

The amphibians of three national forests in Liberia, West Africa

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Abstract. We surveyed three National Forests in north-western and south-eastern Liberia for amphibians. Forty species were found including five first national records: *Afrivalus nigeriensis*, *Astylosternus occidentalis*, *Bufo superciliaris*, *Chiromantis rufescens* and *Phrynobatrachus villiersi*. Following the IUCN Red List categories and criteria, eleven species are Near Threatened, two are Vulnerable and two Endangered. *Bufo superciliaris* is listed under CITES. All three forests under investigation harbour an amphibian community mainly consisting of forest specialists that are endemic to the Upper Guinea Forest zone. All investigated sites showed a high potential for conservation, although the presence of some invasive species is a hint that alteration of natural forests has already occurred. We also provide a list of all reptiles encountered to account for the deficiency of data for these vertebrates in Liberia.

Key words. Amphibia: Anura, Reptilia, conservation, diversity, Liberia, rainforest.

Introduction

Liberia is assumed to harbour a high biodiversity and to be one of the richest countries in animal and plant species in West Africa. The diversity of amphibians and reptiles is also thought to be extremely high and to comprise a great number of species endemic to the Upper Guinea Forest zone (stretching from Ghana into Sierra Leone). In particular the eastern part of the country (Cape Palmas) is assumed to be an exceptional biodiversity hotspot as this area is believed to have been a rainforest refugium in Northern glacial times, which were dry periods in Africa (e.g. SOSEF 1994). Today this area has still the highest annual amounts of precipitation (> 2,300 mm) in the whole of West Africa. Whereas most other West African countries have lost enormous amounts of their forest cover, e.g. more than 80% of western Côte d'Ivoire's forests have been logged during the last 30 years (CHATELAIN et al. 1996), Liberia's forests still are quite extensive (Fig. 1). However, Liberian forests face threats such as logging, shifting agriculture, hunting and increasing mining activities. Therefore data

on species' occurrence in Liberia and, more specifically, their distributions within the country, are urgently needed. Due to political instability, i.e. a long lasting civil war, the knowledge of Liberia's fauna is still very scarce and it is more or less completely based on very old data (JOHNSTON 1906, BARBOUR & LOVERIDGE 1927, 1930, PARKER 1936, LOVERIDGE 1941, TAYLOR & WEYER 1958, SCHIÖTZ 1968, EUZET et al. 1969).

Amphibians are not only important parts of tropical ecosystems. Representatives of this taxonomic group are known to be extremely sensitive to habitat alteration. The composition of amphibian assemblages thus reflects the degree of habitat degradation and destruction (compare RÖDEL & BRANCH 2002, RÖDEL & ERNST 2003, ERNST & RÖDEL 2005, ERNST et al. 2006). Hence, based on the presence or absence of particular amphibian species, conservation recommendations can be made that could for example result in the upgrading and declaration of Liberian National Forests to National Parks. We therefore participated in a survey of three Liberian National Forests, within the Rapid Assessment Program (RAP) of Conservation Interna-

tional. The amphibian data are presented in this paper. As the general data deficiency of Liberia's fauna also applies to reptiles, we additionally present a list of the reptile species observed throughout the RAP.

Study sites and methods

The RAP survey was carried out at the end of the rainy season and the beginning of the dry season between 16 November and 14 December 2005. Field work was done in the National Forests (NF) North Lorma and Gola in north-western Liberia and in Grebo NF in south-eastern Liberia (Fig. 2).

The first study area (North Lorma NF; 19 to 24 November 2005) was characterised by primary forest crossed by a large river and many smaller streams (Fig. 3), within a moderately hilly landscape. There was no obvious anthropogenic disturbance within the individual sites under investigation and there was no larger habitat variation. The second study site (Gola NF; 28 November to 4 December 2005) was mainly characterised by primary forest with rocky streams in a very hilly landscape with several indications of anthropogenic impact such as old mining areas and a miners' camp. The third study site (Grebo NF; 7 to 11 December 2005) was characterised by a 20 year old mature secondary forest. Here some of the collection localities were located near an old logging road. Aquatic sites within the area were medium sandy streams, with a few stones and rocks, as well as large ponds. A list of all sites investigated, including a short habitat description, is given in Appendix 1. Geographical positions were taken with a hand-held GPS receiver (Garmin 12XL).

