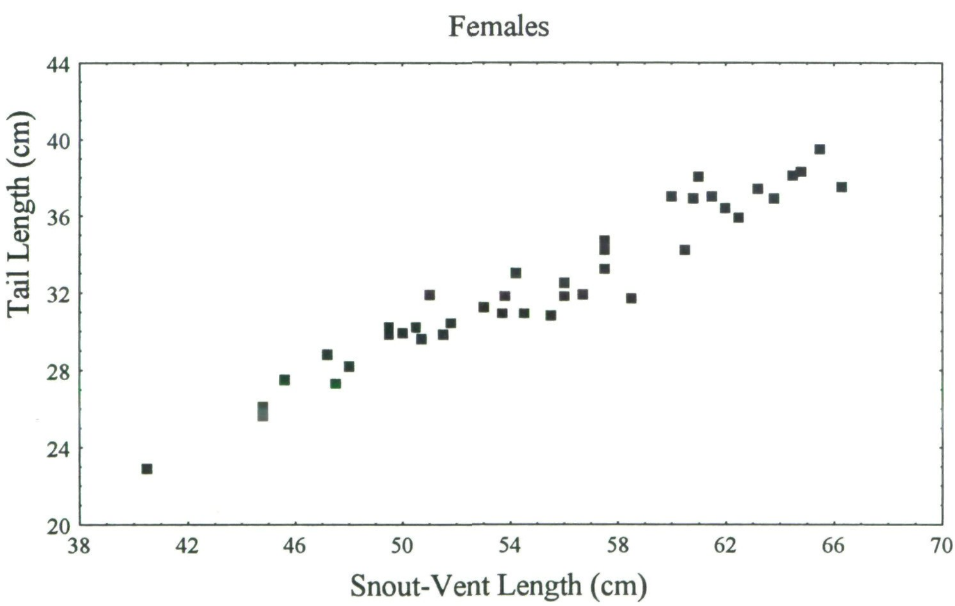

Fig. 3: Relationship between SVL (cm) and tL (cm) in 50 male (top) and 42 female (bottom) *Gastropyxis smaragdina* from southern Nigeria.

Abb. 3: Die Beziehung zwischen Kopf-Rumpflänge (SVL, cm) und Schwanzlänge (tL, cm) bei 50 männlichen (oben) und 42 weiblichen (unten) *Gastropyxis smaragdina* aus dem südlichen Nigeria.

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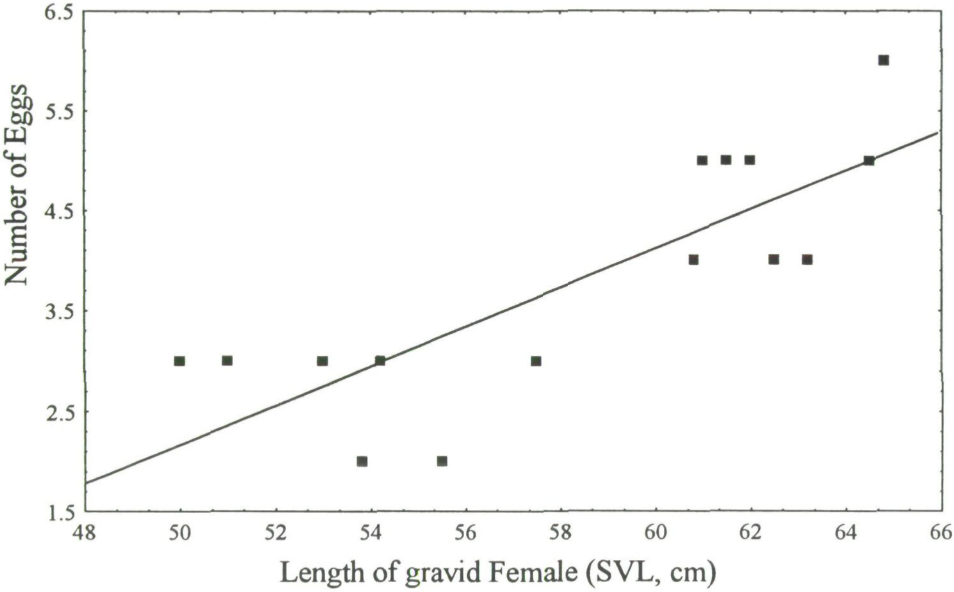

Fig. 4: Relationship between maternal SVL (cm) and clutch size in 15 gravid *Gastropyxis smaragdina* from southern Nigeria.

