

Habitats of snakes in the rainforests of Eket (Akwa-Ibom State, south-eastern Nigeria) (Squamata: Serpentes)

Habitats von Schlangen im Regenwald von Eket
(Provinz Akwa-Ibom, Südost-Nigeria)
(Squamata: Serpentes)

LUCA LUISELLI & GODFREY C. AKANI

KURZFASSUNG

Wir untersuchten den Lebensraum von Schlangen in einem Regenwaldgebiet Südost-Nigerias in der Umgebung von Eket (Provinz Akwa-Ibom). Das Untersuchungsgebiet umfaßte ein Mosaik von Sumpfrengwald, nicht sumpfigem Regenwald, landwirtschaftlich genutzten Flächen und Siedlungsraum; letzterer erstreckt sich besonders entlang der Hauptstraßen. Insgesamt wurden während der Untersuchung (Juni bis September 1997; 109 Felderhebungstage) 237 Exemplare von Schlangen aus 24 Arten beobachtet. Mit einem UPGMA-Dendrogramm auf Grundlage der Ähnlichkeit der Lebensräume lassen sich die Schlangenarten zu sieben Clustern bündeln: (i) *Calabaria reinhardtii*, *Naja nigricollis*, *Thelotornis kirtlandii*; (ii) *Psammophis phillipsi*, *Gastropyxis smaragdina*; (iii) *Python regius*, *Atheris squamiger*, *Bitis gabonica*; (iv) *Python sebae*, *Dendroaspis jamesoni*; (v) *Bitis nasicornis*, *Naja melanoleuca*, *Grayia Smythii* und andere typische Sumpfwaldbewohner; (vi) *Aparallactus modestus*, *Mehelya crossi*, *Mehelya poensis*; und (vii) *Dasypeltis* sp. Von den drei Haupttypen von Lebensräumen des Untersuchungsgebietes beherbergte der Sumpfrengwald die artenreichsten und sehr wahrscheinlich auch dichtesten Schlangenpopulationen. Betrachtungen über die Schlangengesellschaften der drei Haupttypen von Lebensräumen im Untersuchungsgebiet werden angestellt.

ABSTRACT

The habitat of snakes was studied in a rainforest area of south-eastern Nigeria, situated in the surroundings of Eket (Akwa-Ibom State). Patches of both swamp rainforest and dryland rainforest were available in the territory, which was however characterized by a mosaic of farmlands, cultivations and suburbia, especially near the main roads. A total of 237 snake specimens, composed of 24 species, was observed throughout the research period (June to September 1997; 109 days of field work). A UPGMA dendrogram based on habitat similarities between species allows to define seven clusters of snakes: (i) *Calabaria reinhardtii*, *Naja nigricollis*, *Thelotornis kirtlandii*; (ii) *Psammophis phillipsi*, *Gastropyxis smaragdina*; (iii) *Python regius*, *Atheris squamiger*, *Bitis gabonica*; (iv) *Python sebae*, *Dendroaspis jamesoni*; (v) *Bitis nasicornis*, *Naja melanoleuca*, *Grayia Smythii*, and other typical swamp rainforest species; (vi) *Aparallactus modestus*, *Mehelya crossi*, *Mehelya poensis*; and (vii) *Dasypeltis* sp. Among the three main habitat types prevailing in the study area, the swamp rainforest patches housed the highest snake species diversity, and very probably the most abundant snake populations. Some considerations on the snake assemblages in the main habitat types of the study area are given.

KEY WORDS

Reptilia, Squamata, Serpentes; Afrotropical snakes, habitat, ecology, community structure, rainforests, Eket, Nigeria.

INTRODUCTION

Rainforests of south-eastern Nigeria house a variety of remarkable vertebrate species, which are still largely unknown (POWELL 1993; ISOUN & al. 1996). Even among primates, which represent the best known order of mammals and possibly of vertebrates, two remarkable new taxa have recently been described from the south-eastern Nigeria region which extends from

the Niger Delta (Port Harcourt, Rivers State) to the Cross River bordering the Cameroon (Calabar, Cross River State): *Procolobus badius epieni* and *Cercopithecus sclateri* (OATES & al. 1992, 1994; TOOZE 1995). Our knowledge of Nigerian reptiles in general, and snakes in particular, is still scarce, in spite of several more or less detailed contributions and records (e.g.,

ROMER 1953; DUNGER 1971a, 1971b, 1972a, 1972b; JOGER 1981, 1982; BUTLER & REID 1986, 1990; REID 1989; SCHMITT 1996; LUISELLI & al. 1998 a, 1998 b; AKANI & al. 1998, 1999; LUISELLI & AKANI 1999 a, 1999 b).

