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Amphibians and National Parks in Gabon, western Central Africa

Amphibien und Nationalparks in Gabun, westliches Zentralafrika

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KURZFASSUNG

Wir geben eine Zusammenfassung des derzeitigen Wissens über die Amphibieninventare der in Gabun in jüngster Zeit eingerichteten Nationalparks. Vorläufige Arteninventare sind nur für fünf der 13 Parks vorhanden: Crystal, Ivindo, Loango, Lopé und Moukalaba-Doudou. Sechsundsiebzig (86%) der 88 aus Gabun bekannten Arten, alle 10 (100%) der fast endemischen, und drei der sechs (50%) für Gabun endemischen Arten sind aus diesen Nationalparks nachgewiesen. Vorrangig sollte es sein, die Verbreitung der Amphibien in Gabun durch intensive Surveyarbeit besser zu verstehen und neue Schutzgebiete für die Arten zu schaffen, deren Vorkommen noch nicht ausreichend durch die bestehenden Nationalparks abgedeckt sind.

ABSTRACT

A synthesis of the current state-of-knowledge of amphibian diversity in Gabon and in the recently created Gabonese National Parks is provided. Preliminary inventories are available for five of the 13 parks: Crystal, Ivindo, Loango, Lopé and Moukalaba-Doudou. Seventy-six (86%) of the 88 species known to occur in Gabon, all ten near-endemics (100%), and three of the six Gabonese endemic species (50%) are currently represented in these parks. Future priority actions should comprise an intensified survey activity to document the distribution of Gabonese amphibians. For those species whose range areas then are not sufficiently covered by the Gabon Park network new protected areas should be established.

KEY WORDS

Amphibia: Anura: Gymnophiona, biodiversity, conservation, national parks, Gabon, Africa

INTRODUCTION

A network of 13 national parks was established in 2002 on initiative of Gabon's President OMAR BONGO ONDIMBA in order to develop ecotourism as a diversification of the local economy and to ensure protection of the country's rich biodiversity. The total surface area of the parks represents about 30,000 km², i.e., more than ten percent of the country's territory (ANONYMOUS no date b; Fig. 1). Although park delimitations were selected to protect as many ecosystems as possible, from mangroves to mountain tops, inventories for most botanical and zoological groups are lacking for almost all parks. Since the vast majority of the country's surface area outside of the parks is under logging concessions, or threatened by urbanization and slash and burn agriculture, a crucial and urgent step in biodiversity conservation is to make sure that in national parks viable populations exist for all species, especially the most ecologically sensitive ones and (near-) endemics. Such a synthesis was done in Gabon for a single zoological group, i.e., the reptiles (PAUWELS 2004; PAUWELS et al. 2006). The present work aims to provide a compilation of all available amphibian records made in the National Parks of Gabon, as a preliminary step towards potential conservation actions.

MATERIALS AND METHODS

Species records for the National Parks are based on an extensive study of available literature and on intensive field work led by the first author in Gabon in 2001-2006. The field surveys were mainly sponsored by WWF-CARPO (in Crystal Mounts, Chaillu

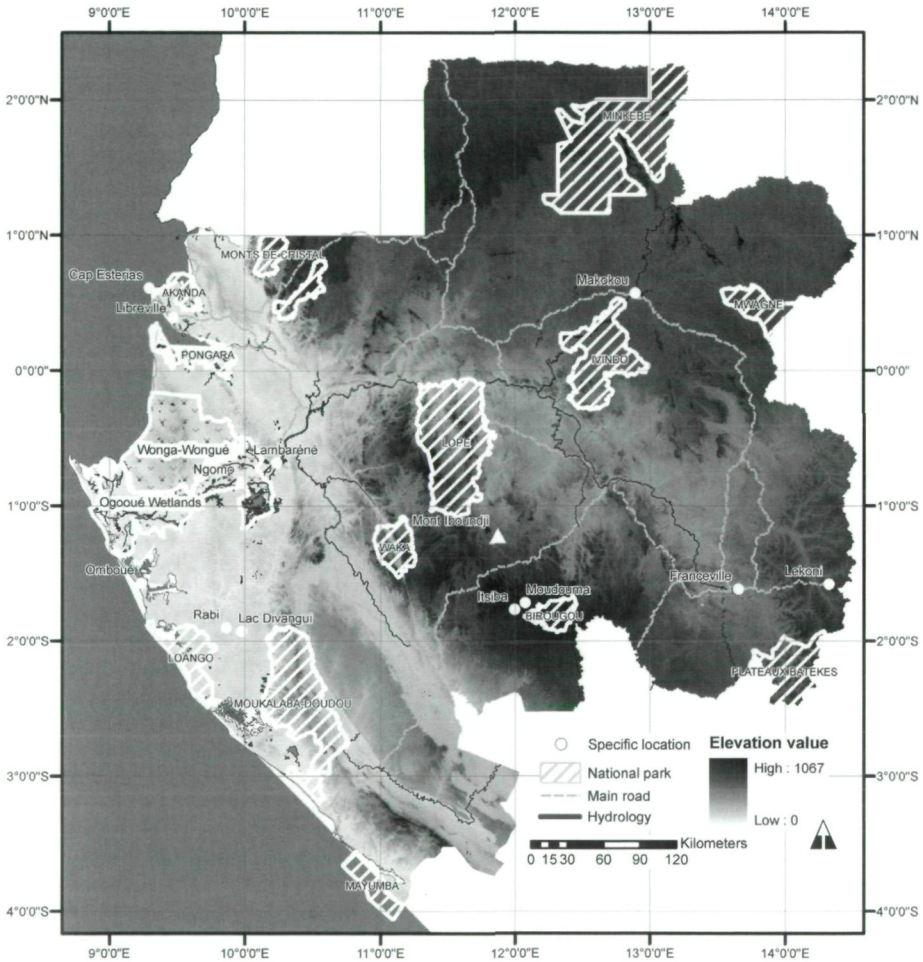

Fig. 1: Map of Gabon, showing the relief, hydrography, national parks and other localities mentioned in the text.
Abb. 1: Karte von Gabun mit dem Relief des Landes, den wichtigsten Flüssen, den Nationalparks und anderen im Text erwähnten Lokalitäten.

