

Rediscovery of the Mount Nimba Reedfrog, *Hyperolius nimbae* LAURENT, 1958, in western Ivory Coast

(Anura: Hyperoliidae)

Wiederentdeckung des Mount Nimba Riedfrosches, *Hyperolius nimbae* LAURENT, 1958
im Westen der Elfenbeinküste
(Anura: Hyperoliidae)

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KURZFASSUNG

Die vorliegende Arbeit berichtet über die Wiederentdeckung von *Hyperolius nimbae* LAURENT, 1958, einer Riedfroschart, die nur vom Fuß der östlichen Flanke des Mount Nimba im Westen der Elfenbeinküste bekannt ist. Die Art wurde 1958 beschrieben und 1963 zum letzten Mal beobachtet. Siebenundvierzig Jahre später wurden innerhalb des bekannten Verbreitungsgebietes, kleine Populationen dieses Riedfrosches in der Nähe der Dörfer Dagbonpleu, Danipleu, Kouan-Houlé und Zéalé wiederentdeckt. Allerdings konnten nur insgesamt sieben Exemplare registriert werden. Die Lebensräume zeigten unterschiedliche Grade der Degradierung von Sumpfwäldern bis zu Reisfeldern in degradiertem Wald oder Sekundärwuchs. Der starke menschliche Einfluß im Gebiet, besonders seine landwirtschaftliche Nutzung, könnte das langfristige Überleben der Art gefährden. Die Autoren empfehlen eine intensive weitere Suche nach bestehenden Populationen und deren Monitoring, um die Gefährdung für das Überleben von *H. nimbae* abzuschätzen.

ABSTRACT

The authors report the rediscovery of *Hyperolius nimbae* LAURENT, 1958, a reedfrog species known only from the lowlands of the eastern flanks of Mount Nimba, western Ivory Coast. The species was described in 1958 and last seen in 1963. Forty-seven years after that date small populations were rediscovered near four villages, Dagbonpleu, Danipleu, Kouan-Houlé and Zéalé, within the formerly known range. However, only a total of seven individuals were recorded. The habitats showed various degrees of degradation, ranging from swampy forest to rice fields within degraded forest and secondary growth. The strong anthropogenic impact, in particular agricultural activities, may be an imminent risk compromising the species' long-term survival. The authors recommend further intensive search for persisting populations and their monitoring to evaluate the factors threatening the survival of *H. nimbae*.

KEY WORDS

Amphibia: Anura: Hyperoliidae; *Hyperolius nimbae*, reedfrog, biodiversity hotspot, conservation status, Mount Nimba endemic, Côte d'Ivoire, Ivory Coast, Upper Guinea

INTRODUCTION

The Mount Nimba massif is located in the border region collectively shared by the West African countries Liberia, Guinea and Ivory Coast (LAMOTTE 1983, 1998). These mountains harbor a rich endemic fauna and flora (LAMOTTE & ROY 2003), including reptiles (INEICH 2003) and amphibians (RÖDEL et al. 2004). The amphibian fauna is dealt with in numerous publications. First

summaries were published by GUIBÉ & LAMOTTE (1958, 1963) and LAURENT (1958). The flagship species of the massif is the endemic Nimba Toad, *Nimbaphrynoides occidentalis* (ANGEL, 1943), the only truly viviparous anuran species worldwide (LAMOTTE 1959; XAVIER 1986; LAMOTTE & SANCHEZ-LAMOTTE 1999; HILLERS et al. 2008; SANDBERGER et al. 2010). Recently two frog spe-

cies were described from the Liberian part of the Nimba Massif (RÖDEL et al. 2009, 2010a).

One species believed to be endemic to the Ivorian foothills of the Nimba Mountains was described in 1958 by LAURENT from "Yanlé", Ivory Coast, under the name *Hyperolius viridiflavus nimbae*. In July 1963, the Danish herpetologist ARNE SCHIØTZ collected a larger series (28 males, 5 females) of the species between the Ivorian settlements Danané and Zéalé, approximately 40 km south-east of the Mount Nimba chain (SCHIØTZ 1967). SCHIØTZ (1967) raised LAURENT's (1958) taxon to species level, compared it to other treefrog species, provided first biological data and, in particular, wondered why the range of this species was so restricted as its habitat preferences seemed to be by no way particular. Later, LAURENT (1983) and SCHIØTZ (1971) considered this frog a subspecies of *Hyperolius tuberculatus* (MOCQUARD, 1897), a species otherwise known from western Central Africa (AMIET 2012; FRÉTEY et al. 2012). In a subsequent publication, SCHIØTZ (1999) again recognized *H. tuberculatus* and *H. nimbae* as distinct species. SCHIØTZ's observations from July 28, 1963 seem to be the latest encounters with the species in the wild.

Following the global awareness of a tremendous worldwide amphibian decline (e.g., BLAUSTein & KIESECKER 2002; FERRAZ et al. 2003; STUART et al. 2004, 2008; MOORE & CHURCH 2008), specula-

tions started recently about the possibility of the extinction of this reedfrog. Some attempts to locate the species at other sites of close proximity to the known area, e.g., the Mont Sangbé National Park (RÖDEL 2003) and Guinean parts of the Nimba mountains (J. DOUMBIA, L. SANDBERGER-LOUA & M.-O. RÖDEL, unpublished data), revealed no records.

Ivory Coast is quoted among the countries where rainforests are the most threatened in the world (HANSEN et al. 2013). As a result of large scale deforestation, almost 80 % of the forests in the western part of the country were destroyed up to the end of the last millennium (PARREN & DE GRAAF 1995; CHATELAIN et al. 1996). The only sites from where *H. nimbae* was known face severe anthropogenic impact. The former rainforest area is now largely dominated by an agricultural landscape (N. G. KOUAMÉ, pers. obs.).

In 2010, Conservation International initiated the campaign "Search For the Lost Frogs", focusing on the search for 100 amphibian species that have not been seen for decades, but scientists believe may have survived (compare e.g., ONADEKO et al. 2014 for a similar African example). Among these species, *H. nimbae*, not seen at that date for 47 years, was listed. This is why the authors decided to reinvestigate the known range of *H. nimbae* and its surroundings. The aim of the study was to rediscover the Nimba Reedfrog and find further persisting populations.