During our survey we concentrated on amphibians, as there are standardised methods that allow for a comparatively complete record of this fauna in little time. In addition we detected reptiles opportunistically (see Appendix 3). Amphibian specimens were mainly recorded during visual surveys by up to three people. The surveys were undertaken during day and night. Searching techniques



Fig. 1. Aerial view of large tracks of primary forest in northern Liberia.

included visual scanning of the terrain, investigation of potential refuges and acoustical monitoring (see also HEYER et al. 1994, RÖDEL & ERNST 2004). Despite the fact that there was still some rain at the different sites under investigation (at the last site there were heavy rainfalls almost every day), the reproductive activity, i.e. the number of calling males within the forests, was limited. A higher calling activity could only be observed at ponds surrounded by real forest, which were not available at all study sites.

In addition to visual and acoustic monitoring, drift fences and pitfall traps (15 m of drift fence with five buckets), as well as drift fences and funnel traps (10 m of drift fence with eight funnel traps) were installed at all sites under investigation (four nights per site). Only in Grebo NF did the trapping add one additional amphibian species to our species list. Therefore these results are not described in detail.

As our sampling design provides only qualitative and semi-quantitative data we calculated the estimated species richness and thus the sampling efficiency with the Chao 2 and Jack-knife 1 estimators (software: EstimateS, COLWELL 2005). These estimators are

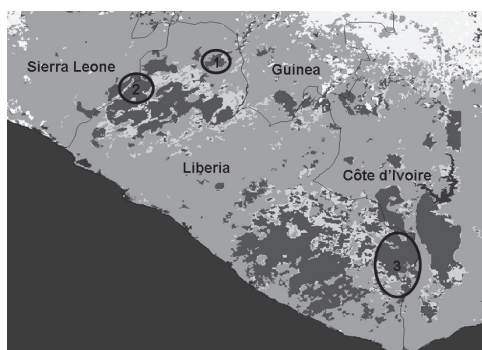


Fig. 2. Map of Liberia and position of the three National Forest: 1 - North Lorma, 2 - Gola, 3 - Grebo; dark grey areas: remaining closed forest blocs; thin line: national borders.

incidence based, calculating with the presence/absence data of the daily species lists (15 days) for 40 species. To avoid order effects we accomplished 500 random runs of the daily species lists. The sampling effort was measured in man-hours spent searching at each study site and we assume that the sampling effort was the same for each site and habitat type.

The nomenclature used herein follows the taxonomy by FROST (2004). Changes according to FROST et al. (2006) are listed in Table 1. Vouchers of all species were anaesthetised in a chlorobutanol solution and thereafter preserved in 70% ethanol. Voucher specimens were deposited at M.-O. RÖDEL's collection at Würzburg University (MOR; Appendix 2). Tissue samples (toe tips) were preserved in 95% ethanol. These samples are stored at the Institute for Biodiversity and Ecosystem Dynamics at the University of Amsterdam, The Netherlands.

Results

Species richness and community composition

We recorded at least 40 amphibian species. *Arthroleptis* sp. almost certainly comprises several species. The comparison of the species accumulation curve to the two incidence



Fig. 3. The RAP team crossing a forest stream in primary rainforest of North Lorma National Forest.

based species richness estimators revealed that more amphibian species probably occur within the three forest areas under investigation (Fig. 4). The Jack-knife 1 estimator as well as the Chao 2 estimator calculated a species richness of about 47 amphibian species. We have thus recorded about 85 % of the amphibian fauna of our study sites. A total list of amphibian species with site records, known habitat preference, distribution and IUCN Red list category (IUCN et al. 2004) is given in Table 1.

Twelve (30 %) of the recorded amphibian species have a distribution range that exceeds western Africa. Eight species (20 %) are restricted to West Africa, while most of the amphibians observed (20 species, 50 %) are endemic to the Upper Guinea forest zone. Further genetic analyses will clarify if one of the latter amphibians can be referred to a known species (*Phrynobatrachus annulatus*) or if it is new to science and then probably a Liberian endemic (see below).

The majority of amphibians were typical forest specialists, some of them also being tolerant of disturbed forest situations (farm-bush *sensu* SCHIÖTZ 1967). Only a few of the recorded amphibian species showed a preference for savannah and/or farmbush habitats. If they were found within the forests they can be interpreted as invasive species, indicating environmental disturbance (see RÖDEL & BRANCH 2002).

