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Using local African communities' Ecological Knowledge to support scientific evidence of snake declines
(Squamata: Serpentes)

Die Nutzung des ökologischen Wissens der lokalen afrikanischen Bevölkerung zur Stützung des wissenschaftlichen Nachweises des Rückgangs von Schlangenpopulationen (Squamata: Serpentes)

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KURZFASSUNG

Neuere Studien legen nahe, daß die Populationsgrößen von Schlangen zumindest auf drei Kontinenten großflächig abnehmen, wobei einige Arten des tropischen Nigeria in Westafrika betroffen sind. Ziel der Arbeit war es, mögliche Beziehungen zwischen verschiedenen Ursachen dieses Rückganges und seine Randbedingungen zu beschreiben, um Vorhersagen zur Abnahme der Schlangendichte machen zu können. Zu diesem Zweck untersuchten die Autoren das diesbezügliche Ökologische Wissen (EK) von Ortsansässigen, also alles was an Kenntnis und Vorstellungen aus Tradition und Überlieferung im kollektiven Gedächtnis der einheimischen Bevölkerung über Schlangen vorhanden war. Die vorliegende Arbeit beschreibt einen auf der Einbindung befragter Personen basierten Ansatz zur Stützung wissenschaftlicher Analysen des Schlangenrückgangs im Delta des Niger-Flusses, wo innerhalb des letzten Jahrzehnts eine deutlich verminderte Schlangenhäufigkeit beobachtet wurde. Dazu wurden die Ergebnisse zweier Erhebungen mittels Fragebogen (die erste in den Jahren 1996-1997, die zweite 2011-2012) verglichen, die jeweils mit Hilfe von Bauern und Jägern aus denselben 41 Ortschaften durchgeführt wurden. Der standardisierte Fragebogen war zweiteilig und umfaßte (i) einen Abschnitt mit allgemeinen Fragen zur persönlichen Einstellung des Befragten gegenüber Schlangen und (ii) einen Abschnitt mit drei Fragen zur wahrgenommenen Formenvielfalt, zum Lebensraum und der gegenwärtige Häufigkeit von Schlangen im Bereich des Wohnortes des Befragten. Hauptsächlich drei Zusammenhänge wurden dabei als Muster erkennbar: (1) die sozialrelevanten Aspekte der Wertschätzung und Gefährlichkeit von Schlangen hatten sich unter der ländlichen Bevölkerung innerhalb der letzten 15 Jahre nicht verändert; (2) einige Schlangenarten wurden als im Rückgang begriffen empfunden; (3) die Zuordnung zwischen bestimmten Lebensräumen und bestimmten Schlangenarten hat sich leicht verändert. Die Schlußfolgerungen aus den beschriebenen Mustern werden unter der Voraussetzung diskutiert, daß verschiedene Aspekte der wahrgenommenen Veränderungen in der Häufigkeit der Zielobjekte tatsächlich mit den Ergebnissen herpetologischer Feldforschung übereinstimmen.

ABSTRACT

Recent studies suggest that snakes are widely declining in at least three continents, and that this decline has targeted some species of tropical Nigeria, West Africa. To describe the possible interrelations among different causes and the boundary conditions to forecast snake decline, we explored local communities' Ecological Knowledge (EK) in this respect, i.e., that cumulative body of knowledge and beliefs concerning snakes, shared in the human community by cultural transmission, thus constituting the social memory. Here we describe a survey-based participatory approach to reinforce the scientific analyses of snake declines in the River Niger Delta, where significant snake declines have been detected over the last decade. We compared the results of two questionnaire-based surveys (the first in 1996-1997 and the second in 2011-2012) to farmers and hunters in a same set of 41 villages. The standardized questionnaire consisted of two parts: (i) a section with general questions on the personal attitude of the respondent toward snakes, and (ii) a section with three questions on perceived snake diversity, habitat, and current abundance around the villages of those interviewed. Three main patterns emerged: (1) the social shared role (value and dangerousness) of snakes in the rural communities was constant in the last 15 years; (2) some species were perceived as declining; and (3) the habitat – species relationships are slightly changed. The implications of these patterns are discussed, given that several aspects of the perceived changes in population abundances of targeted snakes were indeed consistent with herpetological scientific data from the field.