MATERIALS AND METHODS

Study area

Surveys took place in the Danané region of western Ivory Coast, south-east of the Nimba Mountains. Mean annual temperature in Danané (342 m a.s.l.) is 25.1 °C; mean annual precipitation 1,967 mm. The rainy season lasts between seven and nine months, with maximum precipitation in September; January is the driest month (CLIMATE-DATA.ORG 2015). The south- and central-western part of Ivory Coast is naturally covered by a mosaic of lowland rain-

forest and smaller mountains. The regions of Man and Danané are characterized by swampy valleys between granite outcrops, so-called inselbergs (MOUTON 1959). The surveyed sites comprised high grass areas, farmland and degraded forests. Large parts of this forest zone are subject to logging activities. Field work was done at the beginning of the core rainy season from 26 August to 1 September 2010. A hand-held GPS device (Garmin 12XL) was used to record the geographical positions of the study sites (Table 1).

Table 1: Record localities of *Hyperolius nimbae* LAURENT, 1958, in the Danané region, western Ivory Coast, including date and time of recording, number of frogs encountered and short habitat description (see Fig. 1).
 Tab. 1: Fundorte von *Hyperolius nimbae* LAURENT, 1958 in der Danané Region, westliche Elfenbeinküste mit Datum und Uhrzeit der Nachweise, Anzahl der Frösche und kurzer Habitatbeschreibung (siehe Abb. 1).

Village / Ort	Geographical position / Fundortkoordinaten	Date/Time Datum/Uhrzeit	Number of recorded frogs/ Festgestellte Individuenzahl	Habitat description / Habitatbeschreibung
Zéalé	N0°25.978'; W08°17.285';	27.08.2010 at 19:11 h	1 calling male	Clearing in a swampy forest situated app. 150 m of human settlement, water surface (length app. 10 m, width app. 4.5 m, depth ≥ 1.5 m) covered by algae, trees (3-4 m high), canopy cover about 60 % (Fig. 1a)
Kouan-Houlé	N0°23.535'; W08°15.827';	28.08.2010 at 20:09 h	1 calling male	Large thick shrubby/herbaceous swamp (depth between 0.7-1 m close to a rice paddy, shrubs (2-3 m high) (Fig. 1b)
Dagbonpleu	N0°26.911'; W08°23.209';	30.08.2010 at 20:15 h	1 calling male	Farmbush vegetation, small farms, swamps bordered by shrubs and grasses in a ravine
Danipleu	N0°29.790'; W08°24.481';	1.09.2010 at 21:33 h	4 calling males (including 1 male captured)	Thick shrubs, app. 7 km of the Nimba Mountain range near the Liberian border, paddy field (Fig. 1c), degraded forest (Fig. 1d), wide pond (length app. 35 m, width app. 18 m, depth app. 0.7 m) dominated by floating aquatic plants (<i>Nymphaea</i> spp.) and bordered by grass, shrubs and trees, distance to village app. 250 m

Field work and vouchers

Searching techniques included acoustic and visual encounter surveys by day and night. All available habitats were examined by three people (N.G.K. and two field assistants) who searched for frogs on seven days (26 August to 1 September), eight hours (07:00-11:00 and 18:00-22:00 GMT) per day, i.e., 168 person hours. After capture, frogs were measured and sexed. Morphometric measurements were taken by one person (N.G.K.) with a dial calliper (accuracy ± 0.5 mm). They are given in mm and comprise snout-urostyle-length (SUL), width of head behind eyes, length of head, width of gular gland (thickened skin on vocal sac), length of femur, length of tibia-fibula, length of foot including longest toe, horizontal eye diameter, horizontal tympanum diameter, interorbital space, internarial space, distance from anterior corner of eye to nostril, distance from nostril to tip of snout. Other characters recorded included skin structure and color pattern. Apart from the target taxa, all other syntopic amphibian species were registered. Vouchers were euthanized in a 1,1,1-trichloro-2-methyl-2-propanol hemihydrate solution and thereafter preserved in 70 % ethanol. Voucher specimens are deposited in the research collection of N.G.K. at the Jean Lorougnon Guédé University, Daloa, Ivory Coast.

RESULTS

The authors found the Nimba Reed-frog in Zéalé, Kouan-Houlé (east of Zéalé) and two other villages west of Zéalé: Dagbonpleu and Danipleu. Altogether, seven calling male *Hyperolius nimbae* (Table 1; Fig. 1) were heard. However, only one of them (from Danipleu) was detected and captured. The others remained unseen in swampy habitats difficult to access.

The advertisement calls of an adult male at Zéalé consisted of a series of metallic click sounds that came from a clearing within a swampy forest (Fig. 1a). The frog seemed to call (after 19:00 GMT) perched between leaves on a tree, about three meters above the water surface of a pond (surface app. 200 m²) which was covered by algae;