In North Lorma NF we recorded 18 and in Gola and Grebo NF 30 amphibian species respectively. Although we also recorded a few disturbance indicating species, e.g. *Bufo maculatus*, North Lorma's amphibian community was dominated by true primary forest species, including three Near Threatened, one Vulnerable and one Endangered species. These five species were all very abundant within the study area.

A higher number of species, also including disturbance indicating species, was observed in Gola NF (Fig. 5). One reason for the presence of those species that indicated habitat alteration might be the existence of old mining areas within Gola NF. The rocky streams in Gola NF represented a special habitat for species that are related to lotic forest habitat and that could not or only rarely be registered in the other forests under investigation. We detected five Near Threatened, one Vulnerable and two Endangered species in Gola NF.

A similar situation occurred in Grebo NF, where we recorded for example frogs specialising in streams and large ponds. These species and habitats were not present at North Lorma NF. In Grebo NF we recorded nine Near Threatened and two Vulnerable species. Surprisingly, these were mainly true forest species, although the study area mostly consisted of mature secondary forest.

known. We recorded several amphibian species for the first time for Liberia: *Bufo superciliaris*, *Astylosternus occidentalis*, *Phrynobatrachus villiersi* (Vulnerable), *Chiromantis rufescens* (Fig. 6) and *Afrixalus nigeriensis* (Near Threatened; IUCN et al. 2004). We recorded all Upper Guinea Forest endemics that have been described and are known to be associated with lotic forest habitats (*Bufo togoensis*, *Conraua alleni*, *Petropedetes natator*, *Astylosternus occidentalis*, *Cardioglossa leucomystax*, *Hyperolius chlorosteus*), as well as some characteristic species of lentic forest habitats (e.g. *Phrynobatrachus plicatus*, *Phlyctimantis bouleengeri*, *Chiromantis rufescens*).

Arthroleptis spp.: A definite determination of these species is not possible in West Africa (RÖDEL & AGYEI 2003, RÖDEL & BANGOURA 2004). The taxonomic status of recorded specimens will be clarified by further genetic analyses (A. HILLERS et al. in prep.).

Bufo superciliaris BOULENGER, 1888 "1887": This largest African toad was recorded for the first time in Liberia. It is listed as a CITES I species (IUCN et al. 2004). *Bufo superciliaris* probably comprises a complex of three species (see RÖDEL et al. 2004). The West African form (an available name would be *Bufo chevalieri* MOCQUARD, 1909) is likely to be threatened.

Phrynobatrachus cf. *annulatus* PERRET, 1966: The individual recorded in Grebo NF was conferred to *P. annulatus* because of the presence of an eyelid cornicle and the ventral pattern. However, this frog showed some differences to *P. annulatus* from for example North Lorma NF, Nimba mountains, Guinea, and Taï National Park, Côte d'Ivoire (own unpublished data), by exhibiting deep reddish colours on the groin and thighs and being slightly sturdier (Fig. 7). Its taxonomic status remains to be clarified.

Notes on species

We only comment on a few species that are of uncertain taxonomic status or not well

Discussion and conclusions

The observed amphibian assemblages showed a high potential for conservation in all three

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Tab. 1. Amphibian species recorded in three Liberian National Forests with record sites (see Appendix 1), habitat preference and African distribution of species. S = savannah, FB = farmbush (degraded forest and farmland), F = forest, A = Africa (occurs also outside West Africa), WA = West Africa (Senegal to eastern Nigeria), UG = Upper Guinea (forest zone West of the Dahomey Gap), E = endemic to Liberia, * = records possibly comprise several species, ** = CITES listed species, spp. & cf. = determination needs confirmation or new species are involved, LC = Least concern, NT = Near threatened, VU = Vulnerable, EN = Endangered, ¹ = first national record.

FROST et al. (2006) introduced many new names and relationships. As these are not yet generally accepted and to allow for a better orientation, we list the old names in the table. The new affiliations according to FROST et al. (2006) are: The West African *Bufo* species are now in the genus *Amietophrynus*, the African *Amnirana* species in the genus *Hydrophylax*. *Astylosternus* and *Leptopelis* moved into the family Arthroleptidae. *Conraua* now belongs to the family Petropedetidae, *Hoplobatrachus* into the family Dicroglossidae, *Ptychadena* into the family Ptychadenidae and *Phrynobatrachus* forms the family Phrynobatrachidae.