KEY WORDS

Reptilia: Squamata: Serpentes; decline; snakes; Nigeria; questionnaire-based surveys; Ecological Knowledge (EK), social memory

INTRODUCTION

Several independent long term studies (READING et al. 2010; BOMBI et al. 2011; MADSEN & UJVARI 2011; UJVARI et al. 2011; FRANK et al. 2012; LUISELLI et al. 2012) suggest that snake populations are declining worldwide. It is, however, difficult to find definite ecological causes for these declines, which are probably multifaceted with one or few common roots (READING et al. 2010). These declines have affected such a diverse array of species as pythons, vipers, and colubrids in at least three continents and disparate ecological conditions (READING et al. 2010). Thus, the evidence of a widespread snake decline has raised considerable concern in the international community of conservation biologists.

The science goal is obviously to describe the possible interrelations among different causes and the boundary conditions to forecast this possible decline, and to add more robust empirical evidence for the general trend picture in such a way as to speed up management solutions. In this sense, exploring the local communities' Ecological Knowledge (EK) is an emerging task. This kind of knowledge is defined as a cumulative body of knowledge and beliefs shared in the human community by cultural transmission and, for these reasons, becoming social memory (BERKES et al. 2000; DAVIDSON-HUNT & BERKES 2003). Even if not even with good results (DIAMOND 2005), social memory has historically and all over the world structured the local communities' decision making processes in ecosystems and landscape management (FRANCO et al. 2007; HORSTMAN & WIGHTMAN 2001) and its losing may represent a problem (FRANCO & LUISELLI, unpublished data). The communities' EK is a dynamic entity, able to register possible changes based on trial and error selection of information about local species (distribution, abundance, habitats, taxonomy, phenology, when and where they are found), linked to their harmfulness and utility.

For all these reasons, this social resource is used more and more, even in rural development programs (ANEGBEH et al. 2004) or in conservation research and programs involving participatory approaches (ZWEIFEL 1997; UGBOGU & AKINYEMI 2004; CASTELLO et al. 2009; RIST et al. 2010). Even if this kind of approach is often associated with the planning stages, it has a significant role in selecting research questions and designing working hypotheses (MACDONALD & WEBER 1998).

This paper describes a survey-based participatory approach to reinforce the scientific analyses of snake declines in a rainforest region of West Africa (River Niger Delta in southern Nigeria) where significant snake declines have been detected over the last decade (READING et al. 2010). More in detail, we compare the results of participatory research based on a two-step survey made in 1996-1997 and in 2011-2012. Our aims were to verify the evolution of local communities' EK of some conspicuous snake species (e.g., *Python regius*, *Bitis gabonica*) comparing it with ecological scientific research in the same region (e.g., LUISELLI et al. 1998; AKANI et al. 1999a, 1999b; READING et al. 2010).

MATERIALS AND METHODS

Study area

Data given here were collected during standardized interviews conducted in 1996-1997 and in 2011-2012 at 41 villages in southern Nigeria (Appendix 1). Notably, interviews were conducted in the Port Harcourt region in the eastern branch of the River Niger Delta (Rivers State), the Uyo area in Akwa-Ibom State, and the Calabar area in Cross River State. These territories are densely populated, with remnant patches of rainforest and swamp forest interspersed among wide plantations (yam, cassava, pineapple, oil palms, banana, plantains, etc.) and forest-derived savannah vegetation (DE MONTCLOS 1994). Mangroves were found along the coastal areas with brackish water channels and rivers. This is also one of the most developed regions of

Sub-Saharan Africa due to oil and petroleum industry (DE MONTCLOS 1994), and this industrial development has considerably affected the natural habitats and biodiversity (for the case of reptiles, see AKANI et al. 1999a).

Interview protocol

In both 1996-1997 and in 2011-2012, interviews were conducted in a same set of 41 villages. A total of 63 interviewees in 1996-1997 and 71 interviewees in 2011-2012 were sampled.