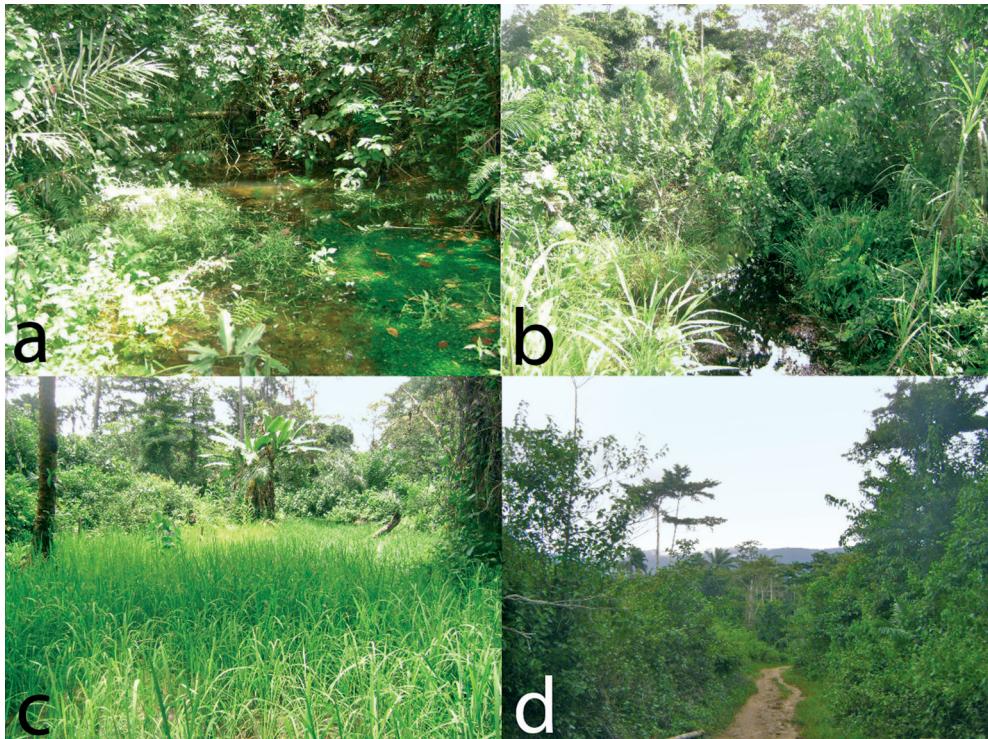


Fig. 1: Habitats of *Hyperolius nimbae* LAURENT, 1958, in the surveyed area; a – clearing in a swampy forest at Zéalé; b – thick shrubs with herbaceous swamps; c – paddy field within a degraded forest (site where the single male *H. nimbae* was captured); d – thick secondary growth with a dirt road leading to the Nimba Mountain range (in the background).

Abb. 1: Lebensräume von *Hyperolius nimbae* LAURENT, 1958; a – Lichtung in einem Sumpfwald bei Zéalé; b – dichtes Gestrüpp mit von Kräutern bewachsenem Sumpf; c – Reisfeld in einem degradierten Wald (hier wurde das einzige Individuum von *H. nimbae* gefangen); d – dichter Sekundärwuchs mit einer Piste, die zum Mount Nimba Massiv führt (sichtbar im Hintergrund).

water depth was ≥ 1.5 m. The site had an open canopy, was surrounded by heavily degraded forest and located 150 m from a settlement. Syntopic treefrog species were *Chiromantis rufescens* (GÜNTHER, 1869), *Leptopelis spiritusnoctis* RÖDEL, 2007 and *Kassina cochranae* (LOVERIDGE, 1941) (Table 2). At Kouan-Houlé, *H. nimbae* was heard calling after dusk (19:04 GMT). This site was characterized by thick shrubs, a swamp with dense herbaceous vegetation and a nearby paddy field. The calls seemed to come from a shrub at two meters above the ground. Syntopic treefrog species at this site were *Arixalus dorsalis* (PETERS, 1875), *Hyperolius concolor* (HALLOWELL, 1844),

Hyperolius fusciventris PETERS, 1876 and *Hyperolius guttulatus* GÜNTHER, 1858. At Dagbonpleu, a male was heard at night (20:12 GMT) outside the village at a site dominated by farms and swamps. Syntopic treefrogs were *A. dorsalis*, *H. concolor*, *Hyperolius picturatus* PETERS, 1875, and *H. guttulatus*.

Close to Danipleu village, near the Liberian border, approximately seven km east of the Nimba Mountain (Figs. 1c, 1d), four male *H. nimbae* were heard calling on 1 September 2010 around 21:33 h during a heavy rainfall. The site consisted of a pond and paddies surrounded by degraded forest and thick shrubby vegetation. One male

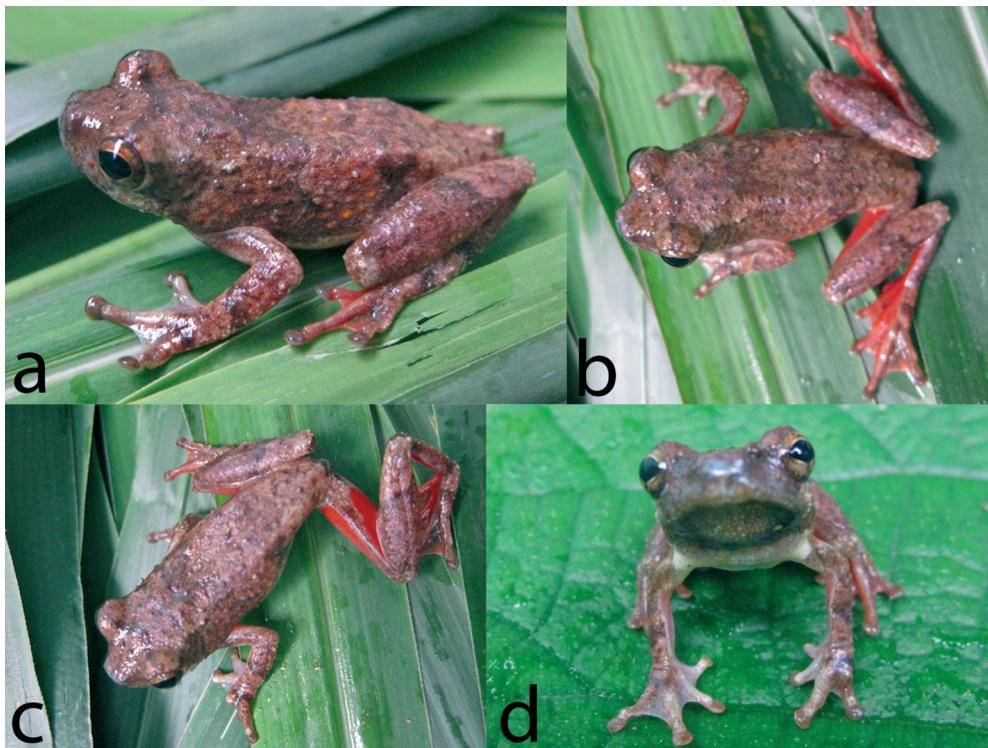


Fig. 2: Male *Hyperolius nimbae* LAURENT, 1958, from Danipleu, a village situated seven km south-east to Mount Nimba, western Ivory Coast; note the warty dorsal skin and reddish thighs.