Species	Site	S	FB	F	A	WA	UG	E	IUCN Red list category
Arthroleptidae									
<i>Arthroleptis</i> spp. *	NL 1, 6, 7; GO 1, 5; GRE 1, 2, 4, 5, 9		x	x			x		LC
<i>Cardioglossa leucomystax</i>	NL 1, 5; GO 1, 5; GRE 1			x	x				LC
Astylosternidae									
<i>Astylosternus occidentalis</i> ¹	GO 1, 5			x			x		LC
Buonidae									
<i>Bufo maculatus</i>	NL 6; GO 3, 6; GRE 7, 9	x	x	x	x				LC
<i>Bufo regularis</i>	NL 6; GO 6; GRE 9	x	x		x				LC
<i>Bufo superciliaris</i> ** ¹	NL 1, 3			x	x				LC
<i>Bufo togoensis</i>	NL 1; GRE 1			x			x		NT
Hyperoliidae									
<i>Afraxalus dorsalis</i>	GO 3, 6; GRE 8	x	x	x	x				LC
<i>Afraxalus nigeriensis</i> ¹	GO 3; GRE 1, 7, 8		x	x		x			NT
<i>Hyperolius chlorosteus</i>	GO 1; GRE 1, 4			x	x		x		NT
<i>Hyperolius concolor</i>	GO 6	x	x	x		x			LC
<i>Hyperolius fusciventris</i>	GO 3, 6; GRE 6, 7		x	x		x			LC
<i>Hyperolius gutturalis</i>	GO 3, 6; GRE 6, 7		x	x	x				LC
<i>Hyperolius picturatus</i>	GO 6; GRE 1, 2		x	x			x		LC
<i>Leptopelis hyloides</i>	NL 1, 5; GO 6; GRE 1		x	x		x			LC
<i>Leptopelis macrotis</i>	GRE 1			x			x		NT
<i>Leptopelis occidentalis</i>	GRE 1			x			x		NT
<i>Phlyctimantis boulengeri</i>	GRE 8		x	x		x			LC
Petropedetidae									
<i>Petropedetes nator</i>	GO 1			x			x		NT
<i>Phrynobatrachus accraensis</i>	GO 6	x	x			x			LC
<i>Phrynobatrachus alleni</i>	NL 1, 2, 3, 5, 6, 8, 9; GO 4; GRE 4			x			x		NT
<i>Phrynobatrachus annulatus</i>	NL 3, 6			x			x		EN
<i>Phrynobatrachus</i> cf. <i>annulatus</i>	GRE 2			x		(x)			(EN)
<i>Phrynobatrachus fraterculus</i>	NL 1, 3, 5, 9; GO 3			x			x		LC
<i>Phrynobatrachus guineensis</i>	GRE 2, 4			x			x		NT
<i>Phrynobatrachus liberiensis</i>	NL 1, 2, 3, 5; GO 1, 5; GRE 1, 2, 4			x			x		NT
<i>Phrynobatrachus phyllophilus</i>	NL 1, 5; GO 1, 3, 5; GRE 2, 4			x			x		NT
<i>Phrynobatrachus plicatus</i>	NL 1, 6, 9; GO 1; GRE 2, 4, 9			x		x			LC
<i>Phrynobatrachus tokba</i>	NL 1, 3; GO 1, 4, 5; GRE 2, 9			x			x		LC
<i>Phrynobatrachus villiersi</i> ¹	NL 2; GO 5; GRE 2			x			x		VU
Pipidae									
<i>Silurana tropicalis</i>	GRE 1		x	x	x				LC
Rhacophoridae									
<i>Chiromantis rufescens</i> ¹	NL 6; GO 3, 7; GRE 8			x	x				LC
Ranidae									
<i>Amnirana albolabris</i>	NL 1; GO 6; GRE 1, 2, 4		x	x	x				LC
<i>Amnirana occidentalis</i>	GO 1			x			x		EN
<i>Conraua alleni</i>	GO 1; GRE 2,			x			x		VU
<i>Hoplobatrachus occipitalis</i>	GO 3, 6	x	x	x	x				LC
<i>Ptychadena aequiplicata</i>	NL 1, 4, 5; GO 3; GRE 2			x	x				LC
<i>Ptychadena bibroni</i>	GO 3, 6	x	x		x				LC
<i>Ptychadena longirostris</i>	GO 3; GRE 9		x	x		x			LC
<i>Ptychadena superciliaris</i>	GRE 6			x			x		NT

