EXPEDITION REPORT FROM UGANDA: HERPETOLOGICAL SURVEYS AT BWINDI IMPENETRABLE NATIONAL PARK, RWENZORI MOUNTAINS NATIONAL PARK, AND THE NORTHERN SHORE OF LAKE VICTORIA

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INTRODUCTION

Uganda is located in East Africa and is exceptionally important in terms of biodiversity. Although Uganda accounts for only 0.18% of the world's terrestrial and freshwater surface, the country harbors 4.6% of the dragonflies, 6.8% of the butterflies, 7.5% of the mammals, and 10.2% of the bird species recognized globally (Eilu and Winterbottom, 2006). Uganda is also unique for its mosaic of ecosystems, including semi-arid woodlands, savannas, forests (Fig. 1), montane habitats and wetlands. Furthermore, Uganda has more species of primates than anywhere else on Earth of

Figure 1: Montane forest at Bwindi Impenetrable National Park. Photo by DFH.

similar area—Kibale National Park (760 km^2) has 12 species of primates.

In particular, the Albertine Rift (AR) region of western Uganda is an important region for global conservation because it is an Endemic Bird Area and is part of the Eastern Afromontane Biodiversity Hotspot (Plumptre et al., 2003). This region contains more than half of continental Africa's bird species and nearly 40% of its mammal species. The conservation importance of this area stems not only from the high number of species, but also a high level of endemism. For example, this region has more endemic vertebrates than any other site in continental Africa (Plumptre et al., 2007). Western Uganda is a key component of the AR and the forests and lakes within this area constitute one of the most species rich parts of the world (Eilu and Winterbottom, 2006).

The National Geographic Society has considered Uganda as one of the top 20 global tourism destinations, in large part because of the numerous game parks, game reserves and forest reserves that harbor Uganda's immense biodiversity. Many of Uganda's vertebrate groups are well known because of their ecotourism appeal, yet reptiles and amphibians have arguably received far less attention. Therefore, the overall goal of this project was to assess the conservation value of two of Uganda's national parks (NP) and also the northern shore of Lake Victoria, with respect to the herpetofaunal diversity. One specific objective was identified—undertake herpetofaunal surveys in order to provide empirical updates to checklists of Uganda that will be useful tools for management, and to bolster conservation efforts.

MATERIALS AND METHODS

***Study areas*. – Northern shore of Lake Victoria** (Entebbe region) (N00.26135, E32.63582) is largely an urban landscape, dominated by reedy vegetation and man-made structures. With a

surface area of 68,800 km^2, Lake Victoria is Africa's largest lake by area, and the largest tropical lake in the world. Lake Victoria contains nearly 2750 km^3 of water, making it the world's ninth largest continental lake by volume. It receives water from precipitation and an influx of streams. The lake is drained by the Nile River near Jinja along the northern shore. Lake Victoria occupies a shallow depression with a maximum depth of 84 m and an average depth of 40 m. The lake has a shoreline of 4828 km and is divided among three countries: Kenya (6%), Uganda (45%) and Tanzania (49%). The shoreline habitat consists of open landscapes of headland or beach, with vegetation made up of swamp plants, such as the papyrus sedge, *Cyperus papyrus*. The sampling location was a low elevation (< 1200 m) urban beach habitat with flooded reed-like vegetation and many shallow pools. A large chorus of frogs was heard, and one snake (Fig. 2) was encountered in the grass near the lake. This site was sampled for one night on 22 May 2014.

Figure 2: *Crotaphopeltis degeni* from Lake Victoria. Photo by EG.

Bwindi Impenetrable National Park (S01.04883, E29.79016) is a 32,100 ha protected area located in southwestern Uganda with an elevational range from 1160–2607 m, with 60% of the park over 2000 m. The hillsides consist of primary afromontane forest that contain more than 1000 flowering plant species, including 163 species of trees and 104 species of ferns. The climate is tropical with annual mean temperature ranging from 20–27°C and annual rainfall ranging from 1400–1900 mm. The biannually peaking wet season occurs from March to April

and September to November. This area protects an estimated 320 mountain gorillas—nearly half of the world's population. It also provides ideal habitat for over 120 mammal species, including elephants and antelopes. There are nearly 350 species of birds that can be found in this forest, including 23 AR endemics. Sampling locations within the park included a low elevation (~1500 m) wetland site near the Ihihizo River, and a high elevation (~2200 m) site at Rwizi Swamp. These sites were sampled from 25–31 May 2014.

