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HERPETOFAUNAL DIVERSITY AND COMMUNITY STRUCTURE AT LAKE NABUGABO AND SURROUNDING RAMSAR AREA WETLANDS IN SOUTHERN UGANDA

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AMPHIBIA
REPTILIA
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ABSTRACT. – Community ecology patterns are poorly understood in Uganda, as well as in the rest of East Africa. Therefore, the aim of the study was to determine the patterns of diversity and distribution of reptiles and amphibians in selected wetland sites in the greater Nabugabo-Ramsar area, Uganda, with contributions to the understanding of their ecology and conservation status. A baseline survey of the herpetofauna of Lake Nabugabo and surrounding wetlands was carried out from 9-18 November 2016. We used visual encounter surveys, pitfall trapping with drift fences, dip-net sampling and opportunistic surveys to sample the herpetofauna. Twenty-seven amphibian species belonging to nine families and 12 genera were recorded. Species richness for amphibians was highest at the landing sites of Kaziru, Lambu, Bukakata and Namirembe. The most frequently encountered amphibian species were *Hyperolius kivuensis*, *H. cinnamomeoventris, Ptychadena nilotica, P. porosissima*, *Hoplobatrachus occipitalis*, *Sclerophrys vittata* and *S. regularis*. We did not detect any species threatened with extinction based on their conservation assignment in the IUCN Red List. Twenty-four reptile species belonging to eleven families and 16 genera were recorded. The most species-rich sites for reptiles were Namirembe landing site, Lake Nabugabo Wetland system, Jubiya FR, Kawoko-Bigasa in the Katonga wetland system, and Kaziru landing at the shores of Lake Victoria. The most frequently encountered reptile species were *Naja melanoleuca*, *Trachylepis maculilabris*, *T. striata, Python sebae*, and *Varanus niloticus*. For either the amphibian or reptilian fauna, there was no one particular site or habitat that we identified as very unique from the others or critical for one species or taxon.

INTRODUCTION

The Nabugabo Wetland Ecosystem in Masaka District was recently named a Ramsar site because of its unique characteristics some of which are geological, ecological, climatic and socioeconomic (Busulwa *et al*. 2005). These wetlands are home to diverse flora and fauna and is also a water reservoir represented by three lakes – Nabugabo, Birinzi and Kayugi. Nonetheless, community ecology patterns have been poorly investigated in these wetlands, despite their considerable ecological and conservation relevance at the regional scale.

In the present study we aimed at specifically assessing the herpetofaunal diversity at selected sampling sites within the above-mentioned systems based on the available habitat types.

The following were the main objectives of the study:

1 – provide a checklist of the amphibians and reptiles of the area, with preliminary indication of the apparent abundance of the various species;

2 – determine the species diversity and species richness patterns.

MATERIALS AND METHODS

Study area: We conducted surveys at the Lake Nabugabo-Ramsar Site area, Lake Nabugabo satellite lakes, wetland systems adjoining Lake Victoria and the Bunjako Bay of the River Katonga in southern Uganda, Africa (Fig. 1). Twenty-one site code named N1-N21, representing key habitats and lying between 113 and 1165 m a.s.l. were chosen to study the herpetofaunal diversity (Table I). Main habitat characteristics of these sites are presented in Appendix 1.

Field protocol: The field surveys were conducted, in each day of research, concurrently by two people from 9-18 November 2016, which yielded a total field effort of 80 hours. Surveys were carried out both during the daytime (0700-1800 hr) and in the evenings (1900-2100 hr). The latter survey period was cho-

