

## Anuran surveys in south-western Nigeria

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**Abstract.** We report on the results of amphibian surveys in three south-western Nigerian states: Lagos, Ogun and Oyo. In total, we recorded between 35 and 38 species. The number of species per state ranged from 22 to 29. Most species were typical farmbush or savanna frogs. Although the overall species richness was comparatively low and only a few species were forest specialists, we observed a surprising number of frogs that could not unambiguously be assigned to described species. This was especially true of the genera *Leptopelis* and *Phrynobatrachus*. Whereas some of these taxa (*Leptopelis* cf. *macrotis*, *Phrynobatrachus* cf. *liberiensis*) seem to indicate closer relationships between south-western Nigeria and the Upper Guinea forests, other findings (the eastern variation of *Phlyctimantis boulengeri*, *Nectophryne afra*) indicate the opposite geographic relation. The position of the study sites between the diversity hotspots of Upper and Lower Guinea would suggest high anuran diversity. We failed to record such a high diversity, but possibly found species from both areas and probably undescribed taxa (*Phrynobatrachus* sp., *Leptopelis* sp.). We believe that the high amount of degraded and converted natural forests may have already resulted in an impoverished anuran fauna. Remarkable and even new species may have survived in some of the small remaining forests. Intensive surveys and sustainable conservation of the remaining forests of south-western Nigeria is therefore highly recommended.

Key words. Amphibia, distribution, diversity, biology, forest, new records, savanna.

### Introduction

With 130-140 million people, Nigeria is the most densely populated African country. The high human population with the resulting pressure on natural habitats, as well as the country's position of being the twelfth largest producer of oil, has resulted in a remarkably high proportion of degraded and converted land ([www.en.wikipedia.org/wiki/Nigeria](http://www.en.wikipedia.org/wiki/Nigeria); latest accessed 14 May 2007). In contrast, Nigeria also comprises a great variety of ecosystems, ranging from mangrove swamps and rainforests along the coast, various types of savanna further north, to finally the Jos-Plateau in Central Nigeria and the south-eastern region towards Cameroon offering mountainous habitats. From a biogeographic point of view, Nigeria is situated between West and Central Africa, and hence between the biodiversity hotspots of the Upper and Lower Guinea forest regions (BAKARR et al. 2004). Consequently, Nigeria might be expected to harbour high biological diversity composed

of West and Central African species alike. So far, about 103 amphibian species, 101 anurans and two caecilians, have been recorded from within Nigeria's borders (IUCN et al. 2006). This is astonishingly few, compared to the approximate 200 species of neighbouring Cameroon (LEBRETON 1999, FRÉTEY & BLANC 2000, IUCN et al. 2006, J.-L. AMIET pers. comm.). However, it is questionable whether Cameroon is really that much richer in amphibian diversity or if simply Nigeria is less well explored.

Many contributions to the knowledge of the country's amphibian fauna date back to the sixties of last century (SCHIØTZ 1963, 1966, 1967, WALKER 1966, 1967, 1968, 1969) or even earlier (SANDERSON 1936, ROMER 1953). Due to long lasting political unrest, with the exception of a few papers (AKINTOLA 1976, REID 1987, BÖHME & NIKOLAUS 1989, REID et al. 1990) not much has been published on Nigerian amphibians for the last decades. Within the last five years several papers on Nigerian amphibians have appeared again, mainly

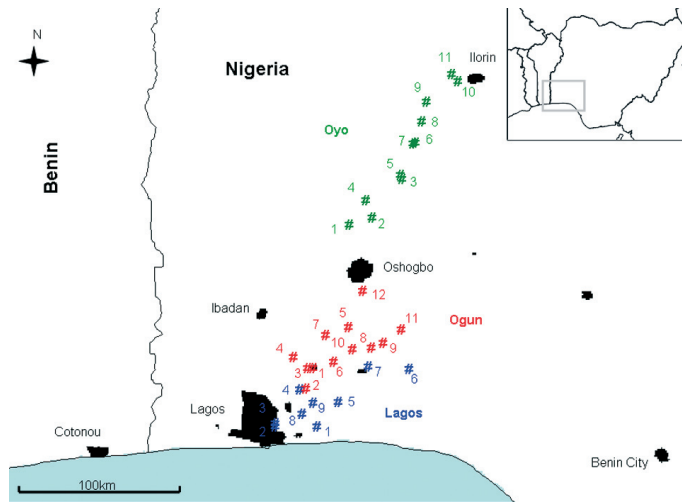


Fig. 1. Geographic positions of the study sites in south-western Nigeria (compare Appendix 1).

dealing with the Cross River region and the area of the oil rich Niger Delta, including the respective environmental problems (ENIANG & LUISELLI 2002, LEA et al. 2003, 2005, AKANI et al. 2004).