It should be stressed that we structured the first 1996-97 survey to get some pilot information about the sites where snakes were abundant, in order to facilitate our practical decisions, i.e., which places were good for establishing long-term monitoring programmes on snake populations. On the other hand, the survey of 2011-2012 was explicitly carried out to verify local EK on snake decline, as revealed by demographic studies on marked free-ranging snake populations (READING et al. 2010). Thus, given the benchmarking role of the first survey structure, we did not modify the survey structure during the latter survey period, although more direct questions on snake declines would have been possible.

The first survey was focused on those population strata which were supposed to concentrate the information available on snakes at the village level, i.e., only males were selected because women do not usually work in the bush/forest. Even if gender stratification could be important in traditional knowledge analyses (PFEIFFER & BUTZ 2005), we can assume that in this case the bias, if present, does not affect the comparison. The sample population was stratified by the expected expertise about wildlife due to activity (1996-2011: farmers 29-31, fishermen 17-21, hunters 17-19) rather than their seniority (HORSTMAN & WIGHTMAN 2001). The frequency of profession profiles did not change between survey periods (chi^2 test, 2 *df*, *P* = n.s.). Age of the interviewees was 19 to 65 yrs in 1996-1997, and 19 to 63 in 2011-2012). It is to be stressed that our surveys were not intended for analyzing social issues (with the need of obtaining a balanced sample of people representing the whole population structure in each village).

A standardized questionnaire was prepared (Table 1). The questionnaire consisted of two parts: (i) a pre-test section with general questions on the personal attitude of the respondent toward snakes, including its opinion about whether all snakes are dangerous to humans, and (ii) a true test section with three questions on perceived snake diversity, habitat and current abundance around the villages of those interviewed. Identity of those surveyed was not taken to guarantee privacy (many people, especially hunters, may be suspicious if their identity is asked and may refuse to answer). Ages and professions were noted, in addition, the village toponym, its local government area, state, and geographic coordinates were taken (Appendix 1).

Each one interviewed was asked the entire series of questions listed in the standardized questionnaire by a native assistant. This procedure was decided in order to minimize problems of understanding. No one surveyed was allowed to fill in the questionnaire himself. This procedure was decided to secure homogeneity in the compilation of questionnaires, given that some surveyed, especially in small and remote villages and if older than 45, were unable to read and write, whereas many others were perfectly able to do so.

For homogeneity between surveys, we focused our questions on the same species of snakes of ethnic and social relevance, without concentrating on the whole snake fauna of southern Nigeria (CHIPPAUX 2007). In the questionnaire form, we used the 'pidgin English' vernacular names for these snake species. The target species were *Python sebae* (GMELIN, 1789) [defined as 'Big python' in the questionnaire], *Python regius* (SHAW, 1802) ['Small python'], *Typhlops* spp. and *Calabaria reinhardtii* (SCHLEGEL, 1848) ['Two headed snakes'; these species are usually not discriminated by those surveyed], *Bitis gabonica* (DUMÉRIL, BIBRON & DUMÉRIL, 1854) and *Bitis nasicornis* (SHAW, 1802) ['Viper'; these two species are usually not discriminated by those interviewed], *Dendroaspis jamesoni* (TRAILL, 1843) ['Green mamba'; in this term the surveyed also consider some green

Table 1: The questionnaire used in the present investigation.
Tab. 1: Der Fragebogen, der in der vorliegenden Studie verwendet wurde.

DATE:
VILLAGE:
LOCAL GOVERNMENT AREA:
STATE:
NAME OF INTERVIEWEE:
AGE OF INTERVIEWEE:
PROFESSION – FARMER OR HUNTER

PRE-TEST QUESTIONS:

DO YOU LIKE SNAKES?
DO YOU THINK THAT ALL KIND OF SNAKES ARE DANGEROUS?
IF NOT, WHICH KIND OF SNAKE IS NOT DANGEROUS?

TRUE TEST QUESTIONS:

1) How many kinds of snakes do you know?
one some plenty

2) Now we are interested in special kinds of snakes; please describe where you find these snakes (MULTIPLE SELECTION IS ALLOWED).