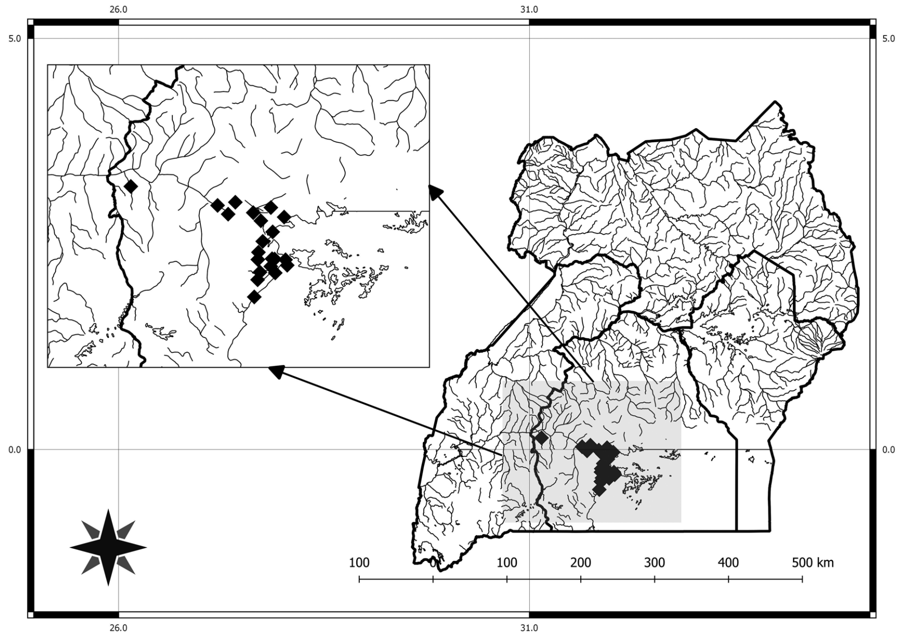

Fig. 1. – Map of the study area showing the sampling plots.

Table I. – Geo-referenced points surveyed for amphibians and reptiles.

Site code	Site name	Eastings	Northings	Altitude (masl)
N1	Kawoko, Bigasa, Bukango parish, Katonga wetland system	348707	3798	1162
N2	Micuncu village, Katonga wetland system	371317	9999219	1154
N3	Mwebesa's farm, Katonga wetland system	390896	9996449	1140
N4	Kasaka landing site, Makonzi	383260	9970225	1133
N5	Kacanga landing site, Bukakata ferry landing	391772	9969595	1137
N6	Kagenda village, Katonga wetland system off Nkozi-Bukasa road	381591	4950	1155
N7	Jubiya forest reserve	384867	9970051	1155
N8	Bukulula, Bugonzi village, Kyenyange wetland	374604	9974297	1142
N9	Lambu landing site, Bukakata subcounty	392855	9966153	1139
N10	Kasaka village, Kituti landing site	374086	995702	1134
N11	Namirembe landing site	371968	9946206	1140
N12	Mazigo Area, along Bukakata road	382445	9965395	1157
N13	Lake Nabugabo wetland system	375631	9961777	1133
N14	Kaziru village, shores of L. Victoria	385248	9961320	1144
N15	Lake Birinzi wetland	374167	9969678	1159
N16	Bulingo landing site, Lukaya	377336	9981171	1138
N17	Naamaliba landing site, Lukaya	383628	9987143	1135
N18	Lweera, Kalungu district	376144	9994121	1141
N19	Seeta village, Katonga wetland system off Nkozi-Bukasa road	382488	244	1162
N20	Nabajjuzi wetland	355405	9998273	1165
N21	Mirambi village, along Gomba road, Katonga wetland	359966	5797	1160

sen because amphibians are more active at night. Nocturnal surveys were conducted with the aid of a flash light. For each sighting, we recorded the species, the number of animals encountered and GPS positions using Garmin GPSmapsec.

Multiple survey methods were used to sample the herpetofauna, including Visual Encounter Surveys (VES) (Heyer *et al.* 1994). We used VES because they are effective in most habitats and for most species, including those that breed in lentic habitats and can generate encounter rates of species in their habitats in a unit hour. During VES, the field team randomly moved through a habitat, turning logs or stones, inspecting retreats, and recording surface-active species. The data gathered using this procedure provided information on species richness of the habitat.

Pitfall traps were set up with a drift fence in selected study sites to sample surface dwelling herpetofauna (Dodd 1991, Heyer *et al*. 1994). Each drift fence comprised of 10, 20-litre plastic buckets placed at an interval of 10 m, covering a total length of 100 m. The buckets were placed in the substrate such that their rim was level with the ground. A 100 m long and 0.5 m high drift fence of black low-density polyethylene supported vertically by wooden poles was set in an alternating manner with the buckets in the line to permit detection of directional movement of animals. The pitfall traps were inspected twice a day.

To sample aquatic species and tadpoles, a standardised dipnet was used. Specimens of aquatic species or tadpoles caught by this method, if not identifiable in the field were preserved for later identification.

Opportunistic records were also made outside the sampling points but occurred in the surrounding area of the surveys. These records supplemented the standardized survey records, and served to maximize animal encounters.

Field identification of the species followed Schiøtz (1999), Spawls *et al*. (2002, 2006) and Channing & Howell (2006). The collected specimens were deposited in the Zoology Museum at Makerere University. The conservation status of the herpetofauna followed the IUCN Red List (IUCN 2016).

