An Assessment of the Amphibian Fauna of the Gamba Complex of Protected Areas, Gabon

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1 Introduction

At the Third World Congress of Herpetology held in 1997 in Prague, Czech Republic, a special mini-symposium titled "Africa, the forgotten continent" was run concurrently with the main event (Branch 1997). The essence of this symposium was to highlight the general paucity of herpetological investigations undertaken in most African countries. In affirmation of this undesirable state of affairs, Lawson and Klemens (2001) hypothesized that the amphibian species richness disparities between comparable African and Neotropical countries were not necessarily because of real higher faunal diversities of the latter. They believed that the higher Neotropical diversity was correlated with increased research effort which commenced in the 1960s, and that the development of national scientific capacity over the following 40 years gave rise to an unprecedented increase in species descriptions of Colombian and Ecuadorian amphibians. They predicted that, since resolution of alpha-level taxonomy of African amphibians and reptiles had not yet been adequately realized, an increase in training of in-country biologists would result in an increase of new species discoveries. Similar sentiments were recently expressed in a report on biological priorities for conservation in the Guineo-Congolian Forest Region (Kamdem Toham *et al.* 2003), communicating a complete absence of baseline data for most of this region, coupled with an impoverished capacity of national biologists and insufficient funding to address this situation.

From a herpetological perspective, Gabon is one of the most neglected African countries (Lötters *et al.* 2001). The datasets currently available are largely incomplete and deficient for assessing the country's herpetofaunal diversity. Although the Gabon amphibian species checklist compiled by Frétey and Blanc (2000) provided an adequate benchmark to build upon, more intensive regional assessments were still needed to gain a better understanding of the country's amphibian faunal richness. To this end the Smithsonian Institution's Monitoring and Assessment of Biodiversity Program (MAB), in collaboration with the Shell Foundation and Shell Gabon, launched a series of biodiversity assessments in the Gamba Complex in southwestern Gabon. The short-term aim of this initiative was to survey selected localities within the Gamba Complex so that a comprehensive account of the biodiversity and natural history of this region could accrue and be published to highlight its conservation importance. A long-term objective is to train in-country biologists so that alpha-level taxonomy could proceed with a national drive. The preliminary results on amphibians for each assessment were presented in MAB briefing papers and newsletters (see www.si.edu/simab), and in publications (Burger *et al.* 2005, Pauwels 2004). The following article summarizes the cumulative amphibian results of the various localities assessed within the Gamba Complex, and highlights findings of special significance.

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2 Study Areas

The Gamba Complex study area is situated in south-western Gabon, at approximately 2 degrees latitude south and 10 degrees longitude east. The study area falls within the Ogooué-Maritime and Nyanga provinces, and at 1,132,000 ha it constitutes about 4% of Gabon. It is a part of the highly diverse Guineo-Congolian Forest Region (see map page xxxii). Within the Gamba Complex, we surveyed four primary localities; two coastal (Gamba and Loango) and two inland (Rabi/Toucan and Moukalaba-Doudou) (<50 km from coast). Detailed habitat descriptions of all the localities surveyed were presented by Lee *et al*. (this volume). Brief locality details are presented below:

- Gamba and environs: The main surveying effort took place on two different occasions, three weeks during July/August 2001 (407 pitfall trap-days) and two weeks during November 2003 (693 pitfall trap-days), but ad hoc collecting also occurred during 2002-2003. Gamba is situated on the coast. Areas surveyed included Gamba government lands and Shell Gabon concessions. Localities visited included the coastal terrain at the Shell Gabon terminal, the road to Setté Cama, Yenzi camp, Vembo camp, Plaine 1, along the Gamba/Mayonami road, the road to Vera and several other sites within the network of oil production roads. Habitats varied from lowland rainforest with closed canopy to more degraded, open secondary forest, a mosaic of forest patches within savanna, slightly hilly savanna terrain, and a variety of wetland types from large lagoons to small stagnant marshes, seasonal pools, and small streams.
- Rabi and Toucan oilfields 85 km NE of Gamba: The main surveying effort took place on two different occasions, four weeks during February/March 2002 (693 pitfall trap-days), and four weeks during May/June 2002 (1353 pitfall and 324 funnel trap-days). Rabi-Toucan is a lowland rainforest locality (elevation 20 – 90 m) comprising a mosaic of swamp and dry rainforest which has been partially modified by the activities of Shell Gabon since 1987. Several artificial swamps were created by the construction of the roads that service the roughly 200 oil wells, gathering stations, quarries, staff quarters, offices and workshops. These developments have caused fragmentation of the forest with some very small and degraded patches, and others that are large and relatively pristine. Some sections have been selectively logged. The extensive network of roads facilitated surveying efforts and allowed for better coverage of this area as opposed to the Loango and Moukalaba-Doudou localities.
- Loango National Park, situated on the coast 45 km NW of Gamba: The southern Réserve de Petit-Loango section of this recently declared national park was surveyed during September/November 2002 (1562 pitfall and 1108 funnel trap-days). Habitats consisted of a mosaic of coastal vegetation types on white sand, including lowland rainforest, scrub, and bunchgrass prairie. Wetland habitats included swampy forest, small to moderate forest streams, and seasonally-flooded marshes both in forest and grassland habitat. All amphibian records were taken within a seven kilometer radius of the MAB base camp (02°20’27”S, 09°35’33”E).
- Moukalaba-Doudou National Park 25 km NE of Gamba: A four-week long survey was conducted at this lowland rainforest locality during March/April 2003 (704 pitfall and 114 funnel trap-days), including two days in the Doussala region (lowland rainforest and savanna). The MAB base camp (02°35’13”S, 10°14’03”E) was situated near the western perimeter of the park and habitat variation within the seven kilometer radius sampled included the edge of Ndogo Lagoon with inundated swamp forest, smaller swampy patches in the interior forest, and clear-water streams through rocky terrain or with sandy substrate. The elevational range was about 20-250 m.

3 Materials and Methods

The two main techniques for surveying the amphibian faunas of the Gamba Complex localities were active search and passive capture using pitfall and funnel traps. The extent of sampling effort varied among localities, mostly due to differences of logistical ease or time constraints, but each primary locality was investigated for a minimum of four weeks including at least 800 trapping-days.

3.1 Searching

Active searching for specimens was the primary sampling method used to assess the amphibian assemblages of the respective study sites. Searches were usually conducted by tracking frog choruses at night, and also included investigations of debris piles, water-filled cavities in trees and logs, leaf axils, etc. Numerous sites were investigated to obtain a representative cross-section of habitat types varying from inundated swamp forest to dry forest, flowing rivers and standing permanent and seasonal wetlands, and disturbed terrain such as quarries and road-side ditches.

Advertisement calls of frogs were taped with a Sony TC-D5 PRO stereo cassette recorder and analyzed using Canary 1.2.4 software. If roads were present at a locality, such as at Gamba and at Rabi-Toucan oilfields, we would drive slowly on rainy nights to search for frogs (and snakes, Pauwels *et al*. this volume). Roads also facilitated exploration of greater habitat and site diversity. Other members of the MAB surveying team occasionally collected specimens in the course of their respective explorations.