Big python, Small python, Spitting cobra, Non-spitting cobra, Green Mamba, Viper, two-headed snake

Forest
Bush (dirty places)
Village
Water
Farm
Plantation
don't know

3) Are these kinds of snakes very plenty around your place?

Big python
Small python
Spitting cobra
Non spitting cobra
Green mamba
Viper
Two-headed snake

(ABUNDANCE LEVELS FOR THE INTERVIEWER: Non present - Very rare (1 every some years) - Rare (1 every two years) - Plenty (1-5 every year) - Very plenty (more than 5 every year)

colubrids like *Hapsidophrys smaragdina* (SCHLEGEL, 1837) and *Philothamnus* spp.], *Naja nigricollis* REINHARDT, 1843 ['Spitting cobra'], and *Naja melanoleuca* HALLOWELL, 1857 ['Non-spitting cobra'; in this term the surveyed also consider some large-sized blackish snakes like *Toxicodryas blandingii* (HALLOWELL, 1844), *Thrasops* spp., and *Pseudohaje goldii* (BOULENGER, 1895)].

Because most Nigerian snakes are found in multiple habitats (LUISELLI & AKANI 1999), the true test question included a multi-response query on the habitat where the various target species are found (Table 1). Seven habitat options were given to the respondents: (a) forest; (b) bush (often called 'dirty places' by respondents); (c) village; (d) water bodies (rivers and marshes, including mangroves); (e) farm; (f) plantation; (g) don't know. These options cover the whole range of natural habitats perceived by rural people as characterizing their environment. Five different abundance options for each kind of snake were given to the respondents: (i) non present; (ii) very rare (i.e., a snake seen by the respondent once in the last 5 years); (iii) rare (a snake seen only once in the last two years); (iv) plenty (a snake seen 1 to 5 times in the last year); and (v) very plenty (a snake seen more than 5 times in the last year).

Statistics

We used parametric tests when the variables were normally distributed; otherwise, nonparametric tests were used (e.g., χ^2 test). Dissimilarity among snakes in terms of their habitat (as perceived by interviewees) was analyzed by cluster analysis, using Ward's method as algorithm and the Euclidean distance as similarity measure. Data were processed by a Statistica (TM) version 8.0 PC package, with all tests being two-tailed and alpha set at 0.05.

RESULTS

Pre-test questions

Question 1: Do people like snakes? Most of the respondents answered 'no' when they were asked whether they liked snakes or not (Fig. 1), and the frequency of the 'no' answers did not vary significantly between survey periods (χ^2 test, 1 *df*, *P* = n.s.).

Questions 2 and 3: Do people believe all snakes are dangerous? If not so, which kind of snakes they believe is not dangerous? Nearly all the surveyed were well aware that only a portion of the snake fauna of their region is dangerous for humans: indeed, only 3.3% (n = 63) of the respondents in 1996-97 and 4.2% (n = 71) in 2011-12 thought that all snakes are dangerous creatures (χ^2 test, 1 *df*, *P* = n.s.). Respondents also showed a good perception of the 'kinds' of snakes which are not dangerous to humans: the great majority of the respondents testified that 'Small pythons' are not dangerous, with 'Big pythons' and 'Two headed snakes' also being considered non-dangerous by several (Fig. 2). Once more, there were no significant differences between survey periods (χ^2 test, 1 *df*, *P* = n.s.).

True test questions

Question 1: How many 'kinds' of snakes do people know? During both surveys, 100% of the respondents were unsurprisingly well aware that there are more than one 'kind' of snake. In both periods, the majority of the respondents (respectively, 65.1%, n = 63, in 1996-97, and 74.6%, n = 71, in 2011-12) answered that there are 'some' kinds of snakes around their villages and not 'plenty' kinds of snakes.

Question 2. Where do people meet the snakes? The raw data on the perceived habitats of snakes by respondents are given in Table 2. For answering to this question, individuals were allowed to choose multiple types of habitats; hence the total counts in Table 2 exceed the total number of respondents. A cluster analysis revealed that there were some noteworthy differences between survey periods (Fig. 3). More specifically: (1) 'Big python' clustered with 'Small python' in 1996-97 (Fig.