Data analysis: Species accumulation curves, diversity indices and cluster analyses were performed to predict species diversity of the sampled locations and important habitats for the amphibian and reptile species. In order to determine the possible maximum diversity for amphibians and reptiles in the sites surveyed, we used different species estimators: Chao1, Chao 2, Jacknife-1, and Jacknife-2 (Hughes *et al*. 2001, Chodak *et al*. 2013). A cluster analysis was performed to determine which habitats/sites group together. A Bray-Curtis Cluster statistic was used to quantify the compositional dissimilarity between different sites, based on counts at each site. In this analysis, sites with similar characteristics tend to cluster together hence harboring more or less the same species composition and the fewer the species that utilize a particular habitat compared to another habitat, the more distant the clusters. All analyses were performed with PAST 3.0 statistical software, with alpha set at 5 %.

RESULTS

Amphibian distribution and diversity

A total of 27 amphibian species belonging to nine families and 12 genera were recorded during the surveys. The amphibian diversity (number of species) by site is given in Fig. 2A. The most species-rich site was Kaziru landing site (N14) with 16 species, followed by Lambu landing site (N9, 14 species), whereas the most species-poor sites were at Micucu – in Katonga wetland system (N2) and Kagenda village (N6), each with five species.

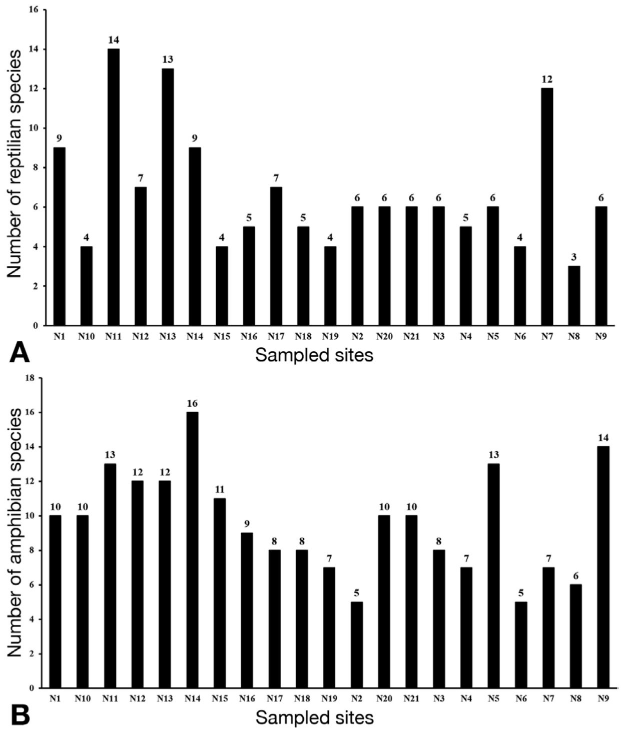

Fig. 2. – Amphibian (**A**) and reptilian (**B**) diversity in the surveyed locations.

The most frequently encountered species were *Hyperolius kivuensis* and *Ptychadena nilotica* in 19 of the 21 sites surveyed, followed by *Hoplobatrachus occipitalis* (17 sites), *Sclerophrys Amietophrynus vittata* (15 sites), *H. cinnamomeoventris* and *P. porosissima* (14 sites each) and *Sclerophrys Amietophrynus regularis* (13 sites). The least common species were *Amnirana* cf. *galamensis* and *Phlyctimatis verrucosus*, each in one site, followed by *Sclerophrys gutturalis, Amnirana* cf. *albolabris, Hyperolius langi, Leptopelis* sp. and *Ptychadena chrysogaster*, each recorded in only two sites. The latter species normally occurs above 1800 m elevation in the Albertine Rift, thus the exact identity of this species should be confirmed by further analysis. However, we consider this record as reliable, as there is evidence that the area was a Pleistocene refugium for forest cover (Katende & Pomeroy 1998, Bakamwesiga *et al*. 2000). The habitats, where these less common species were recorded, were in Kasaka-Kituti landing site (N10), Nabajjuzi wetland (N20), Kacanga Bukakata landing site (N5), Lambu landing site (N9), Lake Birinzi (N15), Jubiya FR (N7), Namirembe landing site (N11), Kaziru landing site (N14) and Mazigo wetland (N12).

A species accumulation curve plotted for the areas surveyed (Fig. 3A) showed that a plateau phase was reached, thus implying that the amphibian diversity of the areas surveyed was almost exhausted. Using species estimators for the possible maximum amphibian diversity in the sites surveyed, Chao 1 predicts up to 27 species, Chao 2 up to 34, Jacknife-1 up to 30 and Jacknife-2 up to 34 species. Chao 1 was in agreement with the survey. With more sample sites and effort, the species estimators predicted a maximum number of species to be between 30 and 34.