With regard to habitat preferences of Nigerian snakes, we can only avail ourselves of a contribution by BUTLER & REID (1986), which however presents merely qualitative considerations, without any quantitative and statistical approach. In this paper, we report some quantitative ob-

servations on the habitats of snake assemblages inhabiting the forests of Eket (Akwa-Ibom State), a town situated in south-eastern Nigeria, between the cities of Port Harcourt (Rivers State) and Calabar (Cross River State).

Compared with the study of BUTLER & REID (1986), the present one is based on a different approach, since it does not make use of an extensive search across a whole region, but focuses on the habitat preferences of snakes in a specific rainforest area.

STUDY AREA AND METHODS

Study area

All observations presented here are based on data collected from June to September 1997 in the surroundings of Eket (04°50'N; 07° 59'E), one of the main towns of the Akwa-Ibom State (south-eastern Nigeria). The area is heavily populated, with several villages and small towns in the surroundings of Eket.

Several terrestrial macrohabitat types, potentially available to snakes, were sampled throughout the present study. Great parts of the territory are occupied by farmlands and cultivations (cassava, yam, oil palm, plantain, banana, pineapple, etc), with wide patches of "bush" interspersed amongst the various villages. The "bush" was partly of the dryland rainforest type, and partly of the freshwater swamp-forest type (moist lowland forest). Dryland rainforests were (i) primary, (ii) secondary, or (iii) bushy forests. Freshwater swamp-forests were permanently or temporarily flooded. For practical reasons, in the following analyses, we assigned these habitats to three main categories: (i) farmlands and suburbia (including cultivations, compounds, and gardens), (ii) dryland rainforest, and (iii) swamp (moist lowland) rainforest.

The climate of the study area is tropical sub-Saharan, with well-marked dry and wet seasons and relatively little monthly fluctuations in maximum and minimum temperatures (GRIFFITHS 1972). The dry season extends from November to April, the wet season from May to October, with the highest rainfall peak during July. Mean

monthly maximum temperatures ranged between 27°C and 34°C, while the minima varied between 22°C and 24°C. The Eket region is one of the wettest of the world, with an average yearly rainfall of more than 3000 mm (source: Department of Geography, University of Calabar).

Methods

Most observations were carried out in ten sample stations, 10 ha in size each, which are well representative of the various macrohabitat types available to snakes in the area. These study sites were not far from Ibeno. A total of 109 days of research were spent in the field. Field trips were made on both sunny and rainy days. The everyday field work was done regularly, approximately from 08.00 a.m. to 06.00 p.m. Because of potential security risks due to groups of criminals operating in the region, we were usually unable to conduct field trips during twilight and nocturnal hours. Random routes for locating snakes were set up throughout all habitat types available in the study area. When seen, snakes were captured by hand (see PHELPS 1981, 1989, for the description of a method to handle large African venomous snakes), sexed by analysing the morphology of the tail (a method which is easy to apply to most snakes but psammophine colubrids), and measured for snout-vent length (SVL) and tail length (TL, both to the nearest ± 0.5 cm), and then individually marked by ventral scale-clipping. However, data concerning body sizes, food habits, and other

ecological matter are reported elsewhere (LUISELLI & AKANI 1999 b). A white number was painted to the back of each captured snake to facilitate later identification of the specimen from a distance without further disturbing it. Meteorological conditions and time of observation were also recorded. Pitfall traps and drift fences were used in each habitat type. Moreover, several snakes were sampled under flat objects which were placed on the ground and checked each day (VITT & VANGILDER 1983). Specimens captured by local people were also examined, although in some cases it was difficult to determine the habitat type where the snake was found. Some individuals of *Bitis gabonica* (DUMÉRIL & BIBRON, 1845), *B. nasicornis* (SHAW, 1802), *Dendroaspis jamesoni* (TRAILL, 1843), *Naja nigricollis* REINHARDT, 1843, and *Calabaria reinhardtii* (SCHLEGEL, 1848) received mini-transmitter implants and were radiotracked, but the analyses concerning these animals are still in progress and will be presented elsewhere.

Snakes found dead (squashed by cars along the road, macheted by farmers, or offered in bush-meat markets of local tribes) were initially preserved in 10% formalin and stored in our private herpetological collections or in the collections of the Zoological Museum of the Rivers State University of Science and Technology, Port Harcourt (Rivers State, Nigeria).