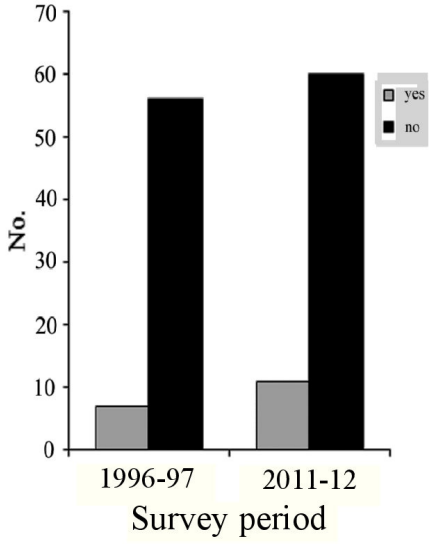

Fig. 1: Number of respondents answering 'yes' and 'no' to the question 'Do you like snakes?', by survey period (1996-1997 versus 2011-2012).

Abb. 1: Anzahl von Befragten, die 'ja' bzw. 'nein' antworteten auf die Frage: "Mögen sie Schlangen?". Vergleich der Befragungsperioden (1996-1997 gegenüber 2011-2012).

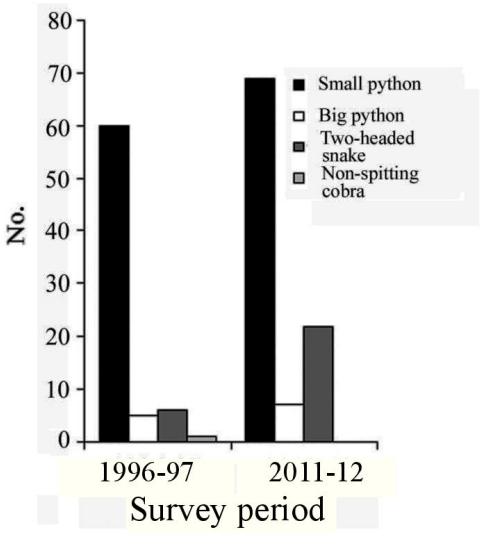

Fig. 2: Number of respondents identifying the 'kind' of snakes which are not dangerous to humans, by survey period (1996-1997 versus 2011-2012).

Abb. 2: Anzahl von Befragten, die verschiedene 'Arten' von Schlangen benennen konnten, die für Menschen ungefährlich sind. Vergleich der Befragungsperioden (1996-1997 gegenüber 2011-2012).

3A) but with 'Non-spitting cobra' in 2011-12 (Fig. 3B), reflecting that more people considered this to be a forest inhabitant during the last survey period; (2) 'Viper' clustered with 'Non-spitting cobra' in 1996-97 (Fig. 3A), but with 'Green mamba' in 2011-12 (Fig. 3B); (3) 'Spitting cobra' clustered with 'Two-headed snake' in 1996-97 (Fig. 3A) and with three other types forming a heterogenous group of snakes in 2011-12 (Fig. 3B).

Question 3: are the various kinds of snakes abundant around respondents' villages? Raw data on the answers by respondents on their perception of snake abundance in the two survey periods are given in Table 3. Comparisons of the data collected in 1996-1997 with those in 2011-2012 revealed that the number of respondents perceiving some 'kinds' of snakes to be 'plenty' or 'very plenty' around their places clearly decreased between survey periods. Notably, this pattern was particularly evident for both the 'big python' and the 'small python' after pooling 'plenty' with 'very plenty' counts and 'non present' with 'very rare' options. In the case of the 'big python', the number of respondents selecting the options 'plenty' and 'very plenty' decreased from 25 (in 1996-97) to 12 (in 2011-12), whereas the number of respondents selecting the options 'non present' and 'very rare' increased from 38 (in 1996-97) to 59 (in 2011-12) (Table 3). For the 'small python', there was also a strongly increasing number of 'non present' and 'very rare' answers from the first to the last surveys (12 versus 49), and an opposite trend for 'plenty' and 'very plenty' (51 vs. 22) (Table 3). The same figures were also seen for the 'viper' although slightly reduced, respectively, 39 (1996-1997) and 51 (2011-2012), and 24 (1996-1997) vs. 20 (2011-2012) counts (Table 3). Those surveyed did not show remarkable differences in their perception of the abundance of all the other kinds of snakes (Table 3).