However, still little is known about the systematics, distribution and especially biology of Nigerian amphibians. Remarkable exceptions are the contributions on frog parasites by AISIEN et al. (e.g. 2001, 2004). Nigeria has lost the large majority of its rainforests and most of its natural savanna habitats (UICN 1996). We know that already minor alteration of natural forest ecosystems in West Africa may result in drastically altered amphibian assemblages, including the loss of many forest specialists (ERNST & RÖDEL 2005, ERNST et al. 2006). Hence, an increased effort to assess herpetofaunistically unknown parts of Nigeria seems extremely pressing. The primary aim of this paper is to present the amphibian results gained throughout several surveys undertaken by one of us (ABO) in the south-western part of Nigeria.

#### Study areas

Nigeria covers an area of 923,768 km<sup>2</sup> and is bordered by the Atlantic Ocean, Benin, Ni-

ger, Chad and Cameroon. The Federal Republic comprises 36 states and the Federal Capital Territory. We investigated the anuran fauna of three south-western states: Lagos, Ogun and Oyo. Lagos, also comprising the homonymous commercial capital, is situated between 6.4-6.7°N and 2.7-4.6°E. Ogun extends between 6.3-7.8°N and 2.7-4.6°E; and Oyo extends between 7.1-9.2°N and 2.7-4.56°E. Nigeria is characterised by a South-North gradient of precipitation. This is mirrored by a gradient of vegetation zones, naturally from tropical humid evergreen forests in the South, gradually transforming into dry savannas in the North.

Along the south-western Nigerian coast there is a belt of mangrove swamps which naturally do not harbour any amphibians. However, some species can be recorded just a few metres from the brackish waters, where this habitat is replaced by freshwater swamps. Such areas were located at Ikorodu, Badore, Badagry and parts of Epe (all Lagos state). North of these swamps, a forest belt does naturally occur. These forests can be divided into rainforest and mixed deciduous or dry forest. Unfortunately, these forests have been heavily degraded, fragmented and converted by many anthropogenic activities, mainly cultivation for agriculture. The remaining

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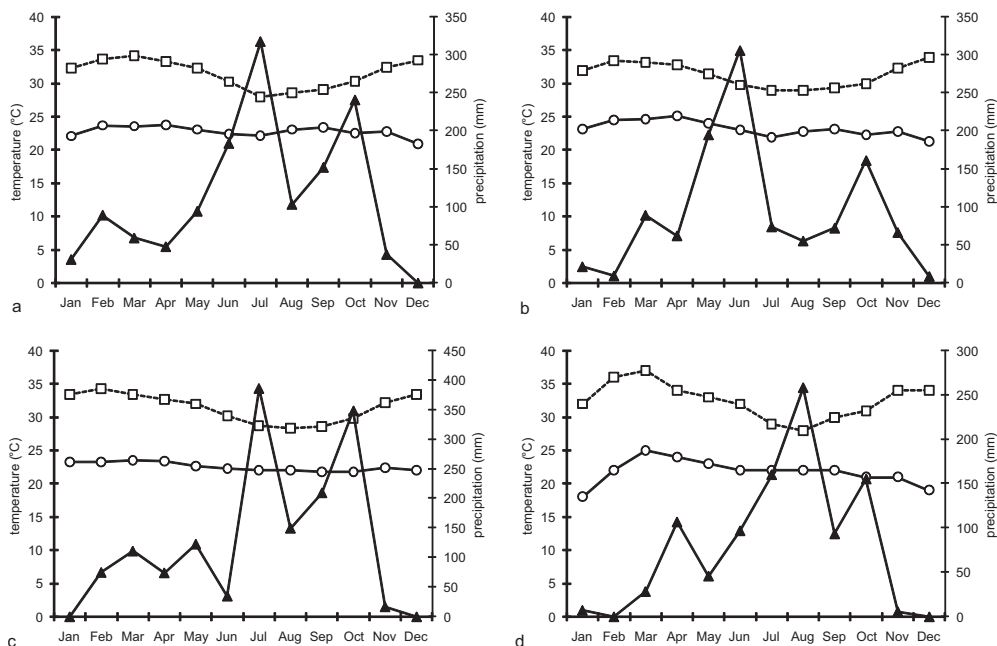


Fig. 2. Monthly rainfall (black triangles) and monthly average maximum (open squares) and minimum (open circles) temperatures in a) Ijebu-Ode (data from 2003), b) Ikeja (2003), c) Ibadan (2003) and d) Ilorin (2002).

forests hence mostly comprise secondary or tertiary vegetation, characterised by dense undergrowths and an open or broken canopy. Farmland, secondary and tertiary forests were encountered at Ikorodu, Ogiyo, Ishara, Ijebu Oru, Ikenne, Onidundun and Fiditi. There only a few pockets of primary or near primary forest were left. Further north, this zone is replaced by natural and derived savanna, partly comprising a forest-savanna mosaic, especially where cultivation is less dominant. Examples from this zone were Onidundu, Fiditi, Oolo, Ibapon Oyewale and Ogbomoshu. The northernmost collection sites were situated in the moist woodland savanna zone (Guinea savanna), characterised by tall grass with fire resistant trees. Collection in this zone was done in areas north of Ogbomoshu, including Gambari and Otte-Egba, an area close to Ilorin.