Species diversity (D) was calculated using Simpson's (1949) diversity index. Species dominance (d) was assessed by means of the Berger-Parker index (MAGURRAN 1988):

$$d = N_{\max} / N$$

where N is the total number of individuals observed and N_{\max} is the total number of individuals of the most abundant species. An increase in the value of $1/d$ indicates increase of diversity and decrease of dominance (MAGURRAN 1988). All statistical tests given here are two-tailed, with alpha set at 5%. For the statistical analyses we used STATISTICA® version 4.5 for Windows®.

RESULTS AND DISCUSSION

General considerations

A total of 237 snake specimens from 24 species, was observed throughout the research period, including the specimens captured or sighted in the field, captured in traps, or just examined in the hands of local hunters (table 1). On the whole, in the Eket territory we found 22 out of 34 snake species (64.7%) which are known to occur in the adjacent Calabar region, Cross River State (cf. BUTLER & REID 1986), plus two additional species, *B. gabonica* and *Dasypteltis* sp. which are not listed by these authors but were observed by us in the field more than once. Concerning *B. gabonica*, it should be noted that we captured this snake even north of Calabar in Itu, in the Oban Hills, and in the surroundings of Ekan and that the head of an adult specimen from Akampka (Calabar) is stored in the collections of the Cross River National Park (LUISELLI & AKANI, unpublished). Thus, *B. gabonica* is possibly relatively widespread in the whole Calabar and Eket territories, despite its presence was not re-

corded earlier. *Dasypteltis* sp. was already found in south-eastern Nigeria (REID 1989; SCHMITT 1996). Species which are listed by BUTLER & REID (1986) but were not found by us include: *Rhinotyphlops crossii* (BOULENGER, 1893), *Typhlops punctatus* (LEACH, 1819), *Mehelya guirali* (MOCQUARD, 1887), *Lamprophis olivaceum* (DUMÉRIL, 1856), *Philothamnus heterodermus heterodermus* (HALLOWELL, 1857), *Tharsops flavigularis* (HALLOWELL, 1852), *Meizodon coronatus* (SCHLEGEL, 1837), *Toxicodryas pulverulenta* (FISCHER, 1856), *Polemon collaris brevior* (WITTE & LAURENT, 1947), *Pseudohaje goldii* (BOULENGER, 1895), *Causus maculatus* (HALLOWELL, 1842), and *Atractaspis corpulenta corpulenta* (HALLOWELL, 1854). However, among all above-species, only *M. guirali* was reported to occur in swamps, swamp edges, and swamp-forests (BUTLER & REID 1986).

The most recent lists of snakes from south-eastern Nigeria were issued by REID (1989) and SCHMITT (1996), who worked in the mountain forests of the Oban division of Cross River State (Calabar). These

authors mention 42 species to occur, the presence of three of them - *Lamprophis olivaceum*, *Philothamnus heterolepidotus* (GÜNTHER, 1863), and *Psammophis sibilans* (LINNAEUS, 1758) - being uncertain due to identification problems. There are remarkable differences between our data and those of REID (1989) and SCHMITT (1996), as many species listed in their studies were not observed by us in Eket, e. g., the three above mentioned uncertain species and *Mehelya guirali* (MOCQUARD, 1887), *Meizodon coronatus* (SCHLEGEL, 1837), *Philothamnus heterodermus*, *Polemon collaris brevior*, *Thrasops flavigularis* (HALLOWELL, 1852), *Thrasops occidentalis* PARKER, 1940, *Boulengerina annulata* (BUCHHOLZ & PETERS, 1877), *Pseudohaje goldii* (BOULENGER, 1895), *Atractaspis corpulenta* (HALLOWELL, 1854), and *Causus maculatus* (HALLOWELL, 1842).

The reasons for the differences may be explained by different sampling strategies, but REID (1989) and SCHMITT (1996) did not report details on the methods they used. We therefore tried to analyse whether the observed differences in the faunal composition are real or artificial by comparing the index values of species diversity (D) and species dominance (d) of Eket (data in this study) and Calabar (data in REID 1989; indexes were impossible to be calculated from data in SCHMITT 1996). Species diversity was significantly ($P > 0.001$, Mantel test) lesser in Eket ($D = 13.30$) than in Calabar ($D = 17.24$); on the other hand, species dominance was significantly ($P < 0.02$, Mantel test) higher in Eket ($d = 0.173$) than in Calabar ($d = 0.125$). Thus, the mountain forests of Calabar are likely to house really a higher diversity of snake species than the moist rainforests of Eket. To our opinion, the reasons for these differences, are twofold: (i) mountain forest communities are surely different from lowland communities, and (ii) species diversity of Eket should increase when more specimens are sampled and when dry season sampling results are added.