Rwenzori Mountains National Park (N00.36247, E29.99863) is a 99,600 ha protected area located in western Uganda with an elevational range from 1100–3000 m. The Rwenzori Mountains reside along the Uganda-DR Congo border, and are situated in the northern area of the AR. The climate is tropical with annual rainfall averaging 2500 mm. The biannually peaking wet season occurs from March to May and August to December. The diversity of ecosystems here include equatorial snow peaks, lower elevation slopes of moorland, bamboo, and afromontane forest. Five primary vegetation zones have been identified on the mountains and are associated with high elevations—montane forest, bamboo forest, tree heath-bog, *Hagenia-Rapanea* scrub, and afro-alpine moorland. The NP protects 70 mammals and 217 bird species, including 19 AR endemics. Sampling locations within the park included a low elevation (~1650 m) site comprising flooded

Figure 3: *Trioceros johnstoni* from Ruboni Community Hotel near Rwenzori Mountains NP. Photo by EG.

and disturbed vegetation near the Ruboni Community Hotel (Fig. 3), and a higher elevation (~2000 m) site in primary forest along the Mubuku River. These sites were sampled from 31 May to 1 June 2014.

Surveying and collecting. – Between 22 May and 4 June 2014, amphibians and reptiles were caught by hand or net during diurnal and nocturnal searches. The authors, with help from local guides and Makerere University students, searched in forests, around small streams, and near flooded vegetation at each location. Notes were made regarding GPS coordinates, ecology, behavior, date, time, and habitat details of each specimen collected. Animals were preserved in 10% formalin. Tissue samples were taken from most specimens and stored in 100% ethanol. On completion of the expedition, with proper permits, the specimens were transferred to the University of Texas at El Paso (UTEP) Biodiversity Collections in El Paso Texas, USA, for further analysis. Genomic DNA extraction from tissue samples and subsequent PCR reactions with gene-specific primers followed standard laboratory protocols (see Portillo et al., in press).

Species identification. **–** All animals were initially identified by external morphology and putative species ranges published in the literature (Branch, 1998; Schiøtz, 1999; Spawls et al., 2002, 2006; Tilbury, 2010). Initial identifications were corroborated by experts (EG and MB). Phylogenetic analyses of genetic data combined with previously collected samples from eight years of expeditions to the DR Congo side of the AR (EG), were used to confirm species identifications and to detect possible cryptic species.

RESULTS

Total numbers of species. – A total of 185 specimens was collected during the sampling period from the forests of Rwenzori Mountains NP, Bwindi Impenetrable NP, flooded reeds of Lake Victoria's northern shore, representing 20 amphibian species (Table 1) and 21 reptile species (Table 2). Three additional amphibian species and one reptile species were detected outside of the primary collection sites (Table 3), bringing the total species detected to 45. Of these, one frog from Bwindi Impenetrable NP (*Leptopelis* sp. nov., Fig. 4) is confirmed as new to science (Portillo et al., in press), and one lizard (*Leptosiaphos meleagris*) from Rwenzori Mountains NP had not been observed in decades, and no color-in-life photographs previously existed. Several species were unique to each site, yet there was a large degree of overlap between the two AR sites. Only a single species (*Ptychadena nilotica*) overlapped between any of the AR sites and the Lake Victoria site.

Figure 4: *Leptopelis* sp. nov. from Bwindi Impenetrable NP. Photo by EG.

Number of species per site. – Twenty-five total species were detected at Bwindi NP, representing 12 amphibian species and 13 reptile species (Table 1; Table 2). This location was the most species rich site of the three sampled localities in terms of reptiles and amphibians. Some reptile species (e.g., *Philothamnus emini* [currently known as *P. angolensis*] and *Acanthocercus kiwuensis* [currently known as *A. atricollis*]) and at least one amphibian

(*Hyperolius ituriensis* [currently known as *H. cinnamomeoventris*]) found at Bwindi NP, are currently considered synonyms or subspecies, but these animals represent unique lineages that warrant full species status (EG unpub. data), and future publications will clarify their taxonomic status.

Eleven total species were detected at Rwenzori NP, representing one amphibian species and 10 reptile species (Table 1; Table 2). The single amphibian species (*Amietia lubrica*, Fig. 5) detected at Rwenzori NP was also found at Bwindi NP and seems to be widespread in western Uganda, Rwanda and Burundi. The original description for this species was very poor, and no color photographs were provided, but we have now documented this species (with color photos) from its type locality at Lake Bunyonyi. Several reptile species found at Rwenzori NP were also found at Bwindi NP, confirming that they also have a widespread distribution in the AR, including *Atheris nitschei*, *Trioceros ellioti*, and *T. johnstoni*.