The Bray-Curtis cluster analysis showed that all the 21 sites are generally related to each other in terms of species composition (Fig. 4A). The most distant site – Lake Birinzi (N5) – was 60.7 % similar to the rest of the sites. The other sites that stand out from this analysis were Nabajjuzi wetland (N20), Kagenda-Nkozi (N6) and Jubiya FR (N7). The most similar sites were Lambu and Bukakata (Kacanga) landing site at a similarity distance of 88.9 %, Namirembe landing site and Mirambi-Gomba-Katonga wetland system (N11 and N21 at 87 %), Mazigo and Lake Nabugabo wetlands (N12 and N13 at 83.3 %), Bulingo and Namaliba landing in Lukaya (N16 and N17 at 82.3 %) and Kasaka landing-Makonzi and Lweera (N4 and N18 at 79.9%).

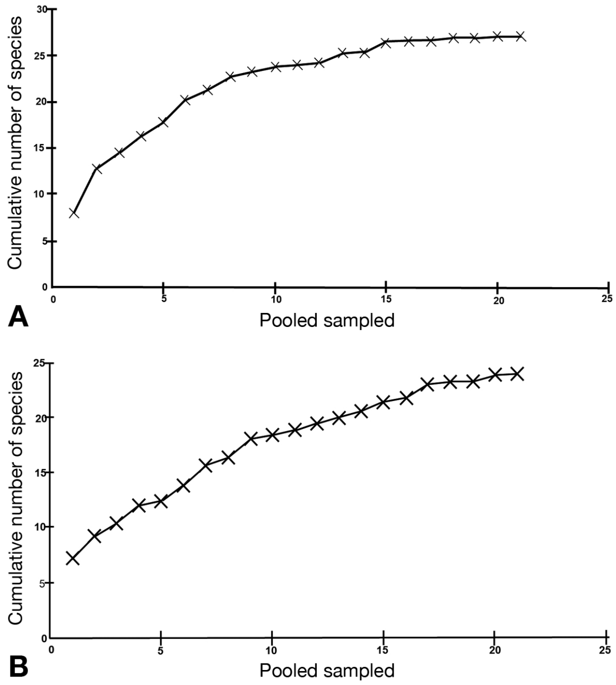

Fig. 3. – Species accumulation curve for amphibians (**A**) and reptiles (**B**).

Reptilian distribution and diversity

A total of 24 reptilian species belonging to eleven families and 16 genera were recorded. The reptile diversity (number of species) by site is given in Fig. 2B. The richest site was Namirembe landing site (N11) with 14 species, followed by Lake Nabugabo Wetland system (N13, 13 species). The species-poorest site was Bukulula-Kenyange (N8, 3 spp.), while Kagenda village (N6), Kasaka-Kituti landing site (N10), L. Birinzi (N15) and Seeta village (N19) had 4 species each.

The most frequently encountered reptile species were *Naja melanoleuca* and *Trachylepis maculilabris*, each recorded from 20 sites, followed by *Python sebae* and *Varanus niloticus* (16 sites each) and *T. striata* (11 sites). The most infrequently encountered species were *Bothrophthalmus lineatus*, *Philothamnus heterolepidotus, Psammophis sibilans* and *P. mossambicus* – each recorded in only one site. These are then followed by *Bitis gabonica, B. nasicornis, Hemidactylus mabouia, Lycophidion capense* and *Philothamnus* sp., each recorded in only two sites. The sites where these rare species were recorded were: N12-Mazigo wetland, N11-Namirembe landing site, N13-Lake Nabugabo wetland, N5-Kacanga-Bukakata landing site, N9-Lambu landing site, N3-Mwebesa's farm – near Katonga bridge, N2-Micucu-Katonga, N21-Mirambi-Gomba-Katonga wetland system and N7-Jubiya FR.

A species accumulation curve plotted for the sites surveyed shows the graph was still rising, relatively steeply (Fig. 3B). This implies that the reptilian diversity of the areas surveyed had not yet been exhausted. More sampling effort could yield a few more species than the 24 recorded. The survey was also done during the dry season, whereas the above-ground activity of most Afrotropical reptiles (especially snakes and tortoises) peaks during the wet months (e.g., Akani *et al*. 2013). Species that become common during the wet season might not have been recorded. A visit during the wet season might yield more species for the area as well. Using species estimators for the possible maximum diversity in the sites surveyed, Chao 1 predicts up to 24 species, Chao 2 up to 38, Jacknife-1 up to 28 and Jacknife-2 up to 32 species. Chao 1 was in agreement with the baseline survey. Since the species accumulation curve is still rising (Fig. 3B), this means that with more sampling, the diversity could be in the range of 28-32 species as predicted by Jacknife 1 and 2 estimators, respectively.