With regard to the snake species recorded by BUTLER & REID (1986), REID (1989), and SCHMITT (1996) but not found by us, it should be noted that *Typhlops punctatus* (LEACH, 1819), a savanna species, is not likely to occur in Calabar and

we suspect that these authors observed *T. congestus* (DUMÉRIL & BIBRON, 1844) instead. *Typhlops congestus* is a forest species which is present in south-eastern Nigeria, including the Niger delta area (several specimens in the British Museum [Natural History], B. HUGHES, pers. comm., November 1997). However, it should be noted that these two typhlopoid "species" were for a long time considered subspecies of *T. punctatus*. *Philothamnus heterodermus*, *Pseudohaje goldii* and *Causus maculatus* were collected both east (Calabar - see BUTLER & REID 1986) and west of Eket (Niger delta - see AKANI & al. 1999). These species are very likely to occur in the Eket territory and apparently escaped our observations. The record of *Boulengerina annulata* from Oban (SCHMITT 1996) deserves confirmation. To our knowledge, this snake was never collected in Nigeria before (SPAWLS & BRANCH 1995) and we never observed it not even in the extreme south-eastern regions of the country. Based on the astonishing resemblance of this aquatic elapid with the water snake *Grayia snythii* (see SPAWLS & BRANCH 1995) we hypothesize that SCHMITT's (1996) record might be an identification error.

Our study has permitted to obtain information on the habitat characteristics of 22 out of 24 species of snakes observed in the Eket area: three pythons, thirteen colubrids, three elapids, and three vipers. Unfortunately, we have no firm records on the habitats of the colubrid species *Lamprophis virgatum* (HALLOWELL, 1854) and *Dipsadoboa duchesnii* (BOULENGER, 1901), in that the few individuals observed were specimens killed by local people which unreliably described the site of capture. However, *L. virgatum* was reported to occur in suburbia and *D. duchesnii* in forests by BUTLER & REID (1986).

The distribution of the observations relative to snake species and main habitat type is presented in table 2. The UPGMA tree diagram on the habitat use similarity of Eket snakes is shown in figure 1. Based on this diagram, seven different clusters of snakes can be defined: (i) *C. reinhardtii*, *N. nigricollis*, *Thelotornis kirtlandii* (HALLOWELL, 1844); (ii) the "racers" *Psammophis phillipsi* (HALLOWELL, 1844), *Gastropyxis smaragdina* (SCHLEGEL, 1837); (iii) *Python*

Table 1. Numbers of male and female specimens captured and total numbers of recaptures of the various snake species at the study area of Eket (south-eastern Nigeria). The table includes only specimens in which the habitat type upon capture was determined.

Tab. 1: Anzahlen gefangener Männchen und Weibchen sowie Gesamtzahlen der Wiederfänge bei den verschiedenen Schlangenarten des Untersuchungsgebietes von Eket (Südost-Nigeria). Nur Arten, bei deren Fang der Habitattyp erfaßt wurde, sind dargestellt.

Species Art	Males Männchen	Females Weibchen	Total number of recaptures Gesamtzahl Wiederfänge
<i>Calabaria reinhardtii</i>	2	5	0
<i>Python regius</i>	3	7	5
<i>Python sebae</i>	2	1	0
<i>Bitis gabonica</i>	3	0	3
<i>Bitis nasicornis</i>	4	5	7
<i>Atheris squamiger</i>	4	0	0
<i>Dendroaspis jamesoni</i>	6	1	8
<i>Naja melanoleuca</i>	2	0	0
<i>Naja nigricollis</i>	6	2	17
<i>Thelotornis kirtlandii</i>	2	1	8
<i>Psammophis phillipsi</i>	8	2	15
<i>Gastropyxis smaragdina</i>	8	4	10
<i>Afronatrix anoscopus</i>	8	9	24
<i>Natriciteres fuliginoides</i>	3	0	0
<i>Natriciteres variegata</i>	3	5	0
<i>Grayia smythii</i>	3	2	0
<i>Lamprophis virgatum</i>	1	0	0
<i>Dipsadoboa duchesnii</i>	1	0	0
<i>Crotaphopeltis hotamboeia</i>	2	0	0
<i>Dasypleltis</i> sp.	2	0	0
<i>Mehelya poensis</i>	1	0	0
<i>Mehelya crossi</i>	0	2	0
<i>Aparallactus modestus</i>	2	0	0
<i>Toxicodryas blandingii</i>	5	2	9

regius (SHAW, 1802), *Atheris squamiger* (HALLOWELL, 1854), *B. gabonica*; (iv) *Python sebae* (GMELIN, 1788), *D. jamesoni*; (v) the typical swamp-forest species, including e.g. *B. nasicornis*, *N. melanoleuca* HALLOWELL, 1857, *Grayia smythii* (LEACH, 1818), etc; (vi) *Aparallactus modestus* (GÜNTHER, 1859), *Mehelya crossi* (BOULENGER, 1895), *Mehelya poensis* (SMITH, 1847); and (vii) *Dasypleltis* sp., which was seen only in cultivated places.