Figure 5: The poorly known species *Amietia lubrica*. Photo by EG.

Eleven total species were detected at the Lake Victoria site, representing nine amphibian species and two reptile species (Table 1; Table 2). Several of the amphibian species detected are common lowland species (e.g., *Hoplobatrachus occipitalis*) and have a large range across sub-Saharan Africa. The single snake species detected at this site (*Crotaphopeltis degeni*, Fig. 1) is the only species of this genus found during the expedition. Nine total species were detected at

sites other than the primary study sites, representing seven amphibian species and two reptile species (Table 3).

Table 1. – List of amphibian species collected in Uganda during the 2014 expedition. Species collected were identified by morphology and phylogenetic analyses. Amphibian taxonomy follows Frost (2014). If a species was detected at two localities the * denotes the locality that the coordinates represent.

Species	Common Name	Bwindi NP	Rwenzori NP	Lake Victoria	Coordinates	Elevation
Afrixalus quadrivitattus	Banded Banana Frog			X	N00.26135, E32.63582	1140 m
Amietia lubrica	River Frog	X*	X		*S01.033597, E29.783446	2111 m
Amietophrynus gutturalis	Guttural Toad			X	N00.26135, E32.63582	1140 m
Amietophrynus kisoloensis	Kisolo Toad	X			S01.033597, E29.783446	2111 m
Hoplobatrachus occipitalis	Crowned Bullfrog			X	N00.26135, E32.63582	1140 m
Hylarana albolabris	White-lipped Frog			X	N00.26135, E32.63582	1140 m
Hylarana galamensis	Marble-legged Frog			X	N00.26135, E32.63582	1140 m
Hyperolius castaneus	Ahl's Reed Frog	X			S01.033597, E29.783446	2111 m
Hyperolius frontalis	White-snouted Reed Frog	X			S00.97942, E29.69155	1468 m
Hyperolius ituriensis	Ituri Reed Frog	X			S00.97628, E29.68685	1485 m
Hyperolius kivuensis	Lake Kivu Reed Frog			X	N00.26135, E32.63582	1140 m
Hyperolius lateralis	Side-striped Reed Frog	X			S00.97628, E29.68685	1485 m
Hyperolius viridiflavus	Common Reed Frog			X	N00.26135, E32.63582	1140 m
Hyperolius v. francoisi	Common Reed Frog	X			S01.033597, E29.783446	2111 m
Hyperolius v. schubotzi	Common Reed Frog			X	N00.26135, E32.63582	1140 m
Leptopelis sp. nov.	Forest Tree Frog	X			S01.04883, E29.79016	2100 m
Phrynobatrachus sp.	Puddle Frog	X			S01.033597, E29.783446	2111 m

Phlyctimantis verrucosus	Warty Striped Frog	X			S00.97628, E29.68685	1485 m
Ptychadena chrysogaster	Rwanda Rocket Frog	X			S01.033597, E29.783446	2111 m
Ptychadena nilotica	Rocket Frog	X*		X	*S01.033597, E29.783446	2111 m

Table 2. – List of reptile species collected in Uganda during the 2014 expedition. Species collected were identified by morphology and phylogenetic analyses. Reptile taxonomy follows Uetz and Hošek (2014). If a species was detected at two localities the * denotes the locality that the coordinates represent.