A list of all study sites including a short habitat description is given in Appendix 1.

Climatologically, the three states are characterised by a rainy season from April to October and a dry season from November to March. The climate of four south-western Nigerian towns is summarized in Fig. 2.

### Material and methods

Our surveys were performed between July 2003 and December 2004. The most intense survey time was during the rainy season which at the same time is the breeding period of most amphibian species. Between two and four people were engaged in surveying. Surveys were normally undertaken during the morning and evening hours. Geographic positions were taken with a hand-held GPS receiver (Garmin eTrex). A short habitat characterisation was noted for each location investigated and all anurans were registered along with their respective habitats and loca-

Tab. 1. Amphibian species recorded in Lagos, Ogun and Oyo States and number of sites where the respective species have been recorded (compare Appendix 1).

Taxon	Lagos	Ogun	Oyo
Pipidae			
<i>Silurana tropicalis</i>	7, 9, 10	3, 9, 11	1, 2
<i>Xenopus muelleri</i>	4, 8, 9, 10	2, 3, 11	2, 6, 10
Hemisotidae			
<i>Hemisis cf. guineensis</i>	9	1, 3, 10, 11	
<i>H. marmoratus</i>			2, 3, 7
Bufonidae			
<i>Amietophrynus maculatus</i>	2, 3, 6-10	1-12	1-2, 4-8, 10, 11
<i>A. regularis</i>	1-4, 3, 4, 6, 8, 10	1-3, 5-7, 9-12	2, 3, 5-8, 10, 11
<i>Nectophryne afra</i>		11	
Dicroglossidae			
<i>Hoplobatrachus occipitalis</i>	1, 5, 8-11	2-5, 10, 11	1, 2, 5, 6, 8
Ranidae			
<i>Hydrophylax albolabris</i>	7, 9	2, 8, 10, 12	
<i>H. galamensis</i>		2, 6	1, 2, 6, 9
<i>Aubria subsigillata</i>	6-8	1, 3, 9, 10	2, 3
Ptychadenidae			
<i>Ptychadena aequiplicata</i>		9, 11	2
<i>P. bibroni</i>	1, 3, 5, 8	1, 2, 4, 10, 11	2, 3, 5, 6
<i>P. longirostris</i>	8, 9	11	
<i>P. mascareniensis</i>	1, 10, 11	3, 4, 10, 11	2, 3
<i>P. oxyrhynchus</i>	1, 6, 10, 11	1, 11, 12	2, 5
<i>P. pumilio</i>	1-6, 8, 11	1-4, 6, 11, 12	2, 3, 5, 6, 8-11
Phrynobatrachidae			
<i>Phrynobatrachus accraensis</i>	1, 2, 6, 8, 10	4, 9, 11	2, 9, 10
<i>P. francisci</i>	7, 9	3, 7, 9	2, 9, 10
<i>P. cf. liberiensis</i>	7		
<i>P. plicatus</i>		2	
<i>P. sp.</i>		9	
Arthroleptidae			
<i>Arthroleptis</i> spp. (2-4 species)	7-9	2, 3, 8, 9, 11, 12	2
<i>Leptopelis cf. macrotis</i>		10	
<i>L. cf. occidentalis/boulengeri</i>		6, 10	
<i>L. sp.</i>		9	
<i>L. viridis</i>	7-9	1, 3, 5, 7, 8	3-5, 7, 9
Hyperoliidae			
<i>Afrivalus dorsalis</i>	1, 4, 5, 8, 11	5-7, 9, 11	2, 5
<i>Hyperolius concolor</i>	3, 4, 8	6, 8, 9, 11, 12	2, 3
<i>H. fusciventris</i>	3-8, 11	2, 6, 8-12	2-4, 6
<i>H. guttulatus</i>	4, 10	6, 11	1
<i>H. nasutus</i>			5
<i>H. nitidulus</i>			2-4, 7, 9, 11
<i>Kassina senegalensis</i>			7, 10
<i>Phlyctimantis boulengeri</i>			2

tions. Specimens were located opportunistically by thorough visual scanning of the particular environment and careful examination of suspected hiding places, e.g. under stones, fallen wood, between leaves, among leaf litter etc. Most of the specimens were released after determination and recording of their characters. Measures were taken with a calliper ( $\pm 0.1$  mm). Voucher specimens of all species were collected, anaesthetized with chloroform and subsequently preserved in 10 % formalin. Most vouchers are deposited in the collection of the Department of Zoology, University of Lagos. Some vouchers will later be deposited in the collection of the Museum of Natural History, Berlin (ZMB). Nomenclature follows FROST et al. (2006) and FROST (2007).