Among the three main habitats prevailing in the study area, the swamp rainforest patches housed the highest snake species diversity: individuals of twenty species were captured in this forest type while eleven species were found in dryland rain forest patches, and only seven in cultivations and suburbia. Moreover, 45% of the taxa captured in swamp rainforest patches were not observed in any of the other habitat types, while only 9% of the

taxa captured in the dryland rainforest and 14.3% of the taxa captured in suburban areas were exclusively found in the respective habitat types. All these observations indicate that swamp rainforests need particular attention in biodiversity and conservation studies in Central Africa (see AKANI & al. 1999).

Did the patches of swamp rainforest not only house the most diverse snake faunas but also the most abundant populations of snakes? Our data in this issue are very preliminary, but the analysis of the total number of snakes observed (given that the sampling effort was approximately identical and that the numbers of traps used was the same in each habitat type) can give some interesting information. As one can see from table 2, 136 snakes were registered in swamp rainforest, 79 in dryland rainforest, and only 20 in suburbia. As expected, snake faunas of suburban and

Table 2: Numbers of snake specimens observed in each of the three main habitat types in the Eket area (south-eastern Nigeria).

Tab. 2: Anzahlen der Schlangenexemplare, die in jedem der drei Haupttypen von Lebensräumen im Gebiet von Eket (Südost-Nigeria) beobachtet wurden.

Species Art	Farmlands, Cultivations Landwirtschaftliches Gebiet	Dryland Rain Forest "trockener" Regenwald	Swamp Rain Forest Sumpf-Regenwald
<i>Calabaria reinhardtii</i>	1	3	3
<i>Python regius</i>	2	13	-
<i>Python sebae</i>	-	1	2
<i>Bitis gabonica</i>	-	5	1
<i>Bitis nasicornis</i>	-	-	16
<i>Atheris squamiger</i>	-	1	3
<i>Dendroaspis jamesoni</i>	-	6	9
<i>Naja melanoleuca</i>	-	-	2
<i>Naja nigricollis</i>	2	13	10
<i>Thelotornis kirtlandii</i>	-	6	5
<i>Psammophis phillipsi</i>	7	11	7
<i>Gastropyxis smaragdina</i>	4	14	6
<i>Afonatrix anoscopus</i>	-	-	41
<i>Natriciteres fuliginoides</i>	-	-	3
<i>Natriciteres variegata</i>	-	-	8
<i>Grayia smythii</i>	-	-	5
<i>Lamprophis virgatum</i>	?	?	?
<i>Dipsadoboa duchesnii</i>	?	?	?
<i>Crotaphopeltis hotamboeia</i>	-	-	2
<i>Dasyplettis</i> sp.	2	-	-
<i>Mehelya poensis</i>	-	-	1
<i>Mehelya crossi</i>	-	-	2
<i>Aparallactus modestus</i>	-	-	2
<i>Toxicodryas blandingii</i>	2	6	8

cultivated areas were very depauperated in comparison with that of the two forest types, not only in terms of species diversity but also concerning the number of snakes. In fact, the number of snakes observed in suburbia was significantly lower than that observed in the two forest types (in all pairwise comparisons, χ^2 test, $df = 1$, $P < 0.0000001$). However, the number of snakes observed in swamp rainforest significantly exceeded that found in dryland rainforest ($\chi^2 = 20.5$, $df = 1$, $P < 0.00000001$), thus suggesting that snakes are really more numerous in swamp than in dryland rainforests. In this regard differences between the two types of forest concerning relative catchability of snakes should be considered possible, i.e. a human observer could e. g. have detected snakes more readily in the swamp than in the dryland rainforest. Despite this alternative hypothesis is difficult to test and cannot be excluded *a priori*, we suggest that the trend is real and not apparent. In fact, the num-

ber of snakes captured in the pitfall traps placed in the dryland forest was significantly lower than that found in the traps placed in the swamp rainforest ($\chi^2 = 11.2$, $df = 1$, $P < 0.0001$), which confirms the above suggestion.