Abb. 2: Männchen von *Hyperolius nimbae* LAURENT, 1958 aus Danipleu, einem Dorf in der westlichen Elfenbeinküste, ca. sieben km südöstlich des Mount Nimba; man beachte die warzige Rückenhaut und die roten Hautpartien der Oberschenkel.

was captured when perched at breast height on a shrub at the edge of a paddy. The other individuals stopped calling upon the approach of their calling sites situated at a large pond, in part covered by floating aquatic plants (*Nymphaea* spp.) and bordered by grass. The syntopic treefrog species encountered were *H. concolor*, *H. fusciventris* (calling males very abundant) and *A. dorsalis*.

The captured male (NGK-NIMBA01) measured 33.0 mm SUL, thus being within the known range of *H. nimbae* (SCHIØTZ 1967): head slightly longer (11.0 mm) than broad (9.0 mm); interorbital space 6.5 mm; distance between eye and nostril (2.5 mm) exceeded distance from nostril to tip of snout (1.5 mm); eye diameter (4.5 mm)

larger than internarial space (3.5 mm) and tympanum diameter (2.5 mm); width of the oval gular gland 9.0 mm; tibia-fibula length (16.0 mm), slightly exceeding femur length (14.0 mm); foot length including longest toe 21.5 mm.

The color pattern in life was within the range of phase F *sensu* SCHIØTZ (1967) and is well visible on Figures 2a-2d and 3a-3b. Discs on toes were small and slightly reddish to greenish. The webbing was well-developed between toes and fingers (Figs. 2b, 2d). The dorsal skin was coarsely granulated with numerous dark brown and few orange spots (Figs. 2a-2c, 3a). The hidden skin parts of the thighs, as well as all lower parts of the hind limbs were red. The throat was greenish brown, the gular gland dark

Table 2: Anuran species recorded in the Danané area, including site (see Table 1), general habitat preference, distribution range and IUCN Red List category. Dag – Dagbonpleu, Dan – Danipleu, Kou – Kouan-Houlé, Zéa – Zéalé, S – savannah, FB – farmbush (degraded forest and farmland), F – forest, A – Africa (occurs also outside West Africa), WA – West Africa (defined as the area West of the Cross River in Nigeria, see PENNER et al. 2011), UG – Upper Guinea (forest zone west of the Dahomey Gap), E – Endemic to Ivory Coast, * – taxon comprises a complex of several species, ** – records comprise several species (based on acoustics; morphology indistinguishable; see RÖDEL & BANGOURA 2004), LC – Least Concern, NT – Near Threatened, EN – Endangered.

Tab. 2: Nachweise von Anurenarten aus der Danané Region. Angegeben sind Fundort (siehe Tab. 1), bevorzugter Lebensraum, Verbreitungsgebiet und IUCN Rote Listen Kategorie. Dag – Dagbonpleu, Dan – Danipleu, Kou – Kouan-Houlé, Zéa – Zéalé, S – Savanne, FB – degradierter Wald und Sekundärwuchs, F – Wald, A – Afrika (kommt auch außerhalb Westafrikas vor), WA – Westafrika (definiert als das Gebiet westlich des Cross Rivers in Nigeria, siehe PENNER et al. 2011), UG – Upper Guinea (Waldzone westlich der Dahomey Regenwaldlücke), E – endemisch für die Elfenbeinküste, * – Komplex kryptischer Arten, ** – Nachweise umfassen mehrere Arten (unterschieden nach Akustik; morphologisch nicht unterscheidbar; siehe RÖDEL & BANGOURA 2004), LC – Least Concern, NT – Near Threatened, EN – Endangered.

Family / Species Familie / Art	Site / Fundort	Habitat S FB F						Distribution range / Verbreitung A WA UG	IUCN Red List Category
		A	WA	UG	E				
Arthroleptidae									
<i>Arthroleptis</i> spp.**	Zéa	X	X			X			LC
<i>Astylosternus occidentalis</i> PARKER, 1931	Kou		X	X		X	X		LC
<i>Leptopelis spiritusnoctis</i> RÖDEL, 2007	Kou, Zéa	X	X			X			LC
<i>Leptopelis occidentalis</i> SCHIÖTZ, 1967	Zéa		X	X		X	X		NT
Bufo nidae									
<i>Amietophryne maculatus</i> (HALLOWELL, 1854)	Dag, Kou, Zéa	X	X			X			LC
<i>Amietophryne regularis</i> (REUSS, 1833)	Kou, Zéa	X	X			X			LC
Dicroglossidae									
<i>Hoplobatrachus occipitalis</i> (GÜNTHER, 1858)	Dag, Zéa	X	X			X			LC
Hemisotidae									
<i>Hemisus marmoratus</i> (PETERS, 1854)	Dag, Zéa	X	X			X			LC
Hyperoliidae									
<i>Afrixalus dorsalis</i> (PETERS, 1875)	Dag, Dan, Kou, Zéa	X	X			X			LC
<i>Afrixalus fulfovittatus</i> <i>fulfovittatus</i> (COPE, 1861)	Kou, Zéa	X	X				X		LC
<i>Hyperolius concolor</i> <i>concolor</i> (HALLOWELL, 1844)	Dan, Kou, Zéa	X	X				X		LC
<i>Hyperolius fusciventris</i> <i>fusciventris</i> PETERS, 1876	Dan, Dag, Kou, Zéa		X	X			X		LC
<i>Hyperolius guttulatus</i> GÜNTHER, 1858	Dag, Kou, Zéa		X	X		X			LC
<i>Hyperolius lamottei</i> LAURENT, 1958	Kou	X				X	X		LC
<i>Hyperolius igbettensis</i> SCHIÖTZ, 1963	Kou, Zéa	X				X			LC
<i>Hyperolius nimbae</i> LAURENT, 1958	Dan, Dag, Kou, Zéa		X				X		EN
<i>Hyperolius picturatus</i> PETERS, 1875	Dag, Kou, Zéa	X	X				X		LC
<i>Kassina cochranae</i> (LOVERIDGE, 1941)	Dan, Kou, Zéa	X				X			NT
Phrynobatrachidae									
<i>Phrynobatrachus fraterculus</i> (CHABANAUD, 1921)	Kou		X	X			X		LC
<i>Phrynobatrachus gutturosus</i> (CHABANAUD, 1921)*	Dan, Dag, Zéa	X	X	X			X		LC
<i>Phrynobatrachus latifrons</i> AHL, 1924	Dan, Dag, Kou, Zéa	X	X			X			LC
<i>Phrynobatrachus liberiensis</i> BARBOUR & LOVERIDGE, 1927	Zéa		X				X		NT
<i>Phrynobatrachus phyllophilus</i> RÖDEL & ERNST, 2002	Dag, Kou		X				X		NT
<i>Phrynobatrachus plicatus</i> (GÜNTHER, 1858)	Dag, Kou, Zéa		X	X		X			LC
<i>Phrynobatrachus natalensis</i> (SMITH, 1849)	Dag, Zéa		X	X	X				LC
<i>Phrynobatrachus tokba</i> (CHABANAUD, 1921)	Dan, Dag, Zéa		X	X		X			LC
Pipidae									
<i>Xenopus tropicalis</i> (GRAY, 1864)	Dan, Kou, Zéa	X	X	X					LC

Table 2 (continued from the opposite page): Anuran species recorded in the Danané area.