3.2 Trapping

Search efforts were supplemented by entrapment of specimens. Arrays of pitfall and funnel traps set in conjunction with drift fences have proven effective as a passive capture system for sampling certain components of a region's herpetofauna (see for example Branch and Rödel 2003, Burger *et al.* 2004). We installed pitfall traps at all of the localities assessed, but funnel trapping was incorporated only during three of the surveys and at less intensity relative to the pitfall effort. Details of trapping effort and capture results are presented in Table 2, and details of trap localities for Loango were presented by Pauwels *et al*. (2004). Note that these traps were also used for reptile and small mammal sampling (see O'Brien *et al*. this volume, Pauwels *et al*. this volume). Details of trap construction are presented below:

- Drift fences were 80 m long strips of plastic sheeting (0.5 m high) that were stapled vertically onto wooden stakes along a meandering trap line. An apron left at the base was covered with soil and leaf litter to encourage organisms to move along the fence (towards the pitfalls) instead of trying to pass beneath it.
- Pitfall traps were plastic buckets sunk at 8 m intervals with their rims flush with the ground, with 11 pitfalls per trap line. Buckets were 355 mm deep with a 295 mm rim diameter and a 255 mm base diameter. Small holes (3-5 mm diameter) were punched in the base of buckets to allow for water drainage after rainfall events.
- A trap-day is defined as one bucket in use for a 24-hour period. Trap lines were checked each morning to collect amphibians and reptiles that fell in during the night. Specimens not retained as vouchers were released in the vicinity of capture. The daily capture rates of each trap line at each locality were calculated by dividing the total number of specimens collected during a trapping period by the number of trap-days.
- The typical pitfall trapping protocol was to set three lines of drift fences with pitfall traps along one side for a period of seven days at a particular site, i.e. 33 pitfalls x seven nights = 231 trap-days per site. At a minimum the traps were moved at least twice to repeat the protocol at other sites within the primary locality under assessment. Additional pitfall trapping was conducted in some instances where time or logistical ease allowed.
- Funnel traps constructed from fine wire mosquito mesh were also set along one side of the plastic drift fences along with the pitfall arrays, and a similar passive capture principle applies. Funnels measured roughly 60 x 25 cm, with one-sided funnel entrances of approximately 30 mm in diameter. The flexible mosquito mesh allowed the funnel entrance to be fitted flush with the ground and with the drift fence wall.

Live specimens of most amphibians collected were photographed by C. Ward, M. Burger, and W. R. Branch to record color and pattern. Representative voucher specimens were retained for taxonomic and biogeographic analyses, and liver and muscle tissue samples were taken for DNA analyses. Voucher specimens have been deposited at the Gabon Biodiversity Program, Gamba, Gabon; Royal Belgian Institute of Natural Sciences, Brussels, Belgium (IRSNB), Port Elizabeth Museum, Humewood, South Africa (PEM), Smithsonian Institution, Washington D.C., U.S.A. (USNM), and South African Museum, Cape Town, South Africa (SAM).

Identifications of amphibian species were based on descriptions in numerous references. Apart from a few exceptions, these are not specifically referred to in this paper – but see Frétey and Blanc (2000) and Burger *et al.* (2004) for extensive bibliographies. Type specimens and other comparative material were examined at the Royal Museum of Central Africa (Belgium), Royal Belgian Institute of Natural Sciences(Belgium) and the Zoologisches Forschungsinstitut und Museum Alexander Koenig (Germany).

4 Results

In the course of the surveys conducted during 2001-2003, we recorded a total of 66 amphibian species, representing two caecilian and 64 frog species. Another 12 frog species, previously recorded from Moukalaba-Doudou National Park (Burger *et al.* 2004), brought the total amphibian richness of the Gamba Complex to 78 species (see Tables 1 and 2). Species richness for the respective localities is discussed below:

4.1 Gamba

The Gamba locality has the lowest recorded amphibian species richness (20 species) of which two were found only in this area. The Gamba amphibian composition is characterized by savanna or grassland assemblages, most notably the occurrence of *Bufo regularis*, *Hoplobatrachus occipitalis*, *Ptychadena* sp. 3 and *Hyperolius cinnamomeoventris*. Surprisingly *Chiromantis rufescens* was not encountered during the surveys. Caecilians and several forest frogs such as species of *Astylosternus*, *Cardioglossa*, *Nectophryne*, *Petropedetes* and *Acanthixalus* were also not found. An exceptionally high pitfall capture comprised 1,189 specimens of *Xenopus epitropicalis* recorded during 693 trapping-days in November 2002. These traps also captured *Hemisus perreti*, a member of a frog family that was only recently recorded for the first time from Gabon (see Burger *et al.* 2004).