Massif and central Gabon) and by the Smithsonian Institution, Shell Foundation and Shell Gabon (in Loango and Moukalaba-Doudou National Parks in the Gamba Complex of Protected Areas, southwestern Gabon) and were documented through voucher specimens deposited in museum collections in Gabon and abroad (specified in our publications, see literature cited). Species records not strictly made within actual park borders are not considered for the park lists. National Park delimitations considered are those presented by ANONYMOUS (no date b). Generic and familial allocations of taxa follow FROST (2004). Endemic species are understood as those currently known to occur only in Gabon. Near-endemic are defined, following ANDERSON (2002), as those which have "more than 50 % of their range within one country and occur in no more than 2-3 countries in total, or that occur only within one geographical unit". Abbreviations: a.s.l. – above sea level; NP – National Park.

RESULTS

All data available for each park are detailed below. Species lists per park are compiled in Table 1. The table includes all taxa represented and identified to species level, however, the unclear "sp." taxa simply as footnotes, except for the only *Kassina* sp. recorded from Gabon. This was done because of the risk of citing species more than once. All species referred to as "cf." are indicated as such in the detailed park accounts (as an indication of the necessity of more taxonomic work on these taxa), but are not entered in Table 1, except if all authors concur that the Gabonese populations mentioned are not typical. Parks and taxa (species within families) are presented alphabetically.

Akanda National Park (540 km²; 0°34'-0°35' N, 9°19'-9°21' E). The Park is situated on the coast around Mondah Bay, just north of Libreville. Its vegetation types include mangroves, littoral and swamp forests, some lowland evergreen forest, and a small savanna pocket. Altitude varies from 0 to 60 m a.s.l. A very detailed description of the park was provided by VANDE WEGHE (2005). Despite its proximity to the capital, no amphibian record is available for the Park.

Bateke Plateaux National Park (2,050 km²). The Park is covered by savanna and traversed by numerous unexplored rivers and deep canyons (ANONYMOUS no date b). The altitude ranges from about 400 to 830 m a.s.l. No amphibian record is available for this remote Park.

Crystal Mountains National Park (1,200 km²). This Park is covered by dense forest and includes some of the highest areas of Gabon, with summits above 900 m a.s.l. The botanical diversity is one of the richest of Africa, with numerous endemics (ANONYMOUS no date b; WILKS 1990). LÖTTERS et al. (2001) provided 22 amphibian species records from Tchimbélé and/or Kinguélé (see also GOSSMANN et al. 2002): *Arthroleptis* cf. *poecilonotus* (PETERS, 1863) and *A. variabilis* MATSCHIE, 1893, *Astylosternus batesi* (BOULENGER, 1900), *Bufo superciliaris* BOULENGER, 1888, *Afrixalus* cf. *fulvovittatus* (COPE, 1861) and *A. paradorsalis* PERRET, 1960, *Hyperolius mosaicus* PERRET, 1959, *H. ocellatus* GÜNTHER, 1859, *H. pardalis* LAURENT, 1948, *H. phantasticus* (BOULENGER, 1899), *Hyperolius* sp. A, *Leptopelis aubryi* (DUMÉRIL, 1856), *L. "brevirostris"* (the specimen is actually *L. crystallinoron*, see LÖTTERS et al. 2005), *L. millsoni* (BOULENGER, 1895), *Phlyctimantis* cf. *boulengeri* PERRET, 1986, *Petropedetes palmipes* BOULENGER, 1905, *P. parkeri* AMIET, 1983, *Silurana epitropicalis* (FISCHBERG, COLOMBELLI & PICARD, 1982), *Amnirana amnicola* (PERRET, 1977), *Conraua crassipes* (BUCHHOLZ & PETERS, 1875), *Ptychadena* sp. A, and *Ptychadena* sp. B. RÖDEL & PAUWELS (2003) described *Leptodactylodon stevarti* from the park near Tchimbélé and mentioned the following species collected in syntopy: *Scotobleps gabonicus* BOULENGER, 1900, *Trichobatrachus robustus* BOULENGER, 1900, *Nectophryne afra* BUCHHOLZ & PETERS, 1875, *Leptopelis* cf. *calcaratus* (BOULENGER, 1906), *L. rufus* REICHENOW, 1874, *Petropedetes newtoni* (BOCAGE, 1895) and *Conraua* cf. *crassipes*. LÖTTERS et al. (2005) described *Leptopelis crystallinoron* from the vicinity of Tchimbélé; the species is still known only from its holotype. They also mentioned *Leptopelis brevirostris* (WERNER, 1898) from Tchimbélé.