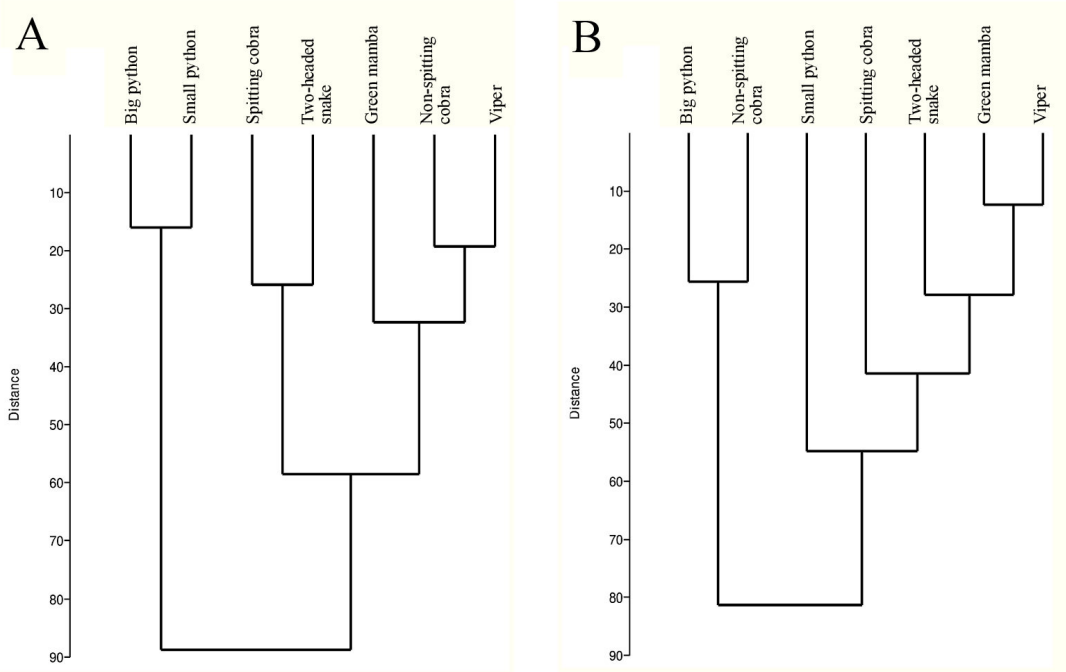

Fig. 3: Cluster analyses showing different habitat - species associations as perceived by rural people in southern Nigeria, during the two survey periods. A - 1996-1997; B - 2011-2012. 'Species' names are detailed in Materials and Methods.

Abb. 3: Clusteranalysen zur Darstellung der unterschiedlicher Zuordnungen von Lebensraum zu Schlangen'art', wie sie von der Landbevölkerung im südlichen Nigeria während zweier Befragungsperioden empfunden wurden. A - 1996-1997; B - 2011-2012. 'Arten'bezeichnungen siehe Legende in Tabelle 2.

Table 2: Summary of the data concerning the answers of respondents to the query which 'kinds' of snakes they encountered in which kind of habitat. Data are divided by survey period.

Tab. 2: Zusammenfassung der Daten aus Antworten der Befragten auf die Frage, welche 'Arten' von Schlangen sie in welchen Lebensräumen angetroffen haben. Angaben getrennt nach Befragungsperiode. Big python - *Python sebae*; Small python - *Python regius*; Spitting cobra - *Naja nigricollis*; Non-spitting cobra - *Naja melanoleuca* und andere dunkle Schlangen; Green mamba - *Dendroaspis jamesoni* und andere grüne Nattern; Viper - *Bitis gabonica* und *Bitis nasicornis*; Two-headed snake - *Calabaria reinhardtii* und Blindschlangen (*Typhlops*).