4.2 Rabi-Toucan

A total of 49 amphibian species, including two caecilian species, were recorded at Rabi-Toucan. Although only two of the frog species were found only at this locality, the richness recorded is the second highest known thus far for Gabon. The Rabi-Toucan species composition is most similar to that of Moukalaba-Doudou National Park, although certain genera such as *Leptodactylodon*, *Scotobleps* and *Trichobatrachus* (all astylosternids) were not recorded. One species of *Hyperolius* recorded appears to be an undescribed taxon. Pitfall and funnel traps captured 18 amphibian species, including all six individuals of *Geotrypetes seraphini*. Interestingly, three pipids, *Hymenochirus boettgeri*, *Xenopus epitropicalis* and *X. fraseri*, were found in a funnel trap set next to a shallow seasonal swamp in rainforest habitat.

4.3 Loango National Park

Thirty-one species of frogs were found, none of which were unique to this site. No caecilians were found, but one or two species probably occur within the park. The most interesting finding was that of *Hyperolius* cf *kuligae*, the first confirmed record of this species from Gabon, although it was also later found at Moukalaba-Doudou National Park (see below). Pitfall traps captured a large series of *Hemisus perreti*, a species poorly represented in museum collections. Further explorations of other sections of this national park are likely to substantially increase the current recorded amphibian species richness.

4.4 Moukalaba-Doudou National Park

With 70 known amphibian species, this park has the highest amphibian species richness known for any site in Gabon. Twenty-two of these species were recorded only at this locality. Part of the reason for this high recorded richness is more sampling; two intensive herpetological surveys have been conducted within the park. The first (Burger *et al.* 2004) recorded 54 species, while this study added 16, including a few species new for Gabon. The other reason for this high recorded richness is the greater diversity of habitats in comparison with the other three localities surveyed. The elevational range (100-660 m) investigated by Burger *et al.* (2004) contributed significantly to the final species checklist. However, they also found large species turnover between different sites of the same elevation. The material at this site includes several species that appear to be currently undescribed, e.g. *Afrixalus* sp. 1, *Hyperolius* sp. 1 and *H.* sp. 2 (see Table 1). The genus *Leptodactylodon* was first recorded from Gabon in 1999, with the description of a new species based on a single specimen (Ohler 1999). Another new species in this genus, based on only two specimens, was recently described

from Gabon (Rödel and Pauwels 2003). The Moukalaba-Doudou series, tentatively assigned to *L. blanci* Ohler 1999, is thus of special taxonomic and biogeographic significance.

5 Discussion

Keeping in mind that the total for the whole of Gabon was 72 species (see Frétey and Blanc 2000) the year before the Gabon Biodiversity Program was initiated by the Smithsonian Institution, the recorded diversity of 78 species within the Gamba Complex is impressive at both local and national scales. In fact, to our knowledge this is the second highest amphibian richness thus far recorded from any region in Africa of comparable size, the highest being at Korup National Park and surroundings where Lawson (1993) listed 90 species. Several of these 90 were, however, not actually recorded from his study area, but were predicted to occur based on nearby locality records of such species.