Ivindo National Park (3,000 km²). This densely forested park includes numerous very large waterfalls (especially Kongou and Didji), Langoué Bai clearing, and high summits, such as Kinguié Mount, culminating at 749 m a.s.l. The northeasternmost part of the park, formerly known as the "Réserve naturelle intégrale d'Ipassa", was subject to extensive scientific exploration thanks to the presence of a research station, and is the only site in Gabon to have been listed as a biosphere reserve by UNESCO (CHRISTY et al. 2003). An undated anonymous report provided a list of amphibians of the Ivindo Basin, including some records from "M'Passa" area, which represents the northernmost part of the Park near Makokou (ANONYMOUS no date a; M'Passa is an incorrect transliteration of the Kota word Ipassa fide J. P. VANDE WEGHE, pers. comm.). From the introduction to the mammal section and the latest dates of the litera-

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ture section, it can be deduced that the report was distributed in 1978. This report, also taken into account by BLANC & FRÉTEY (2004) and FRÉTEY & BLANC (2000, 2001), was based on material collected by LOUIS-PHILIPPE KNOEPFFLER, and gave a list of 38 species for Ipassa: *Arthroleptis* cf. *poecilonotus*, *A. variabilis*, *Cardioglossa gracilis* BOULENGER, 1900, *Schoutedenella sylvatica* LAURENT, 1954, *Astylosternus batesi*, *Bufo camerunensis* (PARKER, 1936), *B. petiti* KNOEPFFLER, 1967 (= *B. gracilipes* BOULENGER, 1899 fide FRÉTEY & BLANC, 2000), *B. superciliaris*, *B. tuberosus* GÜNTHER, 1859, *Nectophryne afra*, *Afrixalus dorsalis leptosomus* (PETERS, 1877), *A. fulvovittatus brevipalmatus* AHL, 1931, *A. laevis* (AHL, 1930), *A. paradorsalis*, *Cryptothylax greshoffi* (SCHILTHUIS, 1889), *Hyperolius cinnamomeoventris* BOCAGE, 1866, *H. pardalis*, *H. tuberculatus* (MOCQUARD, 1897), *Leptopelis calcaratus*, "*L. knoepffleri* PERRET & AMIET" (to our knowledge unpublished), *L. millsoni*, *L. notatus* (BUCHHOLZ & PETERS, 1875), *L. ocellatus* (MOCQUARD, 1902), *Phlyctimantis leonardi* (BOULENGER, 1906), *Dimorphognathus africanus* (HALLOWELL, 1858), *Phrynobatrachus auritus* BOULENGER, 1900, *P. batesii* (BOULENGER, 1906), *Hymenochirus camerunensis* PERRET & MERTENS, 1957 (= *H. boettgeri* [TORNIER, 1896] fide FRÉTEY & BLANC, 2000), *Silurana* "*tropicalis* (GRAY, 1864)" (Gabonese populations actually referrable to *Silurana epitropicalis*, cf. LOUMONT, 1983: 176), *Xenopus fraseri* BOULENGER, 1905, *Aubria subsigillata* (DUMÉRIL, 1856), *Amnirana albolabris* (HALLOWELL, 1856), *A. amnicola*, *A. lepus* (ANDERSSON, 1903), *Conraua crassipes*, *Ptychadena aequiplicata* (WERNER, 1898), *P. perreti* GUIBÉ & LAMOTTE, 1958, *Chiromantis rufescens* (GÜNTHER, 1869). Figures 2 to 4, represent *Hyperolius cinnamomeoventris*, *Leptopelis ocellatus* and *Amnirana albolabris* from the Ipassa Plateau, to confirm the presence of these species in the Park.

Loango National Park (1,550 km²). This coastal park, mostly just above sea level, shows sandy beaches, mangroves, savanna and littoral and swamp forests. In their list of the reptiles of the Park, PAUWELS et al. (2004) mentioned *Hyperolius phantasticus* as stomach content of the colubrid snakes *Dipsadoboa duchesnii* (BOULENGER, 1901) and *Psammophis* cf. *phillipsii* (HALLOWELL, 1844), and *Dimorphognathus africanus* in the stomach of a colubrid snake *Natriciteres fuliginoides* (GÜNTHER, 1858). These authors also provided (loc. cit.: 122) the picture of another *N. fuliginoides* preying on a *Phrynobatrachus auritus* from the Park. The amphibian fauna of Loango benefitted from a dedicated survey (BURGER et al. 2006),

Figs. 2-5 (opposite page). / Abb. 2-5 (gegenüberliegende Seite).

Fig. 2: Adult *Hyperolius cinnamomeoventris* BOCAGE, 1866 photographed on the Ipassa Plateau, Ivindo National Park (Photo: JEAN-PIERRE VANDE WEGHE).

Abb. 2: Adulter *Hyperolius cinnamomeoventris* BOCAGE, 1866 aufgenommen auf dem Ipassa Plateau, Ivindo Nationalpark (Photo: JEAN-PIERRE VANDE WEGHE).

Fig. 3: Adult *Leptopelis ocellatus* (MOCQUARD, 1902) photographed in July 2005 (dry season) in a secondary forest with dense Maranthaceae understorey on the Ipassa Plateau, Ivindo National Park (Photo: NATHALIE VAN VLIET).

Abb. 3: Adulter *Leptopelis ocellatus* (MOCQUARD, 1902) aufgenommen im Juli 2005 (Trockenzeit) in einem Sekundärwald mit dichtem Maranthaceae-Unterwuchs auf dem Ipassa Plateau, Ivindo Nationalpark (Photo: NATHALIE VAN VLIET).

Fig. 4: *Amnirana albolabris* (HALLOWELL, 1856) photographed on the Ipassa Plateau, Ivindo National Park (Photo: JEAN-PIERRE VANDE WEGHE).

Abb. 4: *Amnirana albolabris* (HALLOWELL, 1856), aufgenommen auf dem Ipassa Plateau, Ivindo Nationalpark (Photo: JEAN-PIERRE VANDE WEGHE).

Fig. 5: Adult *Nectophryne batesii* BOULENGER, 1913 photographed in 1995 at Mitendi, near Ololo, in Lopé National Park (Photo: RICHARD OSLISLY). Uniqueness of document may excuse low image quality.