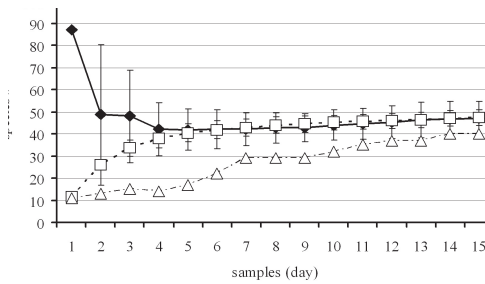


Fig. 4. Estimated species richness for amphibians in the three National Forests investigated throughout the RAP survey (15 days of survey work). Open squares = Jack-knife 1 estimator (47.5 ± 3.6 species); black diamonds = Chao 2 estimator (47.1 ± 5.5 species); open triangles = species accumulation.

forests, being always typical forest assemblages with only some farmbrush elements intermingled. Many of the recorded species are listed in the IUCN Red List categories. The number of individuals of Near Threatened species was extremely high in North Lorma NF, a forest that seemed to be in primary state. In contrast in Gola NF traces of human disturbance were present, i.e. former mining activities. These altered habitats, comprising for example ponds in old mining areas, most likely made possible the invasion of savannah species (*Bufo maculatus*, *Bufo regularis*, *Phrynobatrachus accraensis*, *Hoplobatrachus occipitalis*). Typical primary forest habitat frogs in Gola NF often lived in a particular forest habitat, i.e. rocky streams. This assemblage included some threatened species (e.g. *Conraua allenii*).

In Grebo NF obvious anthropogenic alteration of the forest was greatest. However, we still recorded a high number of typical forest species, including two Vulnerable species (*Conraua allenii*, *Phrynobatrachus villiersi*). It is possible that some of the recorded forest species invaded the secondary forests of Grebo only during the rainy season, whereas their main populations in the region still occur within the large central primary forest area of Grebo NF, which was not studied



Fig. 5. *Bufo maculatus* is a typical species that indicates disturbed forest situations. The figure shows a male with typical yellow breeding color.

during our survey. A similar observation of forest species migrating from primary into altered habitat during more favourable conditions (= higher humidity) was also observed in nearby Taï National Park in Côte d'Ivoire (ERNST & RÖDEL 2005). True forest species, however, seem to be unable to build up stable populations in secondary forest, most likely due to the altered microclimate (ERNST & RÖDEL 2005, A. HILLERS in prep). Taï National Park is one of the most diverse West African amphibian sites and is home to highly endemic forest amphibians (PERRET 1988, RÖDEL & ERNST 2000, 2001, RÖDEL et al. 2003), which potentially could also occur in Grebo NF. This might be for example the case for *Kassina lamottei* and *Bufo taiensis*. In respect to conservation, Grebo NF could most likely play a major role by connecting Taï and Sapo National Parks as a kind of stepping stone.

Based on the fact that, during 15 days of observation, we continuously detected additional species, and based on our species richness calculations, we believe that we were not able to detect all species present in the three National Forests. We might have missed some amphibian species because they had already stopped reproducing and hence calling (the

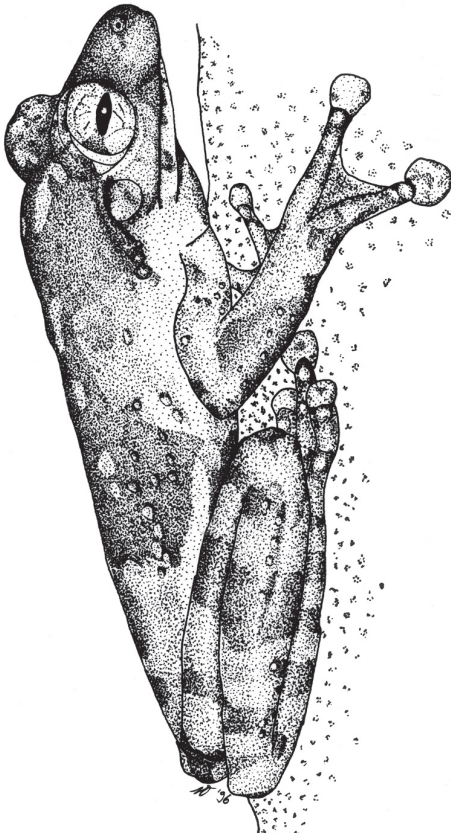


Fig. 6. *Chiromantis rufescens* male; this is a wide-spread African forest frog, here reported for the first time for Liberia.