Tab. 2 (Fortsetzung der gegenüberliegenden Seite): Nachweise von Anurenarten aus der Danané Region.

Family / Species Familie / Art	Site / Fundort	Habitat Distribution range / Verbreitung						IUCN Red List Category
		S	FB	F	A	WA	UG	
Ptychadenidae								
<i>Ptychadena longirostris</i> (PETERS, 1870)	Dag, Kou, Zéa			X		X		LC
<i>Ptychadena mascareniensis</i> (DUMÉRIL & BIBRON, 1841)*	Dan, Kou, Zéa	X	X		X			LC
<i>Ptychadena pumilio</i> (BOULENGER, 1920)	Dag, Kou	X	X		X			LC
Pyxicephalidae								
<i>Aubria subsigillata</i> (DUMÉRIL, 1856)	Dan, Zéa				X	X		LC
Ranidae								
<i>Hylarana albolabris</i> (HALLOWELL, 1856)	Kou, Zéa			X	X	X		LC
Rhacophoridae								
<i>Chiromantis rufescens</i> (GÜNTHER, 1869)	Zéa			X	X			LC

greyish-yellow and coarsely granulated (Fig. 3b). The remaining ventral skin was white.

During the seven-day survey in the Danané region, the authors recorded at least 33 amphibian species; a list with site records, known habitat preference, distribu-

tion range and the IUCN Red List category is given (Table 2). More than one third (13 spp., 39.4 %) of all recorded species are endemic to the Upper Guinea forest zone (forests west of the Dahomey Gap), while *H. nimbae* was the only recorded species endemic to the Nimba Mountains.

DISCUSSION

Frogs living in farmbush (degraded forest and farmland) habitats are believed to be comparatively widespread and abundant (see examples in SCHIÖTZ 1967; RÖDEL 2000; AMIET 2012). *Hyperolius nimbae* is such a farmbush species, probably related to the forest zone but living in degraded habitats. According to SCHIÖTZ (1967) *H. nimbae* was abundant, and already then seemed to be restricted to a small area in a forested region south-east of the Nimba Range. In absence of a distinct geographic barrier, the spatial restriction of the range was not understood, the more so as the species obviously tolerated degraded habitats.

The present account details the species' rediscovery, 52 years after its description and 47 years after it has been seen for the last time in the wild. All four observation sites mentioned here are within the formerly known range. SCHIÖTZ (1967) reported that the species was patchily distributed, but abundant where it occurred. In

particular, he reported numerous *H. nimbae* from two sites at presumably temporary swamps within clearings surrounded by high grass. The area at that time was already heavily cultivated, although neighboring the dense and humid forest of the Mount Nimba massif. The frog fauna which he recorded from that area reflects the mixture of primary forest (e.g., *Kassina lamottei* SCHIÖTZ, 1967, *Leptopelis macrotis* SCHIÖTZ, 1967, *Afrixalus nigeriensis* SCHIÖTZ, 1963) and farmbush habitats (e.g., *Kassina cochranae*, *Leptopelis spiritusnoctis*, *A. dorsalis*) at that time. Another frog species mentioned by SCHIÖTZ (1967) for the *H. nimbae* sites, is *H. concolor*, however, being less abundant than the Nimba Reedfrog. *Hyperolius concolor* is a typical farmbush species (SCHIÖTZ 1967; RÖDEL 2000) and was also recorded at three of the four new *H. nimbae* sites.

At present, the entire area is largely dominated by agricultural land. The remain-