Abb. 5: Ausgewachsene *Nectophryne batesii* BOULENGER, 1913, aufgenommen 1995 in Mitendi im Lopé Nationalpark, nahe Ololo (Photo: RICHARD OSLISLY). Mangelnde Bildqualität wurde wegen des Dokumentationswertes in Kauf genommen.

which gathered 31 taxa (see Table 1), including *Arthroleptis* cf. *adelphus* PERRET, 1966, *A.* cf. *poecilonotus*, and *Hyperolius* cf. *kuligae* MERTENS, 1940.

Lopé National Park (4,970 km²). The Park is mostly covered by forest but also comprises savanna-forest mosaic (ANONYMOUS no date b; CHRISTY et al. 2003). The southern area of the Park belongs to the Chaillu Massif. The highest summits are over 700 m a.s.l. OHLER (1999) described *Leptodactylodon blanci* from "campement Soforga" situated within the Park, and mentioned *Alexteroon* sp. (probably *A. hypsiphonus* AMIET, 2000, the only *Alexteroon* mentioned from this site by FRÉTEY & BLANC 2001: 382), *Schoutedenella sylvatica*, *Bufo latifrons* BOULENGER, 1900, *Conraua crassipes*, *Dimorphognathus africanus*, *Phrynobatrachus cornutus* (BOULENGER, 1906), *Phrynobatrachus* sp. and *Ptychadena perreti* from the same locality. FRÉTEY & BLANC (2001) gave an amphibian inventory of the Park and the "Forêt des Abeilles" ("Bees' Forest"), just east of the Park (a species list for the "Forêt des Abeilles" had already been presented by FRÉTEY & DEWYNTER 1998; note that LÖTTERS et al. 2001: 22 indicated that FRÉTEY & DEWYNTER's 1998 record of *Silurana tropicalis* from Makandé might very possibly actually concern *S. epitropicalis*). FRÉTEY & BLANC's (2001) species records within the Park's limits number 25: *Arthroleptis* cf. *poecilonotus*, *A. taeniatus* BOULENGER, 1906, *Cardioglossa leucomystax* (BOULENGER, 1903), *Schoutedenella sylvatica*, *Leptodactylodon blanci*, *Scotobleps gabonicus*, *Bufo latifrons*, *B. maculatus* HALLOWELL, 1855, *Afrixalus dorsalis* (PETERS, 1875), *Alexteroon hypsiphonus*, *Leptopelis aubryi*, *L. omissus* AMIET, 1992, *Phlyctimantis leonardi*, *Dimorphognathus africanus*, *Petropedetes newtoni*, *Phrynobatrachus auritus*, *P. cornutus* and *Phrynobatrachus* sp., *Silurana epitropicalis*, *Amnirana albolabris*, *Conraua crassipes*, *Ptychadena aequiplicata*, *P. perreti*, *P. pumilio* (BOULENGER, 1920), and *Chiromantis rufescens*. They moreover identified (loc. cit.: 383) a juvenile *Hyperolius* as *H. cinnamomeoventris*, but with some doubt. BLANC & FRÉTEY (2004) did not specifically give locality records for their amphibian records, but the following 13 species records from their biotopes numbered 3, 7 and 8, were unambiguously made within the Park borders: *Arthroleptis* cf. *poecilonotus*, *Bufo camerunensis*, *Hyperolius cinnamomeoventris* (thus confirming the doubtful record by FRÉTEY & BLANC 2001), *Leptopelis aubryi*, *L. omissus*, *Petropedetes newtoni*, *Phrynobatrachus auritus*, *P. cornutus*, *Silurana epitropicalis*, *Conraua crassipes*, *Ptychadena perreti*, *P. taenioscelis*, and *Chiromantis rufescens*. Although FRÉTEY & BLANC (2000: 22; 2001: 385) indicated *Ptychadena taenioscelis* LAURENT, 1954 as synonymous with *P. pumilio*, BLANC & FRÉTEY (2004) did not list *P. pumilio*, but *P. taenioscelis*, without comments. We provisionally regard them as synonyms, following RÖDEL (2000). We presently add *Nectophryne batesii* BOULENGER, 1913 to the Park's batrachofauna, on the base of an adult specimen photographed by R. OSLISLY in the park at Mitendi, just North of Ololo (Fig. 5). This and other pictures of this specimen show a short-snouted *Nectophryne* without concavity from snout tip down to the mouth, as is diagnostic for the species (PERRET 1966: 323).

Mayumba National Park (80 km²). This is essentially a marine park, with a very limited land surface along the beach (ANONYMOUS no date b). The biotopes include beach and some littoral forest, mostly just above sea level. No amphibian records are available from this park.

Minkebe National Park (7,570 km²). This Park is the largest of all Gabonese parks and it includes a number of summits and inselbergs, including some above 900 m a.s.l. in the Kokaméguèl Mounts (ANONYMOUS no date b). Due to its difficult access, no amphibian survey was done so far in the Park.

Moukalaba-Doudou National Park (4,500 km²). The richness of biotopes of this Park is remarkable, from papyrus marshes, swamp forest and savanna to the forests of the Doudou Mounts, with a peak culminating at 820 m a.s.l. (ANONYMOUS no date b). Two intensive amphibian surveys were done, in the eastern and southwestern parts of the Park respectively (BURGER et al. 2004, 2005, 2006). Among the 70 taxa listed by BURGER et al. (2006) are *Arthroleptis* cf. *adelphus*, *A.* cf. *variabilis*, *Leptodactylodon*

cf. *blanci*, *Hyperolius* cf. *kuligae*, *Leptopelis* cf. *millsoni* and *Xenopus* cf. *laevis* (DAUDIN, 1802). Since this latter work we have re-examined the *Leptodactylodon* specimens and confirm they belong to *L. blanci*. The *Xenopus* cf. *laevis* record refers actually to *X. petersii* BOCAGE, 1895 (M. BURGER, pers. comm., 2005), formerly regarded a synonym of *X. laevis*, but currently recognized (see FROST 2004). We regard BURGER et al.'s (2004, 2006) *Kassina* sp. as an undescribed species.