Farmlands and suburbia

A mosaic of more or less wide farmlands and villages surrounded almost every forest patch. In these "suburban" areas the gardens may have mango trees, plantains, oil palm trees, and ornamental shrubs, which can occasionally house small snake populations. The snake fauna is very poor in terms of (i) species diversity and (ii) numbers of individuals. The unique venomous snake relatively common in these habitat types was *N. nigricollis*, which appeared abundant not only in the Eket territory but also in the suburban Port Harcourt and Calabar, as well as in the small "bushes" surrounding Calabar International

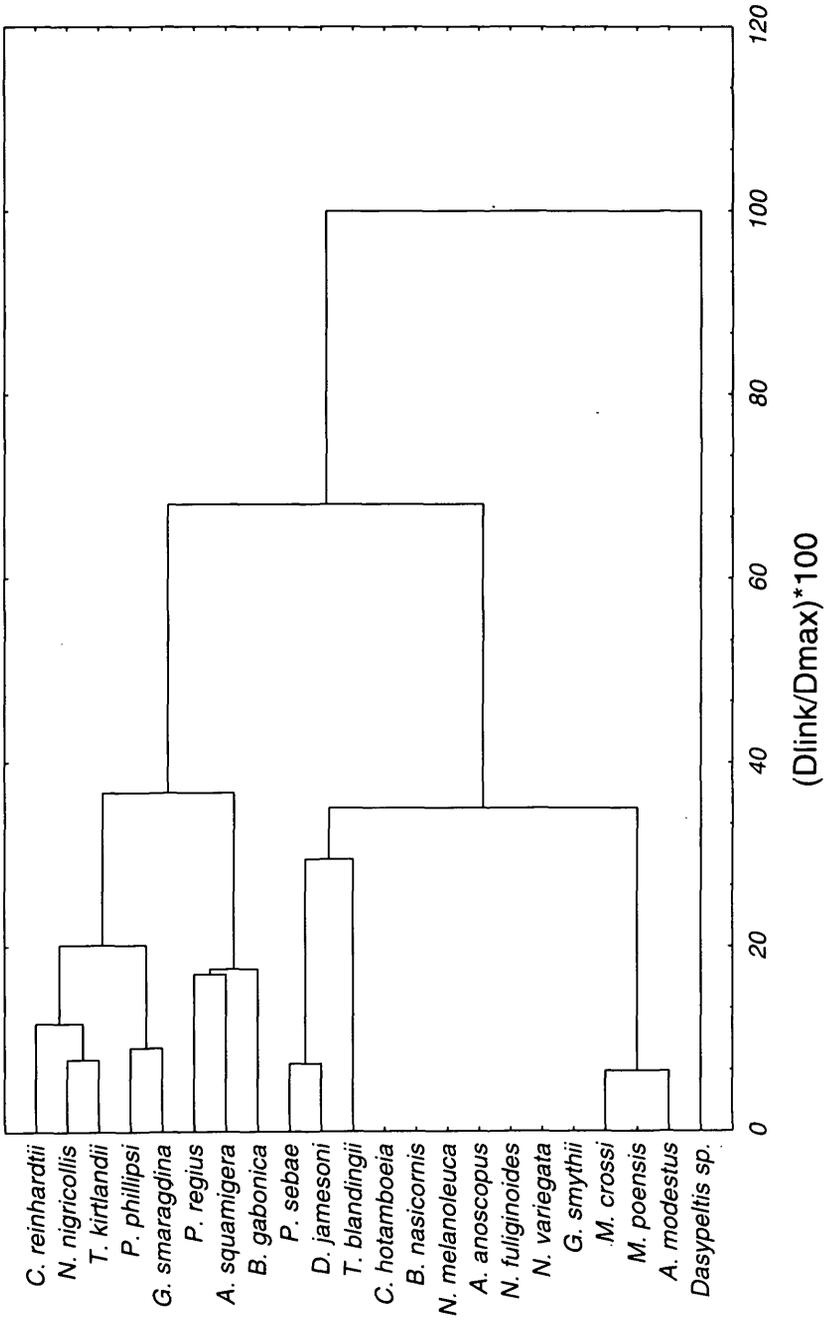


Fig. 1: UPGMA tree diagram (standardized to 100%) showing the similarities between snakes as far as habitat of occurrence is concerned.

Abb. 1: UPGMA-Baumdiagramm (standardisiert auf 100%) zur Darstellung von Ähnlichkeiten zwischen den Schlangen hinsichtlich des von ihnen bewohnten Lebensraumes.

Airport. The two most common species were the colubrids *P. phillipsi* and *G. smaragdina*, frequently called "house snakes" by local people, whereas *T. blandingii*, *P. regius* and *C. reinhardtii* were occasionally encountered only.