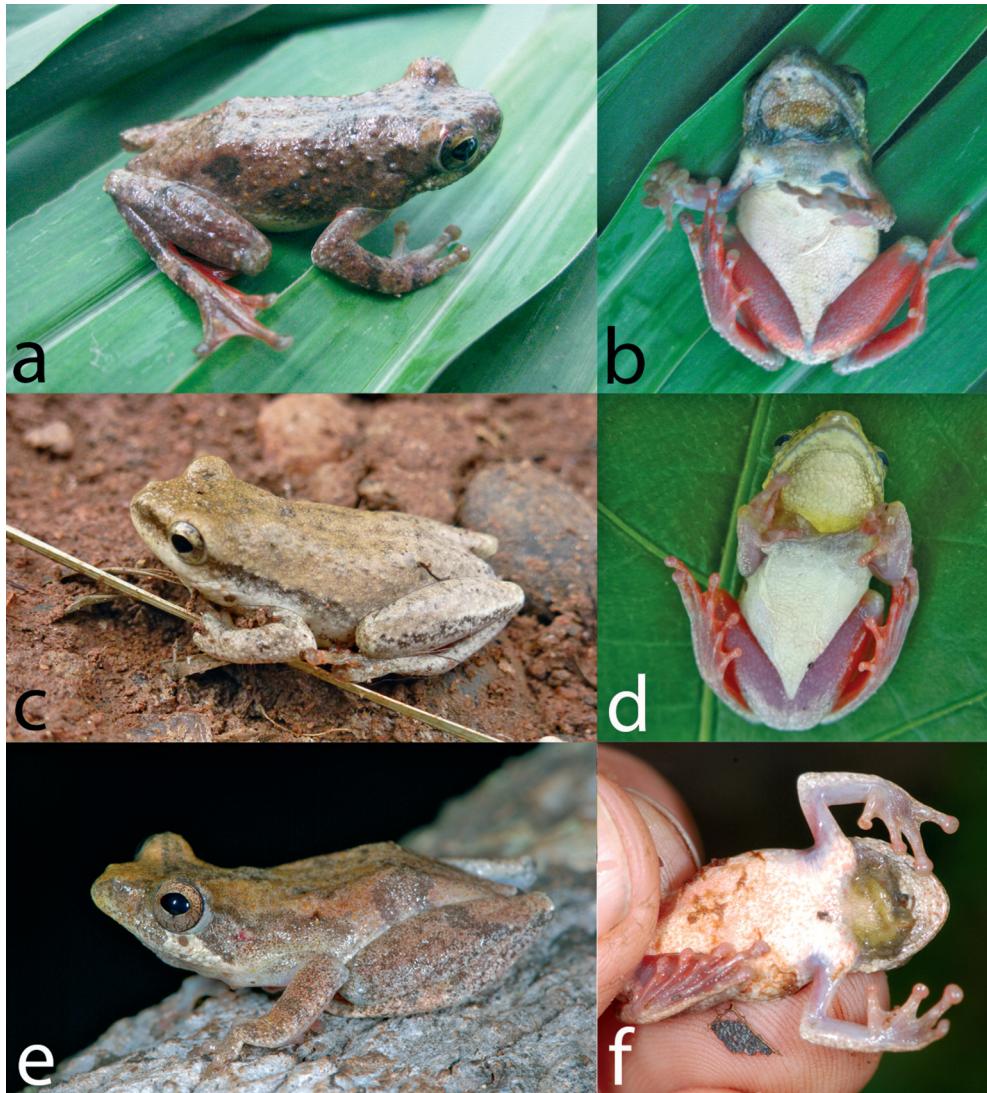


Fig. 3: Life coloration of an adult male *Hyperolius nimbae* LAURENT, 1958, and two *Hyperolius* species to which *H. nimbae* was previously assigned at the subspecies level,
i.e., *Hyperolius nitidulus* PETERS, 1875, and *Hyperolius tuberculatus* (MOCQUARD, 1897);
a – dorsolateral view of *H. nimbae* male, color pattern phase F from Danipleu, Danané, remark the
coarsely granulated skin; b – ventral view of *H. nimbae*, throat greenish brown with smaller,
roundish, dark greyish-yellow gular gland flap; c – dorsolateral view of *H. nitidulus* male
from Daloa urban area (central-western Ivory Coast), remark the numerous small warts on skin;
d – ventral view of *H. nitidulus*, throat yellow with very large yellow gular gland;
e – dorsolateral view of *H. tuberculatus* male from near Dja forest, Cameroon, remark the granular skin;
f – ventral view of *H. tuberculatus*, throat white and gular gland greenish-brown.

Abb. 3: Lebendfärbung von männlichen *Hyperolius nimbae* LAURENT, 1958
und zwei anderen Riedfroscharten, denen *H. nimbae* früher als Unterart zugeordnet war,
Hyperolius nitidulus PETERS, 1875 und *Hyperolius tuberculatus* (MOCQUARD, 1897);
a – Dorsolateralansicht von *H. nimbae* (Männchen der Farbvariante F) aus Danipleu, Danané,

ing forests show clear traces of previous and ongoing human impact, e.g., logging, roads and tracks, absence of a closed canopy and clearings in forested parts. The Nimba Reedfrog was rediscovered in similar habitats as originally described by SCHIØTZ (1967), however, the sites were probably even more degraded, and the frogs much lower in number. This low number may have different reasons. SCHIØTZ (1967) observed the species late in July, the authors' records date from end of August, early September. Differences in abundances thus may be due to the breeding phenology, although this is not a very likely explanation as most West African *Hyperolius* species are prolonged breeders, being present at the breeding sites for most of the rainy season (SCHIØTZ 1967; RÖDEL 2000). Nevertheless, the numbers of calling males can vary from day to day, e.g., correlated with actual precipitation (KOUAMÉ and RÖDEL, unpublished data). The current findings, thus do not allow to judge or comment on potential population trends. More in-depth assessments of the distribution and abundance of the Nimba Reedfrog in the Danané area are thus desirable.

As outlined in the introduction, *H. nimbae* has a variable taxonomic history, being regarded as a distinct species or subspecies to different *Hyperolius* species (Fig. 4). Whereas, SCHIØTZ (1999) finally regarded it a species of its own, AMIET (2012) considers still possible that *H. nimbae* is a West African population of *H. tuberculatus*, representing another typical example of the distribution pattern of what he terms “parasylvicole” species, which occur at both forest edge and degraded forest habitats. Indeed some of these species such as *A. dorsalis* and *H. fusciventris* occur in both West and Central Africa. However, many other West African forest and forest-related species do not occur in Central Africa (see

e.g., PENNER et al. 2011; RÖDEL et al. 2014). In contrast to the species mentioned by AMIET (2012), *H. nimbae* is an extremely range-restricted taxon and not known to occur outside its minute range on the eastern foothills of Mount Nimba. The high rate of endemism at this mountain range is usually explained by the mountain's supposed role as a Pleistocene forest refugium (e.g., PARREN & DE GRAAF 1995; MALEY 1996; POORTER et al. 2004), which could account for the small range of *H. nimbae*.

Unfortunately there is no tissue available appropriately preserved to test for the phylogenetic relationships of *H. nimbae* with other West and Central African *Hyperolius*. However, the following traits support the assumption that *H. nimbae* is indeed a valid species (compare SCHIØTZ 1967, 1999; RÖDEL 2000; RÖDEL et al. 2010b; AMIET 2012): (i) its restricted range at this particular mountain area, (ii) the acoustic differences to *H. nitidulus* PETERS, 1875, and *H. tuberculatus* (*H. nitidulus*: single note calls; *H. nimbae* and *H. tuberculatus*: multinote calls, the notes of *H. tuberculatus* being repeated at a higher rate but lower frequency; see SCHIØTZ 1999), (iii) differences in size (SUL of adult males: *H. nitidulus*: 23-26 mm, *H. nimbae*: 30-37 mm, *H. tuberculatus*: 28-32 mm; SCHIØTZ 1999; RÖDEL 2000) and (iv) skin morphology under wet season conditions (*H. nitidulus*: smooth; *H. tuberculatus*: granular; *H. nimbae*: granular with protruding round warts, compare Fig. 3), as well as (v) different habitat requirements (farmbush: *H. nimbae*, *H. tuberculatus*; savannah: *H. nitidulus*).