### Results and discussion

In total we recorded between 35 and 38 species in the three south-western states (Table 1). Within the genus *Arthroleptis*, we most probably recorded between two and four species. However, because of the lack of acoustic and genetic data, and the morphological similarity of species in this genus, a more precise figure and exact species names cannot be given (cf. RÖDEL & BANGOURA 2004). We therefore conservatively count all *Arthroleptis* records as belonging to one species. In Lagos state we recorded 22 species (62.9 %), in Ogun state we registered 29 species (82.9 %) and in Oyo state we encountered 25 species (71.4 %). Without considering the *Arthroleptis* species, we analysed to what extent the anuran fauna in the three states was either dominated by forest or savanna species. As expected the northernmost state Oyo had the highest proportion of savanna species, i.e. 19 out of 24 (79.2 %). In Ogun state, about half each of the 28 species were forest (46.4 %) and savanna (53.4 %) specialists, respectively. In Lagos state, one third, i.e. 7 of all 22 (31.6 %) species, preferred forest habitats, while the remaining 15 were savanna species.

### Accounts of selected species

We herein refer to species of particular interest concerning rarity, distribution or taxonomy or to interesting observations on habitat choice and/or biology. For descriptions of the species' general distributions and natural history data we refer to SCHIØTZ (1963, 1967, 1999), RÖDEL (2000) and IUCN et al. (2006).

*Xenopus muelleri* (PETERS, 1844) and *Silurana tropicalis* GRAY, 1864

These species seem to survive the dry season by either migrating into streams or other permanent waters or by hiding in wet mud or beneath leaves (SCHIØTZ 1963, RÖDEL 2000). We recorded *Xenopus muelleri* as fairly abundant at Ijebu Oru (Liberian Refugee Camp), Onidundun and Abowa. The sites at Ijebu Oru and Abowa were located near a forest, while Onidundun was a muddy patch in a rice farm. These sites all dried up during the dry season. In a drying savanna pond at Oolo we collected some *X. muelleri* from the mud. We discovered further *X. muelleri* in holes, about half a metre depth, around the drying up pond.

Most of the registered *S. tropicalis* were found at Onidundun in a pool not far from a large stream, close to a forest. However, other specimens were collected near Ogbomosho in a savanna region. We dug them up on the banks of dried up ponds at Onidundun.

*Hemissus marmoratus* (PETERS, 1854) and *Hemissus guineensis* COPE, 1865

These predominantly fossorial frogs were collected at various sites, mostly by digging soil on farmland. Most likely two species are involved, namely the savanna dwelling *Hemissus marmoratus* and the forest species *H. guineensis*. However, both apparently comprise complexes of species and despite the revision of the genus by LAURENT (1972) even the distinction between the two names is not well understood. Specimens collected from Ijede and Abowa were larger (snout-urostyle-

length – SUL - males: 4.0-4.9 cm, females: 4.5-5.4 cm) than those collected from Fiditi and Ibapon Oyewale (males: 2.2-4.0 cm, females: 3.6-4.2 cm). We tentatively assign the larger *Hemisus* to *H. guineensis*, the smaller ones to *H. marmoratus* (compare RÖDEL & ERNST 2003). The *H. guineensis* localities were in forest or former forest.

*Nectophryne afra* BUCHHOLZ & PETERS in PETERS, 1875

So far the westernmost known locality of this small Central African toad was in the Niger Delta, West of the River Niger (BOULENGER 1913, PERRET 1966, SCHIÖTZ 1966). Our records from a secondary forest with sparse undergrowth close to the Oru River at Ijebu Oru is hence an expansion of the known distributional range. This toad is known to breed in water-filled tree holes (SCHEEL 1970). We observed it a few metres above ground climbing on plants. The SUL was 1.9 cm. The toad had a greenish brown back with three transverse yellow lines, additional yellow spots could be observed on the flanks (Fig. 3). The yellow pattern was also present on the hind legs. The webbing between the thumb and the first finger was yellow, the remaining part being orange-brown. The toad only moved slowly in a very clumsy way.