Twenty-four of the species recorded during these studies were additions to the list of Frétey and Blanc (2000), but 18 of these were also found during other recent surveys in Gabon. Thus, sequentially, Lötters *et al.* (2000, 2001) added six species new for Gabon, Burger *et al.* (2004) added another 12 species, a further six species were added during these studies, and Rödel and Pauwels (2003) and Rödel *et al*. (2004) recently described two new species. With a country increase from 72 to 98 (27%) species in just three years, the value of intensive biodiversity assessments is unambiguously affirmed and supports Lawson and Klemens' (2001) hypothesis that African amphibian diversity remains poorly known. Intensive herpetological surveys are thus important, contributing to: 1) baseline data and species checklists for a specific locality; 2) increase in the known species richness for a country; and 3) discovery of new species. Clearly the opportunity for further discoveries remains substantial and thus it is important that more surveys be undertaken in other priority areas. Some of the species newly recorded for Gabon may in fact also be new to science. Specimens that are currently proving difficult to identify require thorough examination and comparison with type material in various museums. Following that, a detailed analysis incorporating all of the previously mentioned data will have to be completed and presented as an updated checklist of Gabon amphibians.

5.1 Species accumulation curve

Species accumulation curves for amphibians and reptiles were plotted as new species were recorded on consecutive days at each of the primary localities sampled. The general trend for amphibians was rapid species accumulation within the first few days, with 80% of the species typically recorded within the first ten days. An example of the amphibian species accu-

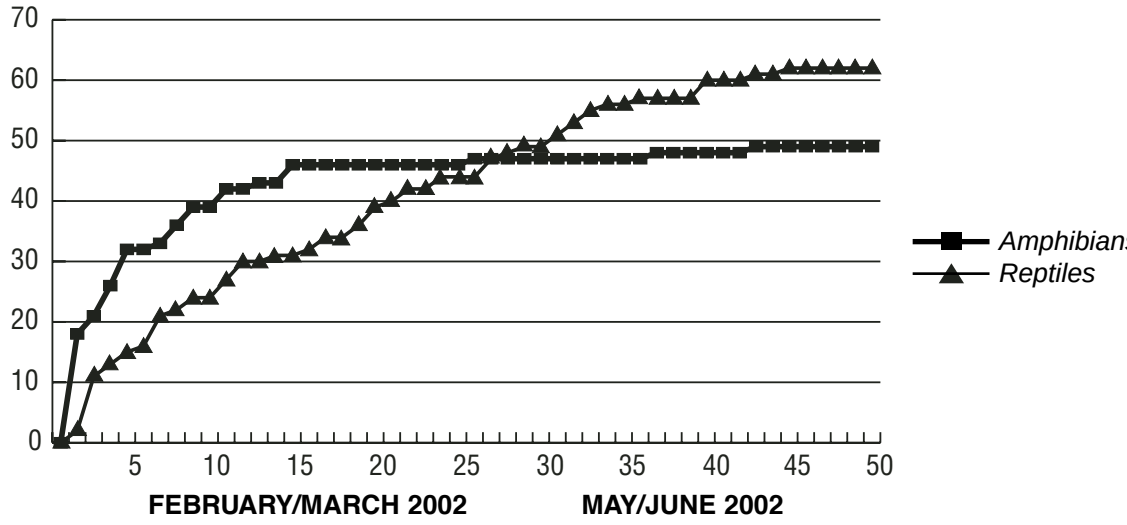

Figure 1. Species accumulation curve for amphibians and reptiles recorded during the two Rabi-Toucan herpetofaunal surveys. Note that although a total of 64 reptiles were recorded from Rabi-Toucan (see Pauwels *et al.* in this volume), only 62 were recorded during these two specific periods.

mulation in comparison with reptiles, recorded during the two Rabi-Toucan surveys, is presented in Figure 1. Of the final figure of 49 amphibian species recorded over seven weeks, 17 (35%) were found after one day. It took only three days to record more than half (26 = 53%) of the species recorded during seven weeks of surveying effort, and after ten days, 42 (86%) of the species were noted. Thereafter the species accumulation curve flattens rapidly, but even so species were still added up to the end of survey, e.g. the last three species were noted on days 25, 36 and 42. In contrast, the reptiles accumulated slowly but more steadily, and it took 26 days to equal the amphibian richness. Thereafter it continued to increase, showing the first signs of reaching a plateau after 40 days. These results clearly demonstrate the different efforts required to adequately sample amphibian and reptile faunas. The main difference is that amphibians are highly vocal during their breeding seasons and thus it is possible to record species richness rapidly by evaluation of choruses. Of course such surveys should target periods of peak breeding activity.