Dryland rainforest

The snake fauna of the dryland rainforest includes arboreal, terrestrial (including fossorial) and semiaquatic species. The most common species were *P. regius*, *N. nigricollis*, *P. phillipsi*, and *G. smaragdina*, complexively accounting for 64.6% of the total number of snake sightings in this habitat type. It should also be noted that this is the elective habitat of *B. gabonica*, which is by far the heaviest venomous snake in the Eket area.

Swamp (moist lowland) rainforest

This habitat type houses the most diverse snake fauna in the Eket territory. Particular characteristics of this habitat are the batrachophagous and fish-eating semiaquatic colubrid genera *Afronatrix*, *Crotaphopeltis*, and *Grayia*, as well as *N. mela-*

noleuca, and *B. nasicornis*. Both of these latter species seem to be restricted to this habitat type, possibly because of the concurrent competition with *N. nigricollis* and *B. gabonica*, which are more bound to drier habitats, at least in the Eket territory. Whether the two *Naja* or the two *Bitis* species are true competitors to each other is still debatable. However, it seems obvious that at least in some Afrotropical regions *N. nigricollis* appears to be moving from the savanna, exploiting recently deforested areas, maybe challenging the niche of *N. melanoleuca* (BUTLER 1985; BUTLER & REID 1986). Another remarkable species found along the swamps was *P. sebae*, which is "semi-aquatic" in some places as experienced local hunters told us.

In general, our records indicate that the most versatile snake species, at least in this region of south-eastern Nigeria, were the colubrids *P. phillipsi*, *G. smaragdina*, and *T. blandingii* and the elapid *N. nigricollis*, whereas BUTLER & REID (1986) agreed in considering *T. blandingii* and *N. nigricollis* as very versatile species, but considered also *M. poensis* and *P. sebae* (both rarely encountered by us) as present in a variety of habitats.

ACKNOWLEDGMENTS

We are gratefully indebted with the companies "T.S.K.J. Nigeria Ltd." (Port Harcourt and Lagos), "Eco-system s.r.l." (Bari), "Aqater s.p.a." (San Lorenzo in Campo), and "Amertex Oil & Gas Ltd." (Lagos) for supporting the research of the first author (L. L.) in Nigeria. Special thanks go to Dr EMMANUEL E. ARIKPO, Mr HENRY MANYO NDOMA ("Cross River National Park", Akampka, Calabar) and JENNIFER S. EKANEM (Calabar) for having shown some remarkable sites for observing snakes, and for having permitted examination of several specimens stored in the collection of the institution. Dr

ZENA TOOZE ("Cercopan", Calabar) is thanked for her friendly collaboration, and our friends CYNTHIA, UBONG, LYNNE and HENRY (Calabar) are thanked for field companionships and for having permitted us to spend a lot of nice time in Eket. Dr ULRICH JOGER (Darmstadt Museum) helped us with the identification of some materials. Mr BARRY HUGHES (London) gave us some very valuable information on taxonomy of Nigerian snakes; Dr FRANCESCO ANGELICI (Rome) helped us in the field and commented on a previous draft version.

REFERENCES

- AKANI, G. C. & LUISELLI, L. & ANGELICI, F. M. & POLITANO, E. (1998): Bushmen and herpetofauna: Notes on amphibians and reptiles traded in bush-meat markets of local people in the Niger Delta (Port Harcourt, Rivers State, Nigeria).- *Anthropozoologica*; 26.
- AKANI G. C. & LUISELLI, L. & POLITANO E. (1999): Ecological and conservation considerations on the reptile fauna of the eastern Niger Delta (Nigeria).- *Herpetozoa*, Wien; 11 (3/4): 141-153.
- BUTLER, J. A. (1985): Capture au Nigeria d'un *Naja* noire et blanc de grande taille et notes sur le autres *Najas* de l'ouest African.- *Notes Africaines*; 176: 110-111.
- BUTLER, J. A. & REID, J. (1986): Habitat preferences of snakes in the Southern Cross River State, Nigeria. pp. 483-488. In: ROCEK, Z. (ed.): *Studies in herpetology*. Charles University Press, Prague.
- BUTLER, J. A. & REID, J. (1990): Records of snakes from Nigeria.- *Nigerian Field*; 55: 19-40.
- DUNGER, G. T. (1971 a): The snakes of Nigeria. Part I. The file snakes of Nigeria.- *Nigerian Field*; 36: 54-71.
- DUNGER, G. T. (1971 b): The snakes of Nigeria. Part II. The house snakes of Nigeria.- *Nigerian Field*; 36: 151-163.
- DUNGER, G. T. (1972 a): The snakes of Nigeria. Part III. The harmless water and marsh snakes of Nigeria.- *Nigerian Field*; 37: 21-38.
- DUNGER, G. T. (1972 b): The snakes of Nigeria.