*Hoplobatrachus occipitalis* (GÜNTHER, 1858)  
Adults and juveniles of this frog were collected at most locations though in different habitats. This habitat separation has also been observed elsewhere (RÖDEL 2000) and most likely is due to avoidance of intraspecific predation. Adult *Hoplobatrachus* are known to prey on almost anything smaller than themselves (RÖDEL 2000), but usually arthropods predominate in the prey (INGER & MARX 1961, LESCURE 1971). We observed an adult *H. occipitalis* swallowing a *Ptychadena* sp. Another adult *H. occipitalis* (SUL 9.8 cm) tried to devour a *Bufo* sp. (SUL 5.6 cm), but eventually failed most likely due to the massive production of white toxic secretions by the toad. In Nigeria and other West African countries *H. occipitalis*, but also many *Ptychadena* spp.,



Fig. 3. The tree toad *Nectophryne afra* from Ogun State.

are consumed locally directly by villagers or smoked and sold on local markets (A.O. and M.-O.R. unpubl. data).

*Ptychadena aequiplicata* (WERNER, 1898)

We recorded *Ptychadena aequiplicata* mostly from secondary and primary forests that had little undergrowth (cf. RÖDEL et al. 2002). During the rainy season puddles accumulated in these parts of the forest. They were collected at Ijebu Oru and Ijede. SCHIÖTZ (1963) collected this species from Yemoji and Gilligilli but did not report it from south-western Nigeria.

*Ptychadena bibroni* (HALLOWELL, 1845)

This species was often collected together with *Ptychadena oxyrhynchus* and *P. pumilio*. We once observed a male *P. bibroni* in amplexus with a female *P. pumilio*, but are not aware if egg deposition had taken place or not. We dug out a few *P. bibroni* together with *X. muelleri* at a dried up pond at Oolo. This supports BARBAULT (1972) who stated that these frogs spent the dry season in the mud of dry ponds.

*Ptychadena longirostris* (PETERS, 1870)

We collected this species at two locations only and observed it at another one. *Ptychadena longirostris* inhabited both temporary and permanent ponds in secondary forests. Some were found in puddles on forest



roads. *Ptychadena longirostris* is usually considered a rainforest dweller where it often reproduces in puddles on forest roads (RÖDEL & BRANCH 2002). However, SCHIÖTZ (1963) wrote that *P. longirostris* also invades dry forests in Nigeria.

*Phrynobatrachus* cf. *liberiensis* BARBOUR & LOVERIDGE, 1927

This species is believed to be endemic to the Upper Guinean forest bloc, where it inhabits primary and secondary forests close to small creeks and swamps (GUIBÉ & LAMOTTE 1963, RÖDEL & BRANCH 2002, RÖDEL 2003). Its occurrence in Nigeria hence seems unlikely. Nevertheless, we collected a specimen in a secondary forest in Lagos State that morphologically exactly fits the Upper Guinean populations. However, as long as genetic and acoustic comparisons are lacking, affiliation of our voucher to *P. liberiensis* should be taken as tentative.

*Phrynobatrachus plicatus* (GÜNTHER, 1858)

This species has a southern West African distribution from Liberia into Nigeria, where it predominantly inhabits open, swampy rainforests (GUIBÉ & LAMOTTE 1963, RÖDEL et al. 2005a, LEACHÉ et al. 2006, HILLERS & RÖDEL 2007, SEGNIAGBETO et al. 2007). East of the Cross River, Nigeria, it is replaced by the similar *Phrynobatrachus auritus* (LAMOTTE & XAVIER 1966). We recorded the species in a secondary forest near Ogiyo.

*Phrynobatrachus* sp.

We collected a few specimens of an unknown small *Phrynobatrachus* (SUL ca. 1.9-2.0 cm) during a light rain from a secondary forest not far from Ijebu-Ode along the Ijebu-Ode-Ibadan road (Ogun State). All specimens had a dark, almost black, head and eyelids. The back was orange-red and the extremities were brown. On the eyelids and the forehead a few larger warts were discernible. There were no warts or ridges on the back. The slightly granular back was almost coloured uniform red-brown. The hind legs bear one large dark, transverse bar on thighs and lower legs each.



Fig. 4. A subadult *Leptopelis* cf. *macrotis*.



Fig. 5. *Leptopelis* cf. *occidentalis/boulengeri*.

One larger transverse bar was also present on the lower arms. The venter was white without any pattern or with small black spots, especially in the pectoral region and the corner of the mouth. The toe tips were slightly enlarged but did not form a disc. The webbing on the feet was well developed. The webbing formula (sensu RÖDEL & ERNST 2002) was: 1 (0), 2 (0.5-0), 3 (1), 4 (2), 5 (1).