Abb 4: Die Beziehung zwischen mütterlicher Kopf-Rumpflänge (SVL, cm) und Eizahl bei 15 graviden *Gastropyxis smaragdina* aus dem südlichen Nigeria.

more individuals (maximum three) were observed sixteen times, all occurring between July and middle of September. In eight of these cases the sex of the specimens remained unknown, in three cases the interacting individuals were males, and in five cases one male and one female. Although sound information cannot be derived from the above observations, the mating season might coincide with the wet period.

Gravid females were captured in the field only between late October and middle of January, i.e. during the early phase of the dry season (table 1), which also suggests a strong seasonality in the reproduction of females. Moreover, the fact that 75% (n = 20) of the adult females examined in the period of October to January contained eggs (table 1) suggests that there is a rather strong synchronism in the reproductive cycles of the females in the wild.

Table 1: Monthly presence of gravid females in the examined sample of *Gastropyxis smaragdina* from southern Nigeria. Only females longer than 48 cm SVL have been considered for this table. Note that gravid females were observed only between October and January.

Tab. 1: Das Vorkommen gravider Weibchen im untersuchten Material von *Gastropyxis smaragdina* aus dem südlichen Nigeria. Nur Weibchen, deren Kopf-Rumpflänge 48 cm übertraf, werden hier betrachtet. Man beachte, daß gravide Weibchen nur in der Zeit von Oktober bis Jänner feststellbar waren.

Status	January	April	May	July	September	October	November	December
non-gravid	1	5	7	3	5	1	1	0
gravid	4	0	0	0	0	3	5	5
Total	5	5	7	3	5	4	6	5

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Table 2: Prey items found in the alimentary tract of 57 male and 45 female *Gastropyxis smaragdina* from southern Nigeria.

Tab. 2: Die in 57 männlichen und 45 weiblichen *Gastropyxis smaragdina* aus dem südlichen Nigeria festgestellten Nahrungsobjekte.

Prey item (taxon) / Nahrungsobjekt (Taxon)	Prey items found / festgestellte Nahrungsobjekte			
	Number in males / Anzahl bei Männchen	% in male diet / % in der Nahrung von Männchen	number in females / Anzahl bei Weibchen	% in female diet / % in der Nahrung von Weibchen
Amphibia (total)	(4)	(16.0)	(3)	(21.4)
Hyperoliidae indet.	4	16.0	2	14.3
Ptychadena sp.	–	–	1	7.1
Reptilia (total)	(21)	(84.0)	(11)	(78.4)
Hemidactylus spp.	4	16.0	2	14.3
Lygodactylus conraui	1	4.0	1	7.1
Gekkonidae indet.	2	8.0	1	7.1
Mabuya affinis	5	20.0	1	7.1
Mabuya maculilabris	1	4.0	–	–
Mabuya indet.	4	16.0	2	14.3
Panaspis sp.	1	4.0	1	7.1
Agama agama	3	12.0	3	21.4
Total	25	100.0	14	~100.0

Fifteen pregnant females (SVL between 50.0 and 64.8 cm) were examined during the present study. Palpation of their abdomen indicated clutch sizes of 2 to 6 eggs. Maternal SVL was positively correlated with clutch size ($r = 0.81$, n = 15, $P < 0.001$; fig. 4).

Food habits

Fifty-seven males and forty-five females were analyzed for food in their alimentary tract; 36.8% of the males and 26.7% of the females contained identifiable prey items in the stomachs or in the faeces. The frequency of specimens which contained prey items did not differ significantly between sexes ($\chi^2 = 0.93$, $df = 1$, $P > 0.2$).