study period was the beginning of the dry season). This is especially likely for treefrogs that are better recorded via acoustics, whereas even with visual methods leaf litter frogs still have a high detection probability (RÖDEL & ERNST 2004). Another limiting factor was that the RAP was restricted to comparatively small areas within the respective National Forests. Hence we were most likely not able to visit all of the existing habitat types. Therefore, further surveys are highly recommended for all three study sites. These should predominantly take place during the rainy season, when amphibians are most active. In Grebo NF these studies should focus on primary forest. Intensified research would lead

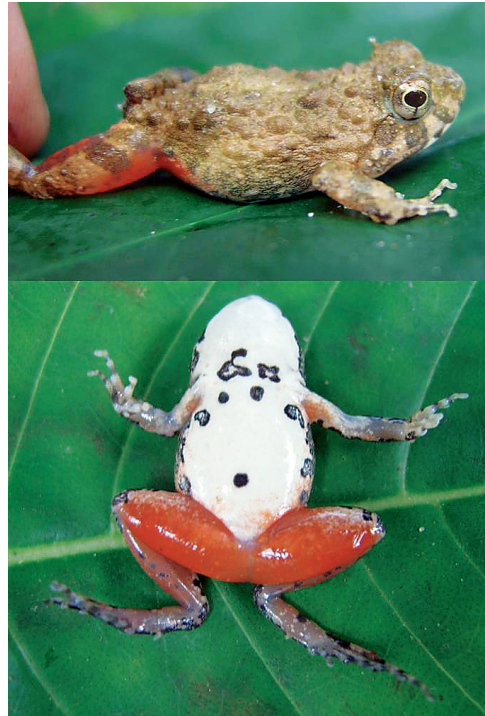


Fig. 7. Lateral and ventral aspects of *Phrynobatrachus* cf. *annulatus* from Grebo National Forest. Note eyelid cornicle, warty and very sturdy body and the bright reddish color on thighs.

to a better knowledge of the existing fauna, population sizes and distribution patterns of particular species. This would be especially important for species with high conservation concern, such as rare or threatened species. Finally further investigations could lead to a better understanding of the forests' status, which would help to provide further conservation recommendations.

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Appendix 1

Locality list and short description of habitats investigated in three National Forests in Liberia: North Lorma National Forest (NL), Gola National Forest (GO) and Grebo National Forest (GRE).

Site	Latitude (N)	Longitude (W)	Description
NL1	8°01.741'	9°44.119'	Primary forest with small stream
NL2	8°01.929'	9°44.161'	Dry primary forest on hill above big river
NL3	8°01.434'	9°44.414'	Primary forest, one part slightly swampy area, other part brook, next to big river
NL4	8°01.523'	9°44.226'	Dry forest, river, many lianas, thick undergrowth
NL5	8°02.043'	9°43.970'	Riverine forest, stream with rocks and stones, forest parts with sandy and slightly swampy area with temporary puddles
NL6	8°02.023'	9°44.143'	Riverine forest, stream with small waterfall, thick shrub storey
NL7	8°02.509'	9°43.682'	Dry forest with big rocks and stones
NL8	8°02.391'	9°43.750'	Swampy forest with <i>Raphia</i> palms and Marantaceae, partly open canopy
NL9	8°01.722'	9°44.124'	Forest with streams and swampy areas
GO1	7°27.178'	10°41.522'	Hilly primary forest with rocky and sandy stream
GO2	7°27.272'	10°41.548'	Dry forest on hill, some rocks
GO3	7°27.376'	10°41.736'	Old diamond mines and ponds within forest, partly open area
GO4	7°27.293'	10°41.632'	Dry forest on hill
GO5	7°27.352'	10°41.483'	Valley within forest with small brook, partly swampy area
GO6	7°26.781'	10°39.063'	Big pond near SLC village
GO7	7°26.404'	10°39.150'	Small pond next to river Mano, stony ground and few trees on the bank
GRE1	5°24.108'	7°44.011'	Mature secondary forest, partly thick undergrowth, with sandy stream and temporary puddles
GRE2	5°24.358'	7°44.106'	Swampy area in forest with small stream, many treefall gaps and lianas, drier forest around the swampy area
GRE3	5°24.535'	7°44.276'	Dry forest
GRE4	5°24.285'	7°43.786'	Swampy area within secondary forest near stream, many lianas and shrubs, thick leaf litter coverage
GRE5	5°24.334'	7°43.631'	Dry forest on hill
GRE6	5°23.857'	7°42.536'	Big pond next to old logging road in mature secondary forest
GRE7	5°24.083'	7°42.892'	Pond next to old logging road in mature secondary forest
GRE8	5°24.286'	7°42.954'	Small pond next to old logging road in mature secondary forest
GRE9	5°24.127' & 5°23.827'	7°43.965' & 7°44.160'	On or next to old logging road in mature secondary forest