Mount Birougou National Park (690 km²). This Park is situated in the heart of the Chaillu Massif and is one of the remotest. It includes mountain tops above 900 m a.s.l. and numerous waterfalls (ANONYMOUS no date b). To date, no amphibian survey was done.

Mwagne National Park (1,160 km²). The Park is remarkable by the existence of Mwagne Bai, the largest bai (natural clearing) in Gabon, and other smaller bais, and is bordered by two large rivers (ANONYMOUS no date b). Altitude ranges from ca. 400 to 571 m a.s.l. Vegetation includes Marantaceae forests. No amphibian records are available from this Park.

Pongara National Park (870 km²; 0°34'-0°35' N, 9°19'-9°21' E). The vegetation of this coastal park includes mangroves, littoral and swamp forests, as well as some savanna and lowland evergreen forest (VANDE WEGHE 2005). Altitude varies between 0 and 45 m a.s.l. VANDE WEGHE (2005: 162) illustrated an *Arthroleptis variabilis* specimen from the Park.

Waka National Park (1,070 km²). This densely forested park is situated in the Chaillu Massif. It is crossed by the Ikobé River forming a deep rift with steep walls, reaching 900 m a.s.l. No amphibian survey was done in this Park and no records are available.

DISCUSSION

Amphibian species richness of Gabon's national parks

Surveys dedicated to the study of amphibians were done in five Parks, and with the exception of a single record for Pongara NP, there are no amphibian records at all for the eight remaining Parks. The highest number of species (70) was observed in the park which was surveyed most intensively, i. e. Moukalaba-Doudou NP. The second biggest survey effort concerns Loango NP (31 taxa), then Lopé NP (28), Crystal NP (30) and then eventually Pongara NP (one opportunistic record) (see materials and methods in the references cited in each park account). No data are available on the search effort by ANONYMOUS (no date a) for Ivindo NP. There is an obvious linkage between collecting effort and the list of taxa gathered for these parks, but we expect actual species richness to vary very much among them, considering their respective surfaces and the variety of macro-habitat types represented. The batrachofauna of Akanda NP is probably not very rich nor peculiar, and probably very similar to that of Pongara NP. The Bateke Plateaux NP savanna is in direct continuation of the Congolese savanna, and we expect the presence of true savanna dwelling batrachofauna, among them probably a number of species that might be absent from the closed, isolated savanna pockets elsewhere in the country, such as in Lopé NP. Field surveys in the Bateke Plateaux might bring a number of additions to the country's batrachofauna. At least 19 of the 30 species (63%) recorded from Crystal NP are found in Monte Alén NP (2,000 km²) in the neighboring Equatorial Guinea (see DE LA RIVA 1994, 2004; LASSO et al. 2002). Due to the ecological similarities between both parks and their geographical proximity, it can be expected that many of the 56 amphibian species recorded in Monte Alén NP will be found in Crystal NP. The species in the list for Ivindo NP were gathered only in the northernmost, most accessible part of the Park. The largest part of the Park is totally unexplored but includes promising sites, such as Mount Kinguié, the Bai of Langoué, and all the waterfalls. BURGER et al. (2006) predicted that the actual diversity in Loango NP must be much higher than the 31 taxa recorded presently, and include a.o. caecil-

ians. The 43 species recorded by FRÉTEY & BLANC (2001) in and near Lopé NP are most probably all present within the Park. Besides these 43, they also mentioned four additional ones that were seen but could not be caught and precisely identified (among them probably *Hemisus* and *Cryptothylax*, according to BLANC & FRÉTEY 2004: 308), raising the number of taxa to 47. FRÉTEY & BLANC (2001: 387) indicated that ten of the species they listed were recorded through a single individual, and that 17 were found in a single site, hence stressing how preliminary their list is. The survey of the southern, hilly parts of the Park, belonging to the Chaillu Massif, will certainly bring many additions. The small land surface and homogeneity of Mayumba NP seem to indicate a low amphibian diversity, very possibly the lowest among all Gabonese Parks. With its large surface and high variety of habitats, the number of taxa of Minkebe NP is potentially very high. With its mountains covered by pristine dense forest, Mount Birougou NP is one of the most promising in terms of richness and endemicity. Moukalaba-Doudou NP is part of the Gamba Complex of Protected Areas, where in total 78 species were recorded. BURGER et al. (2006) expected all 78 species and more to occur within the Park. So little is known about Mwagne NP that it is difficult to make any prediction, but its bais might house interesting species. Waka NP is probably home to many mountain dwelling taxa; the Ikobé rift might house peculiar taxa. Apart from these predictions, the number of 70 species for Moukalaba-Doudou NP is high compared to lists available for other Parks in the area. For comparison, LAWSON (1993: Table 2) listed 53 species from localities situated within Korup NP (1,240 km²), southwestern Cameroon, and RÖDEL (2003) listed 45 (with ten more predicted) for Mount Sangbé NP (950 km²) and 56 for Taï NP (3,500 km²), Ivory Coast (RÖDEL & ERNST 2004). In southeastern Guinea, 57 species were recorded from Pic de Fon Forest Reserve (256 km²) and 48 from Diécké Forest Reserve (590 km²) (RÖDEL & BANGOURA 2004; RÖDEL et al. 2004a). In Mont Nimba Nature Reserve (>200 km² in Liberia, Ivory Coast and Guinea), 60 to 63 species were recorded (RÖDEL et al. 2004a). The Ankasa Conservation Area (518 km²) in Ghana revealed about 40 species so far (RÖDEL et al. 2005). The highest known number of amphibian species on an African site is 93 for Mount Nlonako (150 km²; elevation up to 1,825 m a.s.l.) in Cameroon (HERRMANN et al. 2005). The general pattern for amphibian species richness in West and Central Africa is that species diversity is positively correlated with precipitation, intact rainforest vegetation and habitat diversity (M.-O. RÖDEL & M. WEGMANN, unpubl. data).