As all natural habitats in the minute *H. nimbae* range are under high anthropogenic pressure, the current IUCN Red List classification “Endangered” (SCHIØTZ & RÖDEL 2004), is likely to call for reassessment towards “Critically Endangered”. Further surveys will have to estimate the population

(Abb. 3. Fortsetzung des Abbildungstextes der gegenüberliegenden Seite)

man beachte die stark granulierte Haut; b – Ventralansicht von *H. nimbae*, Kehle grünlich-braun mit kleiner, rundlicher und dunkel-gelbgrauer Kehldrüse; c – Dorsolateralansicht eines *H. nitidulus* Männchens aus dem Stadtgebiet von Daloa (westliche zentrale Elfenbeinküste), man beachte die kleinen Warzen auf der Haut; d – Ventralansicht von *H. nitidulus*, Kehle gelb mit sehr großer gelber Kehldrüse; e – Dorsolateralansicht von *H. tuberculatus*, Männchen aus der Nähe des Dja Waldes, Kamerun, man beachte die granulierte Haut; f – Ventralansicht von *H. tuberculatus*, Kehle weiß und Kehldrüse grünlich-braun.

size as a basis for population monitoring. The authors thus urge further intensive

search for this species and argue for the subsequent protection of its habitats.

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REFERENCES

- AMIET, J.-L. (2012): Les rainettes du Cameroun.- Nyons & Saint Nazaire (Édition J.-L. Amiet & La Nef des Livres), pp. 591.
- BLAUSTEIN, A. R. & KIESECKER, J. M. (2002): Complexity in conservation: Lessons from the global decline of amphibian populations.- Ecology Letters, Oxford; 5: 597-608.
- CHANNING, A. & HOWELL, K. M. (2006): Amphibians of East Africa.- New York (Cornell University Press), pp. 418.
- CHATELAIN, C. & GAUTIER, L. & SPICIGHER, R. (1996): A recent history of forest fragmentation in southwestern Ivory Coast.- Biodiversity and Conservation, Dordrecht; 5: 37-53.
- CLIMATE-DATA.ORG (2015): Klima: Danané. WWW document available at <<http://de.climate-data.org/location/58626/>> [last accessed on June 13, 2015].
- FERRAZ, G. & RUSSELL, G. J. & STOUFFER, P. C. & BIERREGAARD, R. O. & PIMM, S. L. & LOVEJOY, T. E. (2003): Rates of species loss from Amazonian forest fragments.- Proceedings of the National Academy of Sciences of the United States of America, Washington; 100: 14069-14073.
- FRÉTEY, T. & DEWYNTER, M. & BLANC, C. (2012): Amphibiens d'Afrique centrale et d'Angola – Clé de détermination illustrée des amphibiens du Gabon et du Mbini. Paris (Biotope, Mèze, Collection Parthénope), pp. 232.
- GUIBÉ, J. & LAMOTTE, M. (1958): La réserve naturelle intégrale du Mont Nimba. XII. Batraciens (sauf *Arthroleptis*, *Phrynobatrachus* et *Hyperolius*).- Mémoire de l'Institut Fondamental d'Afrique Noire, Dakar; 53: 241-273.
- GUIBÉ, J. & LAMOTTE, M. (1963): La réserve naturelle intégrale du Mont Nimba. XXVIII. Batraciens du genre *Phrynobatrachus*.- Mémoire de l'Institut Fondamental d'Afrique Noire, Dakar; 66: 601-627.
- HANSEN, M. C. & POTAPOV, P. V. & MOORE, R. & HANCHER, M. & TURUBANOVA, S. A. & TYUKAVINA, A. & THAU, D. & STEHMAN, S. V. & GOETZ, S. J. & LOVELAND, T. R. & KOMMAREDDY, A. & EGOROV, A. & CHINI, L. & JUSTICE, C. O. & TOWNSHEND, J. R. G. (2013): High-resolution global maps of 21st-century forest cover change.- Science, Washington; 345: 850-853.
- HILLERS, A. & LOUA, N.-S. & RÖDEL, M.-O. (2008): Assessment of the distribution and conservation status of the viviparous toad *Nimbaphrynoides occidentalis* on Monts Nimba, Guinea.- Endangered Species Research, Oldendorf/Luhe; 5: 13-19.
- INEICH, I. (2003): Contribution à la connaissance de la biodiversité des régions afro-montagnardes: les reptiles du Mont Nimba; pp. 174-179. In: LAMOTTE, M. & ROY, R. (Eds.): Le peuplement animal du mont Nimba (Guinée, Côte d'Ivoire, Liberia).- Mémoire du Muséum National d'Histoire Naturelle, Paris; 190.
- LAMOTTE, M. (1959): Observations écologiques sur les populations naturelles de *Nectophrynoides occidentalis* (Fam. Bufonidae).- Bulletin Biologique de la France et de la Belgique, Paris; 93: 355-413.
- LAMOTTE, M. (1983): The undermining of Mount Nimba.- Ambio, Secaucus; 12: 174-179.
- LAMOTTE, M. (1998): Le Mont Nimba. Réserve de la biosphère et site du patrimoine mondial (Guinée et Côte d'Ivoire). Initiation à la géomorphologie et à la biogéographie. Paris (UNESCO Publishing), pp. 153.
- LAMOTTE, M. & ROY, R. (2003): Le peuplement animal du Mont Nimba (Guinée, Côte d'Ivoire, Liberia).- Mémoires du Muséum National d'Histoire Naturelle, Paris; 190: 1-724.
- LAMOTTE, M. & SANCHEZ-LAMOTTE, C. (1999): Adaptation aux particularités climatiques du cycle biologique d'un anoure tropical, *Nectophrynoides occidentalis* ANGEL, 1943 (Bufonidae).- Alytes, Paris; 16: 111-122.
- LAURENT, R. F. (1958): Les rainettes du genre *Hyperolius*.- Mémoires de l'Institut Fondamental d'Afrique Noire, Dakar; (Série A) 53: 275-299, 3 plates.
- LAURENT, R. F. (1983): La supersetpe *Hyperolius viridiflavus* (DUMÉRIL & BIBRON, 1841) (Anura Hyperoliidae) en Afrique Centrale.- Monitore Zoológico Italiano. Nuova Serie, Supplemento, Firenze; 18: 1-93.
- MALEY, J. (1996): The African rain forest – main characteristics of changes in vegetation and climate from the Upper Cretaceous to the Quaternary.- Proceedings of the Royal Society of Edinburgh, Edinburgh; (B) 104: 31-73.
- MOORE, R. D. & CHURCH, D. R. (2008): Implementing the Amphibian Conservation Action Plan.- International Zoo Yearbook, London; 42: 1-9.
- MOUTON, J. A. (1959): Riziculture et déforestation dans la région de Man, Côte d'Ivoire.- L'Agronomie Tropicale, Paris etc.; 14: 225-231.
- ÖNADEKO, A. B. & RÖDEL, M.-O. & LIEDTKE, H. C. & BAREJ, M. F. (2014): The rediscovery of Perret's toad, *Amietophryne perreti* (SCHIØTZ, 1963) after more than 40 years, with comments on the species'