Species	Common Name	Bwindi NP	Rwenzori NP	Lake Victoria	Coordinates	Elevation
Acanthocercus kiwuensis	Blue-headed Tree Agama	X			S00.95538, E29.67719	1455 m
Adolfus africanus	Multi-scaled Forest Lizard	X			S01.04169, E29.77678	2323 m
Adolfus jacksoni	Jackson's Forest Lizard		X		N00.36247, E29.99863	2075 m
Atheris nitschei	Great Lakes Bush Viper	X*	X		*S01.04452, E29.77541	2296 m
Congolacerta vauereselli	Sparse-scaled Forest Lizard	X			S01.04643, E29.77389	2332 m
Crotaphopeltis degeni	Degen's Herald Snake			X	N00.26135, E32.63582	1140 m
Dasypeltis atra	Common Egg Eater	X			S01.04705, E29.78311	2260 m
Dipsadoboa unicolor	Günther's Green Tree Snake	X			S00.97628, E29.68685	1485 m
Kinyongia adolfifriderici	Ituri Chameleon	X*	X		S01.04836, E29.77684	2284 m
Kinyongia xenorhina	Strange-horned Chameleon		X		N00.36247, E29.99863	2075 m
Leptosiaphos meleagris	Rwenzori Four-toed Skink		X		N00.36247, E29.99863	2075 m
Letheobia sp.	Beaked Snake		X		N00.36247, E29.99863	2075 m
Lycophidion ornatum	Ornate Wolf Snake	X			S01.04705, E29.78311	2260 m
Philothamnus emini	Western Green Snake	X			S01.033597, E29.783446	2111 m
Polemon graueri	Grauer's Snake Eater		X		N00.36247, E29.99863	2075 m
Trachylepis maculilabris	Speckle-lipped Skink			X	N00.25562, E32.61842	1226 m

Trachylepis striata	African Striped Skink	X			S01.04169, E29.77678	2323 m
Trioceros ellioti	Montane Side-striped Chameleon		X		N00.34972, E30.02973	1655 m
Trioceros johnstoni	Johnston's Chameleon	X*	X		*S01.04836, E29.77684	2284 m
Trioceros rudis	Rwenzori Side-striped Chameleon	X			S01.04836, E29.77684	2284 m
Rhampholeon boulengeri	Boulenger's Pygmy Chameleon	X*	X		*S00.97828, E29.69354	1563 m

Table 3. – List of amphibian and reptile species collected in Uganda while traveling to and from study sites during the 2014 expedition. Species collected were identified by morphology and phylogenetic analyses. Amphibian taxonomy follows Frost (2014) and reptile taxonomy follows Uetz and Hošek (2014).

Species	Common Name	Locality	Coordinates	Elevation
Amietia lubrica	River Frog	Lake Bunyonyi	S01.26608, E29.93748	1936 m
Chamaeleo gracilis	Slender Chameleon	On road North of Rwenzori NP	N01.41419, E31.33657	1107 m
Hemisus sp.	Shovel-snouted Frog	Murchison Falls NP	N02.28668, E31.56743	632 m
Hyperolius kivuensis	Lake Kivu Reed Frog	Lake Bunyonyi	S01.26608, E29.93748	1936 m
Leptopelis oryi	Ory's Tree Frog	Nebbi	N02.48015, E31.09239	1009 m
Leptopelis sp. nov.	Forest Tree Frog	Muchuya Swamp	S01.25543, E29.79689	2200 m
Philothamnus emini	Western Green Snake	On road West of Kampala	S00.38467, E31.21775	1186 m
Phrynobatrachus cf. *natalensis*	Puddle Frog	Nebbi	N02.48015, E31.09239	1140 m
Ptychadena nilotica	Rocket Frog	Lake Bunyonyi	S01.26608, E29.93748	1936 m

DISCUSSION

Many of the species collected during this preliminary assessment of Uganda's herpetofauna substantiate their purported presence in these areas (Branch, 1998; Schiøtz, 1999;

Spawls et al., 2002, 2006; Tilbury, 2010). At least one of the frog species is new to science and further analyses need to be done to establish its taxonomic status (e.g., *Leptopelis* sp. nov.) (Portillo et al., in press). Some of the reptile species are currently known as subspecies only, and likely need to be elevated to full species (EG unpub. data). Approximately 119 amphibian species and 175 reptile species can be found in the AR (Plumptre et al. 2003), of which 16 reptiles and 36 amphibians are endemic (Plumptre et al. 2007). Some AR endemics were collected during this expedition (e.g., *Atheris nitschei* and *Hyperolius castaneus*). The species lists provided here can be used by the Uganda Wildlife Authority and other parks management authorities to update previous checklists for these two NPs and for Uganda in general.

These preliminary surveys were relatively brief, and they highlight the need for additional work in Uganda, especially in poorly sampled regions (e.g., Otze Forest and Imatong Mountains) with respect to the herpetofauna. This collection represents a valuable resource for future studies into the natural history, taxonomy, and ultimately the conservation of AR fauna and Uganda's wildlife in general. Considering the limited sampling time (< 1 month), our results most likely do not comprise the full diversity of the herpetofauna for these regions. Yet, several of the species may be new to science, and some of the species have not been observed in many years. These data highlight the importance of conducting surveys in regions known to harbor biodiversity and for understanding the herpetofauna of Uganda.

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