Compared to similar sized West African *Phrynobatrachus* these frogs differ as follows: from *P. annulatus*, *P. calcaratus*, *P. taiensis* and *P. villiersi* by lacking an eyelid cornicle (cf. PERRET 1988); from all these species and *P. guttuosus* and *P. tokba* by the extensive

webbing (RÖDEL 2000, RÖDEL et al. 2005b); from *P. annulatus*, *P. ghanensis*, *P. taiensis* and *P. villiersi* by a different ventral pattern or colour (GUIBÉ & LAMOTTE 1963, PERRET 1988, RÖDEL & ERNST 2002); from all other species, except *P. fraterculus* (but completely different body shape, see e.g. Fig. 3 in RÖDEL & BANGOURA 2004), by lacking discernible warts or ridges on the back, i.e. in the neck region.

We hence believe these frogs may represent an undescribed species, possibly endemic to south-western Nigeria, but refrain from describing it before its taxonomic position can be clarified by acoustic and/or genetic data.

*Leptopelis viridis* (GÜNTHER, 1869)

Farmers reported that *Leptopelis viridis* were dug up during the dry season while they were tilling their lands in preparation for the coming rainy season. Subterranean aestivation and cocoon formation were also reported by LAMOTTE (1967), WALKER (1968), BARBAULT (1972) and GRAFE (2000). SCHIÖTZ (1967) collected this species from Iperin and four miles north of the University in Ibadan.

*Leptopelis cf. macrotis* SCHIÖTZ, 1967

This species is the largest of the West African treefrogs (SCHIÖTZ 1967, 1999); however, the SUL of the sub-adult female that we collected was 5.2 cm only. Our decision to tentatively assign the frog to *L. macrotis* was due to its coloration (Fig. 4) and the fully webbed feet (cf. SCHIÖTZ 1967, 1999). So far this species has been only recorded from rivers in primary forests ranging from Sierra Leone into western Ghana (e.g. RÖDEL & BRANCH 2002, RÖDEL et al. 2005a, HILLERS & RÖDEL 2007). We collected the frog in a secondary forest beside a river along the Shagamu-Benin expressway.

*Leptopelis cf. occidentalis/boulengeri* and *Leptopelis* sp.

This is a medium sized treefrog with a SUL of 4.6 cm (Fig. 5). The white spot beneath the eye and the amount of webbing best fitted the

descriptions of *Leptopelis occidentalis* and *L. boulengeri*. The dorsal coloration best fitted *L. occidentalis*. “Real” *L. occidentalis* are known from Liberia to central Ghana and “real” *L. boulengeri* have been recorded from the Niger Delta south to the Democratic Republic of Congo. According to SCHIÖTZ (1999), similar frogs have been occasionally collected in western Nigeria. Without call recordings (different voice in both species) and/or genetic analyses it is currently impossible to assign these frogs with certainty. *L. occidentalis* inhabits almost exclusively primary rainforest in the Upper Guinea region. *L. boulengeri* seems to choose similar habitats (PERRET 1966, AMIET 1986). Our frog was collected in a rubber plantation that enclosed a small swamp with tertiary vegetation.

Another juvenile *Leptopelis* sp. was caught about 10 km from Ijebu Ode, sitting on a fern in a secondary forest that encircled a swamp. This small frog (SUL: 1.1 cm) had a very broad head, much wider than the body. The dorsal coloration was dark green with conspicuous white spots on the heels and the elbows, hence not fitting any described West African *Leptopelis* (RÖDEL 2007). Another white spot was situated below the eyes. The hind limbs were fully webbed. We cannot decide whether this is a juvenile of the above mentioned species or represents another, potentially undescribed treefrog.

*Hyperolius fusciventris burtoni*

SCHIÖTZ, 1963

Most *Hyperolius fusciventris burtoni* were collected from leaves of the oil palm tree, *Elais guineensis*. Abandoned farmlands near ponds or streams also served as habitats. SCHIÖTZ (1963, 1967) collected specimens from Iperin, Ijebu Oru, south of Oyo and 9 km north of University of Ibadan.

*Hyperolius concolor ibadanensis*

SCHIÖTZ, 1967

*Hyperolius concolor ibadanensis* were collected mostly in the forest region around ponds at Onidundu, Ikenne, Ijebu Oru and on the campus of the University of Lagos. In the for-



est zone they could be found throughout the year in thick vegetation close to water sources.

*Hyperolius guttulatus* GÜNTHER, 1858

The majority of individuals of the extremely variable *Hyperolius guttulatus* (cf. SCHIÖTZ 1967, RÖDEL 2000) were observed in swamps with large stagnant ponds, having dense vegetation, especially floating *Pistia* sp. in secondary forests and farmbush habitats. According to Schiötz (1967) a typical habitat of *H. guttulatus* comprises a large swamp with open water surrounded by shrubs but not by closed forests. We also collected a few specimens from leaves of oil palm trees.