General representation of Gabon's amphibians in national parks

FRÉTEY & BLANC (2000) provided a list of 72 amphibian species for Gabon. Their listing of *Ptychadena superciliaris* however seems to be erroneous, since the species is currently known from Sierra Leone to Ghana (FROST 2004); we hence provisionally withdraw it from the national list. Since their work, 17 species were added to the batrachofauna of Gabon: *Cardioglossa gratiosa* AMIET, 1972, *Leptodactylodon stevarti*, *Trichobatrachus robustus*, *Werneria iboundji* RÖDEL, SCHMITZ, PAUWELS & BÖHME, 2004, *Hemisus perreti* LAURENT, 1972, *Alexteroon obstetricans* (AHL, 1931), *Hyperolius guttulatus* GÜNTHER, 1859, *H.* cf. *kuligae*, *H. mosaicus*, *H. nasutus* GÜNTHER, 1865, *Kassina* sp., *Leptopelis crystallinoron*, *Phlyctimantis* cf. *boulengeri*, *Petropedetes palmipes*, *P. parkeri*, *Xenopus petersii*, and *Hoplobatrachus occipitalis* (GÜNTHER, 1859) (see BURGER et al. 2004, 2006; LÖTTERS et al. 2001, 2005; RÖDEL & PAUWELS 2003; RÖDEL et al. 2004b; this paper). Moreover, a number of unidentified species were mentioned from Gabon, and among them potential new species (see notes under Table 1). We believe Gabonese populations of *Arthroleptis poecilonotus* and *Afrixalus fulvovittatus* to be distinct from the typical West African populations (see a. o. RÖDEL & BANGOURA 2004), but will refer to those species as "cf." until their status is clarified. The total number of amphibian species known from Gabon, excluding the still unidentified taxa mentioned below Table 1, is at least 88 (8 Arthroleptidae, 5 Astylosternidae, 11 Bufonidae, 1 Hemiso-

tidae, 35 Hyperoliidae, 8 Petropedetidae, 6 Pipidae, 11 Ranidae, 1 Rhacophoridae and 2 Caeciliidae). The extremely high representation of the Gabonese herpetofauna in National Parks (see below) is due to the fact that most major amphibian inventories were done in these National Parks and their direct surroundings (ANONYMOUS no date a; BURGER et al. 2004, 2006; FRÉTEY & BLANC 2001), except those made in the "Forêt des Abeilles" (FRÉTEY & DEWYNTER 1998; 38 species), Rabi-Toucan oilfields (BURGER et al. 2006; 49 species) and Gamba (BURGER et al. 2006; 20 species), both latter sites situated between Loango and Moukalaba-Doudou National Parks in the Gamba Complex of Protected Areas. The following 13 species were listed by FRÉTEY & BLANC (2000) or in more recent works from Gabon (see references for the 17 species added since their work), but are not known from one of the country's National Parks: *Bufo funereus* BOCAGE, 1866, *B. regularis* REUSS, 1834, *Werneria iboundji*, *Chlorolius koehleri* (MERTENS, 1940), *Hyperolius marmoratus* RAPP, 1842, *Leptopelis viridis* (GÜNTHER, 1869), *Opisthothylax immaculatus* (BOULENGER, 1903), *Phrynobatrachus ogoensis* (BOULENGER, 1906), *Hymenochirus feae* BOULENGER, 1906, *Xenopus andrei* LOUMONT, 1983, *Aubria masako* OHLER & KASADI, 1990, *Ptychadena mascareniensis* (DUMÉRIL & BIBRON, 1841) (comprising a complex of species; see VENCES et al. 2004) and *P. superciliaris* (GÜNTHER, 1859) (probably not in Gabon; see above). *Bufo funereus* is widely distributed in Central African forests, and its discovery in some of Gabon's parks in the coming years is highly probable, particularly in Ivindo or Minkebe National Parks, since the species is known from the Ivindo Basin (ANONYMOUS no date a). *Bufo regularis* is known from various localities in Gabon (see a.o. LÖTTERS et al. 2001; BURGER et al. 2006), and, being primarily a savanna species, might be expected from Bateke Plateaux, Loango, Lopé and Moukalaba-Doudou National Parks. The wide-ranging savanna-dwellers *Hyperolius marmoratus*, *Leptopelis viridis* and *Ptychadena mascareniensis* might be expected from the same parks. The forest-dweller *Opisthothylax immaculatus* is known from Rabi oilfields (BURGER et al. 2006), at midway between Loango and Moukalaba-Doudou National Parks, where it will probably be found, as well as in other forested parks. *Aubria masako* (regarded by PERRET, 1994 as a possible synonym of *A. subsigillata*; but see RÖDEL et al. 2005 for summarizing the discussion on *Aubria* taxonomy and arguing that *A. masako* is valid) could be expected from the forested parks in central and eastern Gabon.