The most effective amphibian sampling method was investigating on breeding choruses. Excluding the results of Burger *et al.* (2004), 42 of 64 species (66%) were found in this manner. However, many of these were also found unassociated with calling, either in the course of general searches or captured in traps. Pitfall and funnel traps captured 2,342 specimens representing 33 different species. A large proportion of specimens were released after they were examined. With all data from the various localities combined, only two frog species, *Schoutedenella taeniata* and *Xenopus* cf *laevis*, were not recorded by means of active searching. However, trapping contributions were usually higher when the data were evaluated separately for each locality. Some species were also captured more frequently in traps than by active searching, e.g. 1,667 of 1,677 (99%) of *Xenopus epitropicalis*, 65 of 67 (97%) *Hemisus perreti*, 49 of 51 (96%) *Hymenochirus boettgeri*, 17 of 18 (94%) *Bufo tuberosus*, 27 of 30 (90%) *Cardioglossa gratiosa*, and seven of eight (88%) *Geotrypetes seraphini* were captured in traps. Without the traps the voucher series for these species would have been inadequate. A standardized trapping protocol also allows for some level of inter-site comparisons, but such trapping needs to be conducted in concurrent sessions or else the effects of climatic variability may skew results.

5.2 Conservation and management considerations

The recent declaration of a network of national parks in Gabon (Anonymous 2002) was an encouraging step towards conserving a representation of Gabon's rich faunal and floral diversities. But much of the remainder of Gabon is under logging concessions, and oil companies are ever searching for new fields to explore. So what threats do these prospects hold in respect to amphibian conservation in Gabon?

Our results show a certain level of uniqueness among the localities surveyed, but generally the species turn-over between similar sites was rather low. Coastal localities with bunchgrass prairie and lowland rainforest mosaic tended to have fewer species than the more inland, wetter rainforest localities. However, coastal localities still harbored a few species absent from the more homogenous inland forests. With 70 of the Gamba Complex's 78 amphibian species recorded from the Moukalaba-Doudou locality, and the likelihood that the other eight species may in fact also occur there, it appears that the amphibian fauna of Moukalaba-Doudou includes most of the potential species that could occur in the region. Comparisons with the fauna known from the region of Lopé National Park (Frétey and Dewynter 1998), 300 km NE of Gamba town, and the Kouilou River basin in Congo (Largen and Dowsett-Lemaire 1991), 350 km S of Gamba town, highlight other regions of high diversity. We believe that increased conservation efforts in these regions will help protect much of the amphibian diversity of Gabon.

Localities at higher elevations (>500 m) are, however, of special significance in terms of amphibian endemics. Recent investigations at Massif du Chaillu and Monts de Cristal revealed several undescribed frog taxa (Rödel and Pauwels 2003, Rödel *et al.* 2004), and further surveys at other high-lying localities are likely to record even more new species. Amphibian conservation should thus focus on protecting select localities above 500 m in Gabon. It would be informative to test this hypothesis by conducting surveys at low elevation rainforest localities in northern Gabon, and also at selected mountainous sites.

Another useful project would be to study intensively select sites that are earmarked to be logged. A pre-logging benchmark should be set over a period of three years, followed by several years of monitor-

Table 1. Amphibian species checklist for the Gamba Complex, based on surveys at the following localities: Gamba (July/August 2001 & November 2002), Rabi-Toucan (February/March & May/June 2002), Loango National Park (September-November 2002) and Moukalaba-Doudou National Park (March/April 2003). Note that the Moukalaba-Doudou locality also includes the literature (L) records of Burger *et al.* (2004). Other abbreviations used in the check-lists are: V – Voucher specimen in museum, S – Sight record, P – Photographic record (including video), T – Tape recording, H – Heard call.