*Phlyctimantis boulengeri* PERRET, 1986

This treefrog is known from two disjunct areas: (i) coastal Cameroon (including the type locality) and further south plus easternmost Nigeria and (ii) forests from Sierra Leone into western Ghana (PERRET 1986, SCHIÖTZ 1999, RÖDEL et al. 2005a, A. HILLERS unpubl. data). No records have been reported from in-between. It therefore seemed likely that these populations belong to two distinct species. Our record represents the first record of a frog in the distributional gap. Based on its size (SUL: 5.5 cm) and coloration (dorsum beige, hidden part of thighs with traverse yellow and black stripes) our frog resembles more the eastern populations (SCHIÖTZ 1999). The single specimen originated from a stagnant pond covered by *Pistia* sp., about 6 km north of Ibadan. This pond was bordered by secondary forests and farmland.

Further anuran records from  
south-western Nigeria

SCHIÖTZ (1963, 1966) lists a few species for south-western Nigeria, which have not been recorded by us. In particular these are: *Cardioglossa leucomystax* (F), *Leptopelis spiritus-noctis* (F), *Phrynobatrachus calcaratus* (FB), *P. guttuosus* (S-F), *P. alleni* (F), *P. batesi* (F, determination to be verified), *Africalus ni-*

*geriensis* (F), *A. vittiger* (S), *A. weidholzi* (S), *Hyperolius sylvaticus* (F) and *Chiromantis rufescens* (F; for exact localities cf. SCHIÖTZ 1963; taxonomy adopted to current names; F = forest, FB = farmbush, S = savanna).

### Conclusions and recommendations

We recorded a surprisingly high number of unexpected frog species, especially of the treefrog genera *Leptopelis* (*L. cf. macrotis*, *L. cf. boulengeri/occidentalis*, *L. sp.*) and *Nectophryne*, as well as within the leaf litter genus *Phrynobatrachus* (*P. cf. liberiensis*, *P. plicatus*, *P. sp.*). Some of these species may be new to science. If our tentative determinations prove to be correct, this would indicate a potentially high anuran diversity comprising faunal elements from the Upper (e.g. *Phrynobatrachus liberiensis*) and Lower Guinean (e.g. *Nectophryne afra*) forests, as well as potentially endemic species (*Phrynobatrachus* sp.). The overall amphibian diversity of each state, so far being not only comparatively poor with respect to more western localities (cf. RÖDEL et al. 2004), but being even below that of particular West African savanna regions (e.g. LAMOTTE 1967, NAGO et al. 2006), seems to contradict these first findings. A likely explanation for these contradictory results is that south-western Nigeria did indeed harbour a very rich amphibian fauna, but due to the tremendous loss of primary habitats a huge number of these species has already been lost, or at least is now restricted to very isolated remnants of the former habitats. It there would appear to be extremely important to protect and maintain the remaining natural or near natural habitats, in particular the forests (including small fragments) and to survey further forests for those species that so far may have escaped our attention.

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## Appendix 1

Geographic position (see Fig. 1) and short habitat characterisation of collection sites in Lagos, Ogun and Oyo States, Nigeria. F = forest, FB = farmbrush, S = savanna.