Representation of endemics and near-endemics

Since FRÉTEY & BLANC (2000) listed three Gabon endemics (*Leptodactylodon blanci*, *Phrynobatrachus ogoensis* and *Hymenochirus feae*), three more species were described which are also known only from Gabon: *Leptodactylodon stevarti*, *Werneria iboundji* and *Leptopelis crystallinoron*. *Leptodactylodon blanci* is known from two parks, and its representation is thus satisfactory. *Leptodactylodon stevarti* is known from its type locality in Crystal NP, but possibly also occurs in Monte Alén NP in Equatorial Guinea (RÖDEL & PAUWELS 2003). *Leptopelis crystallinoron* is the second species endemic to Crystal NP and is only known from its holotype. *Phrynobatrachus ogoensis* is so far known only from Lambaréné in Moyen-Ogooué Province. It was proposed to be synonym with *P. brongersmai* from Liberia (see FROST 2004), what is highly unlikely for biogeographic reasons. The taxonomic status of *P. ogoensis* and *P. brongersmai* should hence be evaluated. *Hymenochirus feae* is still known only from the Fernan Vaz area, just north of Loango NP where it should be searched. *Werneria iboundji* is known from two specimens of the greater waterfall of Mount Iboundji, about 20 km southwest of Lopé NP and ca. 65 km E of Waka NP. Mount Iboundji, culminating at 972 m a.s.l., is one of the tops of Gabon, but does not benefit to date of any legal protection. We recommend to include it as part of Lopé NP or its designation as a wildlife sanctuary with legal protection. In total, only three of six species endemic to Gabon are known to occur in a Gabonese National Park

Near-endemics include (distribution data follow FRÉTEY & BLANC 2000; FROST

Table 1 (this and opposite page): The table shows an updated list of amphibian species and their records within the six Gabonese National Parks for which records are currently available. Only records from strictly within park borders are taken into account. Literature and sources for species records are specified in the account for each park. Numbers between brackets represent the total species richness, i.e., including taxa that could not be identified to specific level by some authors (see Notes under Table 1), except when they might correspond to species listed by other authors.

Tab. 1 (diese und gegenüberliegende Seite). Die Tabelle bietet eine aktuelle Übersicht der Amphibien Gabuns und der Nachweise für sechs Nationalparks. Wir haben nur Nachweise berücksichtigt die innerhalb der Parkgrenzen gemacht wurden. Literaturangaben und andere Quellen für die Nachweise sind im Text unter dem jeweiligen Nationalparkabschnitt zu finden. Die Zahlen in den Klammern umfassen alle bekannten Nachweise inkl. der Arten die von manchen Autoren nicht bis zur Artebene bestimmt werden konnten (siehe Notes unter Tab. 1), mit Ausnahme der Fälle in der diese Taxa vermutlich mit sicher bestimmten Arten anderer Autoren übereinstimmen.

Taxa / National Parks	Crystal	Ivindo	Loango	Lopé	Moukalaba-Doudou	Pongara
ANURA						
Arthroleptidae						
Arthroleptis cf. *adelphus*			X		X	
Arthroleptis cf. *poecilonotus*	X	X	X	X		
Arthroleptis taeniatus				X		
Arthroleptis variabilis	X	X			X	X
Cardioglossa gracilis		X			X	
Cardioglossa gratiosa			X		X	
Cardioglossa leucomystax			X	X	X	
Schoutedenella sylvatica		X	X	X	X	
Astylosternidae						
Astylosternus batesi	X	X			X	
Leptodactylodon blanci				X	X	
Leptodactylodon stevarti	X					
Scotobleps gabonicus	X			X	X	
Trichobatrachus robustus	X				X	
Bufonidae						
Bufo camerunensis		X	X	X	X	
Bufo funereus						
Bufo gracilipes		X	X		X	
Bufo latifrons				X	X	
Bufo maculatus				X	X	
Bufo regularis						
Bufo superciliaris	X	X				
Bufo tuberosus		X			X	
Nectophryne afra	X	X			X	
Nectophryne batesii				X	X	
Werneria iboundji						
Hemisotidae						
Hemisus perreti			X		X	
Hyperoliidae						
Acanthixalus spinosus					X	
Afrixalus dorsalis		X	X	X	X	
Afrixalus cf. *fulvovittatus*	X	X			X	
Afrixalus laevis		X				
Afrixalus paradorsalis	X	X				
Alexteroon hypsiphonus				X		
Alexteroon obstetricans					X	
Chlorolius koehleri						
Cryptothylax greshoffi		X				
Hyperolius cinnamomeoventris		X		X	X	
Hyperolius guttulatus			X		X	
Hyperolius cf. *kuligae*			X		X	
Hyperolius marmoratus						
Hyperolius mosaicus	X					
Hyperolius nasutus					X	
Hyperolius ocellatus	X		X		X	
Hyperolius pardalis	X	X				
Hyperolius phantasticus	X		X			
Hyperolius platyceps			X		X	
Hyperolius tuberculatus		X	X		X	

Table 1 (continued from opposite page). / Tab. 1 (Fortsetzung von der gegenüberliegenden Seite).