Taxa recorded	Gamba	Rabi-Toucan	Loango	Moukalaba-Doudou
GYMNOPHIONA (Caecilians)				
CAECILIIDAE (2 spp.)				
Herpele squalostoma		V		VP
Geotrypetes seraphini		VP		L & VP
ANURA (Frogs)				
ARTHROLEPTIDAE (8 spp.)				
Arthroleptis cf adelphus		VP	VPT	L & VPT
Arthroleptis cf variabilis		VP		L & VP
Cardioglossa gracilis		VPT		L & VH
Cardioglossa gratiosa		VPT	VPT	L
Cardioglossa leucomystax		VP	VP	L & VP
Schoutedenella aff poecilonota	V		VPT	
Schoutedenella sylvatica		VP	H	L & VPH
Schoutedenella taeniata	VP			
ASTYLOSTERNIDAE (5 spp.)				
Astylosternus batesi		VP		L & VP
Astylosternus sp. 1				VP
Leptodactylodon cf *blanci*				VPT
Scotobleps gabonicus				L
Trichobatrachus robustus				L
BUFONIDAE (8 spp.)				
Bufo camerunensis		VPT	V	L & V
Bufo gracilipes	VP	VPH	VT	L & VH
Bufo latifrons				L
Bufo maculatus				L & VPH
Bufo regularis	VPT			
Bufo tuberosus		VP		L & VP
Nectophryne afra		VP		VP
Nectophryne batesii		VP		L & VP
PIPIDAE (4 spp.)				
Hymenochirus boettgeri		VP	VP	V
Xenopus epitropicalis	V	VP	VP	L & VP
Xenopus fraseri	VP	VP	VP	L & VP
Xenopus cf laevis				L & VP
HEMISOTIDAE (1 sp.)				
Hemisus perreti	V		VP	L
HYPEROLIIDAE (30 spp.)				
Acanthixalus spinosus		VP		L
Afrixalus dorsalis		VPT	VPT	VH
Afrixalus fulvovittatus				L
Afrixalus sp. 1				L & VPT
Afrixalus sp. 2				VPT
Alexteroon obstetricans		VP		L
Hyperolius cinnamomeoventris	VPT	VPT		L & VPT
Hyperolius guttulatus	H	VPT	VPT	L & VT
Hyperolius nasutus	HS	VPT		L & T
Hyperolius ocellatus		VP	VPT	L & VPH
Hyperolius cf *kuligae*			VPT	VP

Table 1. *Continued.*

Taxa recorded	Gamba	Rabi-Toucan	Loango	Moukalaba-Doudou
Hyperolius pardalis		VPT		
Hyperolius phantasticus	VPT	VPT	VPT	
Hyperolius platyceps	VPT	VPT	VPT	L
Hyperolius tuberculatus	VPT	VPT	VPT	L & VT
Hyperolius sp. 1				L & VP
Hyperolius sp. 2		VP		VP
Hyperolius sp. 3				L
Kassina sp. 1				L
Leptopelis aubryi	V	VPT	VPT	L & VH
Leptopelis boulengeri		VP	VP	VP
Leptopelis calcaratus				L
Leptopelis cf *millsoni*		VP		L
Leptopelis notatus	VPT	VP		VP
Leptopelis ocellatus				L & V
Leptopelis omissus		VP	VH	
Leptopelis rufus				L
Leptopelis sp. 1				L
Opisthothylax immaculatus		VPT		
Phlyctimantis leonardi		VPT	VPT	L & HS
RANIDAE (19 spp.)				
Amnirana albolabris	VP	VP	VPH	VT
Amnirana amnicola		V		L & VP
Amnirana lepus		VP		L & VP
Aubria subsigillata	VP	VPH		VPH
Conraua crassipes		VP		L & VP
Dimorphognathus africanus		VPT	VPT	L & VPT
Hoplobatrachus occipitalis	VPH		VPT	L & S
Petropedetes newtoni		VP		L & VP
Phrynobatrachus auritus		VPH	VPH	L & VPH
Phrynobatrachus cornutus		VH	VPT	L & VPT
Phrynobatrachus sp. 1				L
Phrynobatrachus sp. 2				L & VPT
Phrynobatrachus sp. 3				L
Ptychadena aequiplicata		VP	VP	L & VP
Ptychadena perreti				L
Ptychadena sp. 1	VP	VPT		H
Ptychadena sp. 2		VPT	VPT	
Ptychadena sp. 3	VPT		VPT	L & H
Ptychadena sp. 4				VPT
RHACOPHORIDAE (1 sp.)				
Chiromantis rufescens		VPH	VPH	L & VPT
	20	49	31	70