code	latitude (N) / longitude (E)	site description
Lagos state		
1	06°30'064" / 003°36'276"	Badore: swamp with tertiary vegetations and a slow flowing stream, few palm trees, intensive construction work (FB)
2	06°28'174" / 003°24'126"	Badore: dirt road with puddles of various sizes, swamp with dense herb vegetation and shrubs (FB)
3	06°31'074" / 003°24'126"	University of Lagos: pool and fallen tree, few metres from the Lagos Lagoon (FB)
4	06°30'822" / 003°23'688"	University of Lagos: swamp with secondary vegetation, small stream (FB)
5	06°27'736" / 003°42'347"	Lagos-Epe road: small pond, ferns dominating in swamp, many <i>Raphia</i> palms (FB)
6	06°34'996" / 003°56'968"	Epe: close to bridge of Lagos Lagoon, large herbs and grasses, almost permanent swamp forest with <i>Raphia</i> palms (FB)
7	06°39'747" / 003°48'605"	Itokin: about 18 km from Epe, fast flowing stream, banks with sparse vegetation, bordered by secondary forest with sparse under-storey and leaf-litter (F)
8	06°34'072" / 003°35'030"	Ijede: large swamp with slow flowing creek, dense submerse and bank vegetation, overshadowed with bamboo, banana plantation (FB)
9	06°36'177" / 003°34'317"	Ijede: large water-hole without vegetation, supplied by small stream, secondary forest partly degraded, edge of a sugar-cane plantation (F)
10	no GPS data	Badagry: large pond in densely vegetated swamp, bank with large herbs; bordered by secondary and degraded forest (FB)
11	no GPS data	Ikorodu: very large densely vegetated pond, <i>Pistia</i> sp., bordered by tall grasses and shrubs; swamp with dense vegetation (FB)
Ogun state		
1	06°43'465" / 003°34'317"	Abowa settlement near Ogijo: newly cultivated land bordered by a partly degraded tertiary forest, sloping towards a small stream (1 km) (FB)
2	06°44'002" / 003°29'464"	Abowa settlement near Ogijo: small moderately flowing stream without vegetation, banks densely vegetated, in a secondary forest, sparse under-story and nearly closed canopy, fallow 150 m away (F)
3	06°44'403" / 003°29'494"	Erefun settlement near Ogijo: two medium sized temporary pools, sandy soil, dirt road through degraded tertiary forest, <i>Cola acuminata</i> forming canopy, small stream nearby (F)
4	06°46'505" / 003°25'449"	Large and deep pond off the Lagos-Ibadan expressway, water lilies, banks densely vegetated, few banana trees at the perimeter, water filled ditches (FB)
5	06°51'814" / 003°38'793"	large flowing stream, 2 km east of Sagamu, water lilies in stagnant parts, banks densely vegetated, bordered by cultivated land (FB)
6	06°52'059" / 003°41'328"	Ikenne: rubber plantation with low vegetation surrounding a large swamp with densely and sparsely vegetated parts; temporary water bodies present in swamp (F)
7	07°00'127" / 003°41'155"	Ishara: fallow close to a sawmill, sloping towards a small stream; bank with banana trees and herbs (FB)



code	latitude (N) / longitude (E)	site description
8	06°45'782" / 003°51'478"	Idowa: tertiary vegetation, mostly low shrubs along the Ikorodu-Ijebu Ode road, bordered by secondary forest (F)
9	06°56'206" / 003°56'417"	about 2 km from Ogun State University along Ijebu Ode road, tertiary vegetation; large mango trees forming canopy, sparse under-story, Ogun river about 1 km to the east; muddy area with water filled tracks (FB)
10	06°49'487" / 003°49'207"	along Shagamu-Benin expressway: river bordered by secondary / primary forests and farmland (F)
11	06°56'493" / 003°56'792"	Ijebu Oru: Liberian Refugee Camp Settlement: large swamp with dense vegetation, almost permanent, two large shallow ponds, one being very eutrophic, banana trees, about 50 m from fast flowing with rocky River Oru, river bordered by farmland and tertiary growth (FB)
12	07°05'723" / 003°43'796"	along Lagos-Ibadan expressway: river and cultivated island, partly. dense vegetation and low shrubs, bordered by secondary forest (F)
Oyo state		
1	07°36'222" / 003°51'031"	large shallow pond, almost entirely covered by <i>Pistia</i> sp. about 3 km north of Ibadan, bordered by herbs and shrubs, few palm trees (FB)
2	07°37'313" / 003°55'258"	Onidundu: derived savanna, large rice farm in a muddy swamp, bordered by secondary forest and dense herbs and grasses; large stream with overhanging trees and shrubs, <i>Pistia</i> sp., bank with herbs (F)
3	07°43'738" / 003°54'939"	Fiditi: cultivated land bordered by secondary forest sloping towards a valley; small dried up pond overgrown by weeds (F)
4	07°45'190" / 003°55'134"	open degraded savanna about 2 km from Fiditi, bordered by secondary forest (S)
5	07°51'338" / 003°57'723"	large and deep pond in open savanna at the outskirts of Oyo Town, large area without vegetation in pond, water lilies, small stream feeding the pond (S)
6	08°01'385" / 004°07'435"	Oolo: small swamp in the savanna region, with a deep water hole present, partly shaded by shrubs and other vegetations (S)
7	08°05'129" / 004°11'132"	maize and millet fields, small gallery forest close to Ibapon Oyewole (S)
8	08°08'416" / 004°15'082"	immediate surroundings of Ogomosho, swampy area with puddles, highly polluted with mainly domestic wastes (S)
9	08°12'561" / 004°17'050"	very large swamp, partly cultivated, a few kilometres from Ogbomosho, large shallow pond, a partly dried up pond, both surrounded by sparse vegetation, previously cultivated (S)
10	08°17'700" / 004°20'518"	Gbede/Gambari: large pond in a swamp, large area without vegetation, open savanna, small puddles in dried up stream (S)
11	08°18'778" / 004°23'209"	Otte-Egba: northernmost collection site, savanna, about 10 km from Ilorin, drying up pond with sparse vegetation, few shrubs, large fire-resistant trees (S)

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