Taxa / National Parks	Crystal	Ivindo	Loango	Lopé	Moukalaba-Doudou	Pongara
Hyperoliidae (continued)						
Kassina sp.					X	
Leptopelis aubryi	X		X	X	X	
Leptopelis boulengeri			X		X	
Leptopelis brevirostris	X					
Leptopelis calcaratus	X	X			X	
Leptopelis crystallinoron	X					
Leptopelis millsoni	X	X			X	
Leptopelis notatus		X			X	
Leptopelis ocellatus		X			X	
Leptopelis omissus			X	X		
Leptopelis rufus	X				X	
Leptopelis viridis						
Opisthothylax immaculatus						
Phlyctimantis cf. *boulengeri*	X					
Phlyctimantis leonardi		X	X	X	X	
Petropedetidae						
Dimorphognathus africanus		X	X	X	X	
Petropedetes newtoni	X			X	X	
Petropedetes palmipes	X					
Petropedetes parkeri	X					
Phrynobatrachus auritus		X	X	X	X	
Phrynobatrachus batesii		X				
Phrynobatrachus cornutus			X	X	X	
Phrynobatrachus ogoensis						
Pipidae						
Hymenochirus boettgeri		X	X		X	
Hymenochirus feae						
Silurana epitropicalis	X	X	X	X	X	
Xenopus andrei						
Xenopus fraseri		X	X		X	
Xenopus petersii					X	
Ranidae						
Amnirana albolabris		X	X	X	X	
Amnirana amnicola	X	X			X	
Amnirana lepus		X			X	
Aubria masako						
Aubria subsigillata		X			X	
Conraua crassipes	X	X		X	X	
Hoplobatrachus occipitalis			X		X	
Ptychadena aequiplicata		X	X	X	X	
Ptychadena mascareniensis						
Ptychadena perreti		X		X	X	
Ptychadena pumilio				X		
Rhacophoridae						
Chiromantis rufescens		X	X	X	X	
GYMNOPHIONA						
Caeciliidae						
Geotrypetes seraphini					X	
Herpele squalostoma					X	
Σ 88	27 (30) [1]	37 (38) [2]	29 (31) [3]	27 (28) [4]	57 (70) [5]	1

[1] LÖTTERS et al. (2001) and GOSSMANN et al. (2002) – *Ptychadena* sp. A, *P.* sp. B and *Hyperolius* sp. A not included in the park list, pending final identification.
[2] ANONYMOUS (no date) – "*Leptopelis knoepffleri*" not included.
[3] BURGER et al. (2006) – *Ptychadena* "sp. 2" and *P.* "sp. 3" not included.
[4] The *Phrynobatrachus* sp. said to be close to *P. batesii*, mentioned by OHLER (1999) and FRÉTEY & BLANC (2001: 386) not included, final identification pending.
[5] BURGER et al. (2006) – *Astylosternus* sp. 1, *Afrixalus* sp. 1, *A.* sp. 2, *Hyperolius* sp. 2, *H.* sp. 3, *Leptopelis* sp. 1, *Phrynobatrachus* sp. 1, *P.* sp. 2, *P.* sp. 3, *Ptychadena* sp. 1, *P.* sp. 3, *P.* sp. 4 not included; *Hyperolius* sp. 1 reidentified as *H. platyceps*, *Xenopus* cf. *laevis* as *X. petersii* (both reidentified by M. BURGER, pers. comm.).

2004; SCHIØTZ 1999): *Arthroleptis adelphus* (Cameroon, Equatorial Guinea, Gabon), *Cardioglossa gratiosa* (Cameroon, Equatorial Guinea, Gabon), *Hemisus perreti* (Congo Kinshasa, Gabon), *Alexteroon hypsiphonus* (Cameroon, Gabon, Congo Brazzaville), *A. obstetricans* (Cameroon, Equatorial Guinea, Gabon), *Hyperolius mosaicus* (Cameroon, Gabon), *Petropedetes newtoni* (Cameroon, Equatorial Guinea, Gabon), *P. palmipes* (Cameroon, Equatorial Guinea, Gabon), *P. parkeri* (Cameroon, Equatorial Guinea, Gabon), and *Amnirana amnicola* (Cameroon, Equatorial Guinea, Gabon). These 10 species are known from 2, 2, 2, 1, 1, 1, 3, 1, 1 and 3 Gabonese National Parks each. A special effort should thus be done so that populations of near-endemic species are known from as many parks as possible, searching in biotopes where they are known to occur. The possible presence of *Hemisus* (see BLANC & FRÉTEY 2004: 308; then probably *H. perreti*) in southern Lopé NP should be checked. The use of pitfall traps is by far the most effective collecting technique for *Hemisus* in Gabon, as well as for *Cardioglossa gratiosa* and *Arthroleptis adelphus* (see BURGER et al. 2006). *Petropedetes* spp. should be systematically inventoried by a day or night active search on rocks, along fast streams, and waterfalls in dense mature forest. The other species might be found by a night active search in dense forest, especially along streams.

CONCLUSIONS

It is clear that within the Gabonese National Parks many of the most promising sites are still to be prospected, and that the possibility of discovering more new species is very high, especially in Bateke Plateaux NP (potential additions of savanna species to the Gabonese batrachofauna), Mount Birougou NP and Waka NP (higher altitude zones with high potential for new species). All potentially interesting sites inside and outside the parks (particularly mountain tops, inselbergs, rifts, waterfalls and caves) should be systematically inventoried in the frame of multi-taxa surveys in order not to miss rare and endemic taxa. With an increase of more than 15 species within the last five years, there is an obvious indication that the Gabonese batrachofauna is not fully inventoried, especially when one considers that less than half of the National Parks were surveyed. Currently known global representation of the presently recorded Gabonese batrachofauna in the parks is very satisfactory, with 100% of the families, 91% of the genera (*Werneria*, *Chlorolius* and *Opisthothylax* missing, each locally represented by a single species), and 86% of the species. The global representation of near-endemics (100%) is extremely satisfying, but dedicated surveys should be conducted to ensure that they are represented by enough viable populations. Urgent actions are recommended for endemic amphibians, in particular for the three species (i.e., 50% of all Gabonese endemics) which are not yet known from any park. In case the distributions of these endemics prove to be limited to areas outside parks, appropriate conservation measures, such as the evaluation of and remediation to threats, population monitoring and eventually a request for establishing a sanctuary establishment should be done. The amphibian diversity known from the five presently surveyed parks, and that expected from most non-explored parks are high, with promotion of highly valued ecotourism.

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