Appendix 2

List of voucher specimens deposited in the collection of M.-O. RÖDEL (for taxonomic changes compare Tab. 1):

Arthroleptidae: *Arthroleptis* spp.: NL 15, 68, 74, 94, GO 6, 45, GRE 11, 58; *Cardioglossa leucomystax*: NL 87, GO 43, GRE 56; **Astylosternidae:** *Astylosternus occidentalis*: GO 4; **Bufonidae:** *Bufo regularis*: GRE73; *Bufo togoensis*: WOL 80, GRE36; **Hyperoliidae:** *Africalus dorsalis*: GO 60; *Africalus nigeriensis*: GO 61, GRE 43; *Hyperolius chlorosteus*: GRE 46; *Hyperolius fusciventris*: GO 62, 64, 65, 67; *Hyperolius guttulatus*: GO 63, GRE 72; *Hyperolius picturatus*: GRE 41; *Leptopelis hyloides*: NL 101, GRE 45; *Leptopelis macrotis*: GRE 40; *Leptopelis occidentalis*: GRE 42; *Phlyctimantis boulengeri*: GRE 75; **Petropedetidae:** *Petropedetes natator*: GO 39; *Phrynobatrachus alleni*: NL 13, 72, 73, GRE 37, 59; *Phrynobatrachus annulatus*: NL 92; *Phrynobatrachus* cf. *annulatus*: GRE 47; *Phrynobatrachus fraterculus*: NL 51, 52, GO 44; *Phrynobatrachus guineensis*: GRE 48, 62; *Phrynobatrachus liberiensis*: NL 50, GO 41, GRE 13, 53; *Phrynobatrachus phyllophilus*: NL 14, 93, GO 5, 46, 52, GRE 34; *Phrynobatrachus plicatus*: NL 71, GO 42, GRE 30; *Phrynobatrachus tokba*: NL 53, GO 9, GRE 63; *Phrynobatrachus villiersi*: GRE 32; **Rhacophoridae:** *Chiromantis rufescens*: GO 53, 59, GRE 70; **Ranidae:** *Amnirana albolabris*: NL 70, GO 73, GRE 10; *Amnirana occidentalis*: GO 12, 14; *Conraua alleni*: GO 40, GRE 38, 39; *Ptychadena aequiplicata*: NL 75, GRE 9; *Ptychadena longirostris*: GRE 57; *Ptychadena superciliaris*: GRE 71.

Appendix 3

List of reptile species recorded in the three Liberian National Forests North Lorma, Gola and Grebo:

Taxa	Site	CITES
Sauria		
Agamidae		
<i>Agama agama</i>	Gola, Grebo	
Gekkonidae		
<i>Hemidactylus</i> aff. <i>muriceus</i>	Gola	
Scincidae		
<i>Trachylepis affinis</i>	Grebo	
<i>Cophoscincopus</i> sp. 1	North Lorma, Gola	
<i>Cophoscincopus</i> sp. 2	Gola	
Varanidae		
<i>Varanus ornatus</i>	Gola	2
Serpentes		
Boidae		
<i>Python sebae</i>	North Lorma	2
Colubridae		
<i>Dipsadoboa</i> sp.	Grebo	
<i>Grayia smythii</i>	Gola	
<i>Natriciteres variegata</i>	Grebo	
<i>Philothamnus heterodermus</i>	North Lorma	
<i>Rhamnophis aethiopissa</i>	North Lorma	
Viperidae		
<i>Bitis gabonica</i>	Gola	
<i>Atheris chlorechis</i>	North Lorma, Gola	
Chelonia		
Testudinidae		
<i>Kinixys erosa</i>	Grebo	2
<i>Kinixys homeana</i>	North Lorma	2
Crocodylia		
Crocodylidae		
<i>Osteolaemus tetraspis</i>	Gola, Grebo	1

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