Kind of snake Art der Schlange	Forest Wald	Bush Buschland	Village Ortschaft	Water Wasser	Farm Landwirtschaft	Plantation Pflanzung	Don't know Weiß nicht
Survey 1996-1997							
Big python	35	5	0	47	3	17	9
Small python	41	8	1	31	12	8	2
Spitting cobra	33	3	12	2	51	48	0
Non-spitting cobra	37	21	2	14	30	33	0
Green mamba	44	40	16	0	12	47	0
Viper	43	44	0	6	33	32	10
Two-headed snake	11	15	0	0	32	42	13
Survey 2011-2012							
Big python	28	25	0	51	7	28	13
Small python	26	65	0	4	11	17	4
Spitting cobra	7	40	16	6	39	37	0
Non-spitting cobra	44	17	4	27	22	25	0
Green mamba	30	44	5	2	31	36	6
Viper	39	42	0	2	26	29	17
Two-headed snake	25	24	2	5	31	34	33

Table 3: Raw data on the respondents' answers about the perceived abundance of the various 'kinds' of snakes around their villages by survey period.

Tab. 3: Rohdaten aus den Antworten der Befragten über die empfundene Häufigkeit verschiedener Arten von Schlangen im Bereich ihres Wohnortes, nach Befragungsperiode getrennt. Big python (*Python sebae*), Small python (*Python regius*), Spitting cobra (*Naja nigricollis*), Non-spitting cobra (*Naja melanoleuca*), Green mamba (*Dendroaspis jamesoni*), Viper (*Bitis gabonica*, *Bitis nasicornis*), Two-headed snake (*Calabaria reinhardtii*, *Typhlops* ssp.).

	non-present nicht vorhanden (1996-1997)	non-present nicht vorhanden (2011-2012)	very rare sehr selten (1996-1997)	very rare sehr selten (2011-2012)	plenty zahlreich (1996-1997)	plenty zahlreich (2011-2012)	very plenty sehr zahlreich (1996-1997)	very plenty sehr zahlreich (2011-2012)
Big python	33	32	5	27	19	12	6	0
Small python	2	11	10	38	31	19	20	3
Spitting cobra	0	3	3	5	29	41	31	22
Non-spitting cobra	4	4	24	26	32	27	3	14
Green mamba	17	11	4	12	31	46	11	2
Viper	14	21	25	30	14	9	10	11
Two-headed snake	23	32	8	19	26	10	6	10

DISCUSSION

The participatory approach used to detect the evolution of the social memory based on local communities' EK allowed us to clearly detect some relatively stable trends:

1. The socially relevant aspect (value and dangerousness) of snakes in the rural communities was constant over the last 15 years. This is also in good agreement with our unpublished data on snake bites to humans in the River Niger Delta rural communities, which showed no increase in human fatalities due to snake bite during the recent years (Akani et al., unpublished data), despite the fact that several highly venomous species are found in this part of Africa (Chippaux 2007; WHO/AFR/EDM/EDP 2010).

2. Some snakes are considered declining. Indeed, this is indirect (but clear) evidence from our comparisons of the survey results and field ecological analyses, given that the respondents were not directly asked whether they had perceived any snake declines over the recent years. Interestingly, the social memory evolution defined by the comparison of the EK results of two periods registered a more substantial decline for some of the target species, i.e., *Python regius*, *Python sebae* and *Bitis gabonica*, which have indeed demonstrated to be in decline by robust capture-mark-recapture studies (Reading et al. 2010; Akani & Luiselli unpublished data).

3. The habitat – species relationships are slightly changed. This result underlines changes regarding the experiences made by people with some of the species. The fact that 'Big pythons' are considered to be more 'forest-associated organisms' in the 2011-2012 survey suggests that rural communities consider this huge species to be least abundant (or even extirpated) in farmlands and plantations, where it was found to be a relatively common species in the 1996-1997 survey. This possibly indicates that these snakes are nearly extirpated from the rural zones which are immediately contiguous to villages, compounds and houses. Indeed, also our field data confirmed that this species is increasingly rare in altered habitats of southern Nigeria (Luiselli et al.