Some specimens contained more than one prey item in the stomach. In total we collected 25 prey items from 57 males and 14 prey items from 45 females (table 2). Lizards of the families Scincidae (*Mabuya* sp., *Panaspis* sp.), Agamidae (juvenile *Agama agama* LINNAEUS, 1758), and Gekkonidae (*Hemidactylus fasciatus* GRAY, 1845, *H. intestinalis* WERNER, 1897, *Lygodactylus* sp.) accounted for 84% of the male and 85.7% of the female prey items. The remaining prey items were frogs (undetermined Hyperoliidae and young *Ptychadena* sp.). The frequency of occurrence of the various prey items in the stomachs did not differ significantly between sexes ($\chi^2 = 3.41$, $df = 7$, $P > 0.6$).

The mean size (biomass, g) of the prey items ($\bar{x} = 3.3$ g, SD = 1.4 g, n = 21), and the mean ratio of prey mass / predator mass ($\bar{x} = 0.089$, SD = 0.041, n = 21) indicated that these snakes had fed on very small prey in relation to their own body size. However, there was a slight but significant correlation between (log transformed) predator mass and (log transformed) prey mass ($r = 0.314$, n = 21, $P < 0.04$).

DISCUSSION

The arboreal snake-fauna of the rainforest blocks of Nigeria is very rich and diversified, and includes a wide range of ecologically and systematically diverging taxa, including large highly venomous elapids [*D. jamesoni*, *Pseudohaje goldii* BOULENGER, 1895], ambush-foraging colubrids and viperids [e.g., *Thelotornis kirtlandii* (HALLOWELL, 1844), *Atheris squamiger* (HALLOWELL, 1854], and active foragers as well [e.g., *R. aethiopissa*, *D. typus*, *Philothamnus* spp.] (POLITANO 1997;

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AKANI et al. 1999; LUISELLI & AKANI 1999). Larger species feed mainly upon mammals and birds (e.g., *D. jamesoni*, see LUISELLI et al. 2000a, and *B. blandingii*, cf. LUISELLI et al. 1998a), whereas smaller species tend to have a more variable diet composed of ectothermic and endothermic prey (e.g., *R. aethiopissa*, see LUISELLI et al. submitted). Moreover, some species are diurnal (e.g., *D. jamesoni*, see LUISELLI et al. 2000 a), whereas others are active at twilight and night (e.g., *B. blandingii*, *A. squamiger*, see POLITANO 1997; SPAWLS & BRANCH 1997; LUISELLI et al. 1998a). Among this wide range of arboreal snakes, *G. smaragdina* seems to occupy the niche of a diurnal active forager of small prey, either on the ground or on the trees (see below for further specifications).

In terms of adaptability to habitats, the fact that *G. smaragdina* is both arboreal and terrestrial may help the snake to persist even in strongly altered habitats, including suburbia and farms. Indeed, *G. smaragdina* is quite common in gardens and compounds of large urban centers, including Port Harcourt, Calabar, Eket, Yenagoa, Degema, Abonnema, Oguta, and Owerri. In these urban centers, however, it is often confused by the people with the Green Mamba (*D. jamesoni*) and thus killed. Our study has definitely demonstrated that, as a general criterion, *G. smaragdina* should no longer be considered a "typical forest species" (LANZA & VANNI 1976), but a "species of forest and forest-derived secondary bush".

With regard to morphometrics, our study demonstrate that the two sexes average almost the same SVL but have different body proportions, as the tail is comparatively longer in males, as in most snake species studied to date (KING 1989; SHINE 1993). As the snakes grow up, gross body proportions do not tend to change in both sexes (as shown by the lack of any significant correlation between SVL and the ratio tL / SVL). Compared to most other colubrid snakes of the region, *G. smaragdina* has an extremely elongated tail (see also SCHMIDT 1923), averaging more than 50% of the snout vent-length and more than 35% of the total length. The reasons for this extreme tail elongation are not known, but it seems reasonable that this character could be a morphological adaptation to the life aloft, or that it could be important during sexual interactions between males for access to the females. In fact, it has been demonstrated that males of some colubrid species may interact by using their tails to drive away the rivals, and to obtain a better position for copulation to take place (MADSEN & SHINE 1993; LUISELLI 1996).