Part IV. The harmless green snakes of Nigeria.- Nigerian Field; 37: 158-180.

GRIFFITHS, J. F. (1972): Climates of Africa; pp. 321-385. In: LANSBURG, H. E. (ed.): World survey of climatology, Vol. 10, New York (Elsevier).

ISOUN, T. T. & POWELL, C. B. & ZOUBA, A. & ISOUN, M. & WILLIAMSON, K. (1996): Preliminary baseline survey of the flora and fauna of the lowland oil palm project area, Rivers State. Niger Delta Wetlands Centre, Port Harcourt.

JÖGER, U. (1981): Zur Herpetofaunistik Westafrikas.- Bonner Zool. Beitr.; 32: 297-340.

JÖGER, U. (1982): Zur Herpetofaunistik Kameruns (II).- Bonner Zool. Beitr.; 33: 313-342.

LUISELLI, L. & AKANI, G. C. (1999 a): Observations on the ecology of *Bitis gabonica gabonica* and *Bitis nasicornis* (Viperidae) in the rainforests of southeastern Nigeria.- Bull. Soc. Herpet. France; 87-88: 35-44.

LUISELLI, L. & AKANI, G. C. (1999 b): Food resource partitioning of a community of snakes in a swamp rainforest of south-eastern Nigeria.- J. Zool., London; 246.

LUISELLI, L. & AKANI, G. C. & ANGELICI, F. M. & BARIENEE, I. F. (1998 a): Reproductive strategies of sympatric *Bitis gabonica* and *Bitis nasicornis* in the Niger Delta (Port Harcourt, Nigeria): Preliminary data.- Amphibia-Reptilia; 19: 223-229.

LUISELLI, L. & AKANI, G. C. & BARIENEE, I. F. (1998 b): Observations on habitat, reproduction, and feeding of *Boiga blandingii* (Colubridae) from south-eastern Nigeria.- Amphibia-Reptilia; 19: 430-436.

MAGURRAN, A. E. (1988): Ecological diversity and its measurement. Princeton (Princeton Univ. Press), 356 pp.

OATES, J. F. & ANADU, P. A. & GADSBY, E. L. & WERRE, J. L. (1992): Sclater's guenon.- National Geographic Research Explorations; 8: 476-491.

OATES, J. F. & POWELL, C. B. & GONDER, M. K. (1994): A new form of Red Colobus monkey from Nigeria.- Proc. XV. Congr. Internat. Primatol. Soc., p. 121. Bali, Indonesia.

PHELPS, T. (1981): Poisonous snakes.- London (Blandford Press), 237 pp.

PHELPS, T. (1989): Poisonous snakes (Revised Edition).- London (Blandford Press), 237 pp.

POWELL, C. B. (1993): Sites and species of conservation interest in the central axis of the Niger Delta. National Resources Conservation Council, Port Harcourt. 151 pp.

REID, J. C. (1989): Floral and faunal richness of the Oban Division of Cross River National Park.- WWF feasibility study. 6. European Development Fund, London. 184 pp.

ROMER, J. D. (1953): Reptiles and amphibians collected in the Port Harcourt area of Nigeria.- Copeia; 1953: 121-123.

SCHMITT, K. (1996): Zoological survey of the Oban Division, Cross River National Park.- Oban Hills Programme, Calabar, pp. 21.

SIMPSON, E. H. (1949): Measurement of diversity.- Nature, London; 163: 688.

TOOZE, Z. (1995): Update on SCLATER's Guenon *Cercopithecus sclateri* in southern Nigeria.- African Primates; 1: 38-42.

VITT, L. J. & VANGILDER, L. D. (1983): Ecology of a snake community in northeastern Brazil.- Amphibia-Reptilia; 4: 273-296.

DATE OF SUBMISSION: November 12th, 1997

Corresponding editor: Heinz Grillitsch

AUTHORS: Dr. LUCA LUISELLI, Institute of Environmental Pollution Research "Demetra", via dei Cochi 48/B, I-00133 Rome (Italy) [fax: ++39-6-8411964; email: luiselli@earthling.net]; Dr. GODFREY C. AKANI, Department of Biological Sciences, The Rivers State University of Science and Technology, P.M.B. 5080, Port Harcourt, Rivers State (Nigeria).

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Herpetozoa](#)

Jahr/Year: 1998

Band/Volume: [11_3_4](#)

Autor(en)/Author(s): Luiselli Luca M., Akani Godfrey C.

Artikel/Article: [Habitats of snakes in the rainforests of Eket \(Akwa-Ibom State, south-eastern Nigeria\) \(Squamata: Serpentes\). 99-107](#)