2007). In any case, we think that the overall attribution of the habitat – species relationship by the local EK is fairly consistent with field ecological data on the species surveyed. For instance, the generalized habitat use of Spitting Cobras *Naja nigricollis*, and the preference for forested areas by 'Non-spitting' forest cobras *Naja melanoleuca*, or the affinity of *Python sebae* for water bodies, are well consistent with scientific data from the study region (LUISELLI & ANGELICI 2000; LUISELLI et al. 2002, 2007).

Overall, our study indicates that, in tropical Africa, local communities' EK may be reliably used to infer the general trends of wildlife species through questionnaire surveys repeated at convenient intervals of time. This confirms the utility of participatory research in designing or selecting of working hypotheses, even in ecological studies or in natural resources management. Of course, it is likely that the dangerousness of some snakes for humans and their domestic animals (venomous snake bites, and large pythons eating on goats, dogs and occasionally even human beings; LUISELLI et al. 2001; CHIPPAUX 2007; WHO/AFR/EDM/EDP 2011) may have increased the efficiency of people's EK on this issue, so the reliability of people's EK should be tested in other scenarios for generalizing the present findings.

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Appendix 1: The Names and geographic coordinates of 41 villages and towns of the River Niger Delta (Nigeria) where the two surveys (1996-1997 vs. 2011-2012) were carried out.

Appendix 1: Namen und geographische Koordinaten der Orte im Niger-Flußdelta (Nigeria), in denen die Befragungen (1996-1997 und 2011-2012) durchgeführt wurden.

(1) – Eket 04°50'N, 07°59'E; (2) – Kreigeni 05°17'N, 06°37'E; (3) – Abarikpo 05°08'N, 06°37'E; (4) – Otari 04°53'N, 06°41'E; (5) – Rumuji 04°57'N, 06°46'E; (6) – Orubiri 04°42'N, 07°01'E; (7) – Elem Sangama 04°40'N, 06°40'E; (8) – Tombia I 04°46'N, 06°53'E; (9) – Tombia II 04°46'N, 06°51'E; (10) – Orashi 04°44'N, 06°38'E; (11) – Peterside 04°29'N, 07°10'E; (12) – Kaani 04°42'N, 07°24'E; (13) – Bonny 04°24'N, 07°08'E; (14) – Akpor 04°53'N, 06°56'E; (15) – Okrika 04°44'N, 07°05'E; (16) – Kula 04°20'N, 06°38'E; (17) – Ndoni 04°48'N, 06°45'E; (18) – Brass 04°20'N, 06°13'E; (19) – Bodo 04°38'N, 07°15'E; (20) – Toru-Ebeni 04°55'N, 06°14'E; (21) – Otuoke 04°47'N, 06°19'E; (22) – Patani 05°07'N, 06°10'E; (23) – Angalabiri 05°10'N, 06°05'E; (24) – Bassambiri 04°32'N, 06°08'E; (25) – Nembe 04°32'N, 06°05'E; (26) – Afara 04°54'N, 07°08'E; (27) – Oguta 05°60'N, 06°44'E; (28) – Finima 04°25'N, 07°15'E; (29) – Port Harcourt 04°45'N, 07°01E; (30) – Aba 05°14'N, 07°13'E; (31) – Ekpoma 04°20'N, 06°15'E; (32) – Calabar 04°57'N, 08°19'E; (33) – Yenagoa 04°92'N, 06°26'E; (34) – Uyo 05°30'N, 07°56'E; (35) – Degema 04°46'N, 06°46'E; (36) – Abonnema 04°43'N, 06°46'E; (37) – Abraka 05°47'N, 06°60'E; (38) – Owerri 05°29'N, 07°02'E; (39) – Warri 05°31'N, 05°45'E; (40) – Buguma 04°44'N, 06°52'E; (41) – Akamkpa 05°25'N, 08°47'E.

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