- phylogenetic placement and conservation status.- Zoosystematics and Evolution, Sofia; 90: 113-119.
- PARREN, M. P. E. & DE GRAAF, N. R. (1995): The quest for natural forest management in Ghana, Côte d'Ivoire and Liberia. Wageningen (The Tropenbos Foundation), Tropenbos Series 13, pp. 199.
- PENNER, J. & WEGMANN, M. & HILLERS, A. & SCHMIDT, M. & RÖDEL, M.-O. (2011): A hotspot revisited – a biogeographical analysis of West African amphibians.- Diversity and Distributions, Oxford; 17: 1077-1088.
- POORTER, L. & BONGERS, F. & LEMMENS, R. H. M. J. (2004): West African forests: introduction; pp. 5-14. In: POORTER, L. & BONGERS, F. & KOUAMÉ, F. N. & HAWTHORNE, W. D. (Eds.): Biodiversity of West African forests: an ecological atlas of woody plant species. Cambridge (CABI Publishing MA).
- RÖDEL, M.-O. (2003): The amphibians of Mont Sangbé National Park, Ivory Coast.- Salamandra, Rheinbach; 39: 91-112.
- RÖDEL, M.-O. & BANGOURA, M. A. (2004): A conservation assessment of amphibians in the Forêt Classée du Pic de Fon, Simandou Range, southeastern Republic of Guinea, with the description of a new *Amniranana* species (Amphibia Anura Ranidae).- Tropical Zoology, London etc.; 17: 201-232.
- RÖDEL, M.-O. & BANGOURA, M. A. & BÖHME, W. (2004): The amphibians of south-eastern Republic of Guinea (Amphibia: Gymnophiona, Anura).- Herpetozoa, Wien; 17: 99-118.
- RÖDEL, M.-O. & DOUMBIA, J. & JOHNSON, A. T. & HILLERS, A. (2009): A new small *Arthroleptis* (Amphibia: Anura: Arthroleptidae) from the Liberian part of Mount Nimba, West Africa.- Zootaxa, Auckland; 2302: 19-30.
- RÖDEL, M.-O. & EMMRICH, M. & PENNER, J. & SCHMITZ, A. & BAREJ, M. F. (2014): The taxonomic status of two West African *Leptopelis* species: *L. macrotis* SCHIÖTZ, 1967 and *L. spiritusnoctis* RÖDEL, 2007 (Amphibia: Anura: Arthroleptidae).- Zoosystematics and Evolution, Sofia; 90: 21-31.
- RÖDEL, M.-O. & OHLER, A. & HILLERS, A. (2010a): A new extraordinary *Phrynobatrachus* (Amphibia: Anura: Phrynobatrachidae) from West Africa.- Zoosystematics and Evolution, Sofia; 86: 257-261.
- RÖDEL, M.-O. & SANDBERGER, L. & PENNER, J. & MANÉ, Y. & HILLERS, A. (2010b): The taxonomic status of *Hyperolius spatzii* AHL, 1931 and *Hyperolius nitidulus* PETERS, 1875 (Amphibia: Anura: Hyperoliidae).- Bonn Zoological Bulletin, Bonn; 57: 177-185.
- SANDBERGER, L. & HILLERS, A. & DOUMBIA, J. & LOUA, N.-S. & BREDE, C. & RÖDEL, M.-O. (2010): Rediscovery of the Liberian Nimba toad, *Nimbaphrynoides liberiensis* (XAVIER, 1978) (Amphibia: Anura: Bufonidae), and reassessment of its taxonomic status.- Zootaxa, Auckland; 2355: 56-68.
- SCHIÖTZ, A. (1967): The treefrogs (Rhacophoridae) of West Africa.- Spolia zoologica Musei Hauniensies, København; 25: 1-346.
- SCHIÖTZ, A. (1971): The superspecies *Hyperolius viridiflavus* (Anura).- Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening, København; 134: 21-76.
- SCHIÖTZ, A. (1999): The treefrogs of Africa.- Frankfurt am Main (Edition Chimaira), pp. 350.
- SCHIÖTZ, A. & RÖDEL, M.-O. (2004): *Hyperolius nimbae*.- IUCN 2013, Red List of Threatened Species. Version 2014.3. WWW document available at < www.iucnredlist.org >. Last accessed on May 21, 2015.
- STUART, S. N. & CHANSON, J. S. & COX, N. A. & YOUNG, B. E. & RODRIGUES, A. S. L. & FISCHMAN, D. L. & WALLER, R. W. (2004): Status and trends of amphibian declines and extinctions worldwide.- Science, Washington; 306: 1783-1786.
- STUART, S. N. & HOFFMANN, M. & CHANSON, J. S. & COX, N. A. & BERRIDGE, R. J. & RAMANI, P. & YOUNG, B. E. (2008): Threatened amphibians of the World.- Barcelona (Lynx Edicions), pp. 758.
- XAVIER, F. (1986): La reproduction des *Nectophrynoides*. In: GRASSÉ, P. P. & DELSOL, M. (Eds.): Traité de Zoologie, Anatomie, Systématique, Biologie. Tome XIV, Batraciens, fascicule IB. Paris (MASSON), pp. 497-513.

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