Table 2. Details of trapping effort and amphibian capture results of the four main localities surveyed in the Gamba Complex. PT = pitfall trap, FT = funnel trap. The figures in parentheses are for specimens collected in funnel traps.

	Gamba	Rabi-Toucan	Loango	Moukalaba
July/August 2001	407 PT-days			
Feb./March 2002		693 PT-days		
May/June 2002		1353 PT-days		
May/June 2002		324 FT-days		
Sept.-Nov. 2002			1562 PT-days	
Sept.-Nov.2002			1108 FT-days	
Nov.2002	693 PT-days			
March/April 2003				704 PT-days
March/April 2003				114 FT-days
AMPHIBIA				
Amnirana albolabris			(2)	
Amnirana lepus				1
Arthroleptis adelphus		4 (2)	2	3
Arthroleptis variabilis		2		1
Schoutedenella aff poecilonota	12		29 (4)	
Schoutedenella sylvatica		22 (5)		26 (2)
Schoutedenella taeniata	4			
Astylosternus batesi		1		
Aubria subsigillata		(2)		
Bufo camerunensis		45 (9)	2	4
Bufo gracilipes	22	83	56 (1)	35
Bufo regularis	2			
Bufo tuberosus				17
Cardioglossa gracilis				2
Cardioglossa gratiosa		22 (4)	1	
Cardioglossa leucomystax		2		3
Conraua crassipes				(1)
Dimorphognathus africanus		7 (2)	3 (1)	2 (1)
Geotrypetes seraphini		6		1
Hemisus perreti	5		61 (1)	
Hoplobatrachus occipitalis			(3)	
Hymenochirus boettgeri		32 (4)	13	
Hyperolius phantasticus			(2)	
Hyperolius platyceps			(1)	
Leptopelis aubryi			(1)	
Nectophryne batesii		2		1
Petropedetes newtoni				1
Phrynobatrachus auritus		2	(1)	8
Phrynobatrachus cornutus			2	4 (2)
Ptychadena aequiplicata			1	
Ptychadena sp. 1		(32)		
Xenopus epitropicalis	1190	29 (1)	434 (12)	1
Xenopus fraseri	4	9 (2)	9	
Unidentified Arthroleptidae		14		
Total number of specimens	**1239**	**345**	**642**	**116**
Trapping rate	**1.126**	**0.146**	**0.240**	**0.142**

ing during and after the logging operation. This kind of information would be critical for evaluating current and future logging proposals.

The Smithsonian Institution-lead studies conducted at the Rabi-Toucan oilfields provided us with an opportunity to assess the impacts of an oil extracting operation on various faunal and floral groups. The fact that the Rabi-Toucan amphibian communities appeared to be relatively unaffected, at least not in a severely detrimental way, was somewhat of an unexpected finding due to our suppositions of negative oil impacts including habitat degradation. Our results were therefore encouraging, defying the notion that such industries always equate to amphibian biodiversity loss. This is good news for the biodiversity of Gabon, and justification to consider reinforcing long-term site protection even after oil development.

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