Reproduction of tropical snakes (including African species) has been traditionally considered neither seasonal nor synchronous, because of the favorable air temperatures all over the year which would permit the snakes to reproduce at any time (e.g., DE HAAS 1941; LESTON & HUGHES 1968; HENDERSON & HOEVERS 1977; SEIGEL & FORD 1987). Contrary to this claimed general pattern, reproduction in *G. smaragdina* is strongly seasonal and synchronous. Indeed, comparative analysis of the reproductive timing of forest snakes of Nigeria indicated that remarkable species-specific differences can be expected, with some species strongly seasonal and synchronous [e.g., *Bitis gabonica* (DUMÉRIL & BIBRON, 1845) and *Bitis nasicornis* (SHAW, 1802), see LUISELLI & AKANI 1998; LUISELLI et al. 1998c), whereas other species may reproduce over a very prolonged period without showing any clear-cut reproductive season, including the possibility of multiple clutches per year [e.g., *Naja melanoleuca* HALLOWELL, 1857 and *Naja nigricollis* REINHARDT, 1843, see LUISELLI & ANGELICI 2000; *B. blandingii*, see LUISELLI et al. 1998b]. Thus, at least for *G. smaragdina* and other "seasonally reproductive species", the alternation of wet and dry seasons seems to influence their reproductive cycles in a way which compares well with the influence of the seasons autumn / winter and spring / summer on the reproductive cycles of species of temperate regions (SAINT GIRONS 1982; SEIGEL & FORD 1987). Moreover, our data also suggests that *G. smaragdina* females seem to reproduce - on the average - once a year, as is the rule in colubrid snakes from temperate regions (for a discussion see LUISELLI et al. 1997).

The number of eggs (2 to 6) palpated in female *G. smaragdina* from Nigeria is relatively small in comparison with that of

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other tropical snakes of similar body size, but is similar to that produced by conspecifics from elsewhere (e.g., Congo, see SCHMIDT 1923). The positive correlation between maternal size and number of eggs recorded in Nigerian *G. smaragdina* is a nearly universal trend in snakes (SEIGEL & FORD 1987), although no comparable data is available for any conspecific population from elsewhere.

As can be derived from its diet, *G. smaragdina* appears to occupy a very peculiar spatial niche position. In particular, this species seems to search for prey at the "interface" between the trees and the ground (e.g., lower strata of the canopy, basis of trees and termite nests), as testified by the stomach contents which are typical to snakes which haunt in these kinds of habitat (e.g., *Hemidactylus intestinalis*, *H. fasciatus*, and hyperoliid frogs). In any case, this snake may conduct more intense terrestrial activity than other sympatric arboreal forest species (e.g., *D. jamesoni*, see LUISELLI et al. 2000a), as testified by many records of specimens captured on the ground and by the presence of several terrestrial taxa (e.g., *Agama agama*, *Mabuya* sp.), or even semi-aquatic frogs (*Ptychadena* spp.) in their stomachs. In any case, all prey types taken by *G. smaragdina* are very abundant in the Nigerian rainforest (see POLITANO 1997; AKANI et al. 1999), which suggests that *G. smaragdina* is an opportunistic predator. *Gastropyxis smaragdina* preys upon very small prey items in comparison with its own body size, even in comparison with most of the other colubrids studied to date (POUGH & GROVES 1983). The pattern of prey size - snake size relationship observed in *G. smaragdina* fell into the "ontogenetic telescope type" (sensu ARNOLD 1993) [i.e., as the snake grows, the lower limit of prey size does not increase whereas the upper limit increases]. This type is likely to be quite universal among snakes (ARNOLD 1993).

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