A cluster analysis (Fig. 4B) shows that all areas surveyed were related to each other in a hierarchical order. The most dissimilar site was N12 (Mazigo wetland) at a similarity distance of 62.3 %. Kasaka-Kituti landing site at a similarity distance of 66.5 %. Elsewhere, two clades seem to separate out. One clade comprises five sites (N1-Kawoko-Bigasa-Katonga system, N14-Kaziru landing site, N11-Namirembe landing site, N7-Jubiya FR and N13-Lake Nabugabo wetland). The other 14 sites also cluster together. There is however no particular habitat attributable to each clade. The most similar sites were N9-Lambu landing site and N5-Bukakata-Kacanga landing site (100 % similar), N6-Kagenda village, Katonga wetland system off Nkozi-Bukasa Road and N16-Bulingo Landing site, Lukaya (89 % similar), then N1-Kawoko, Bigasa, Bukango Parish, Katonga Wetland system and N14-Kaziru village, Shores of L. Victoria (also 89 % similar), N7-Jubiya Forest Reserve and N13-L. Nabugabo Wetland at a similarity distance of 85 %, while N15-L. Birinzi Wetland and N21-Mirambi village, along Gomba Road, Katonga Wetland, and N19-Seeta village, Katonga

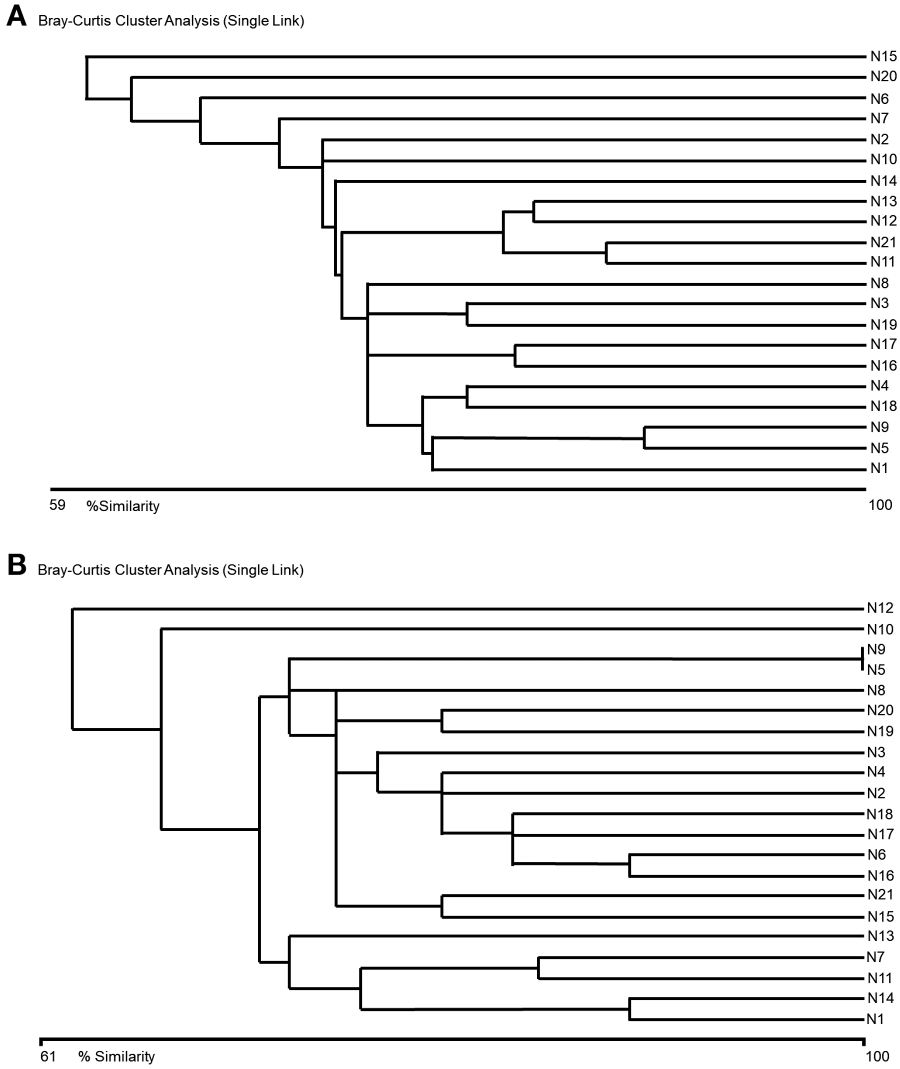

Fig. 4. – Dendrogram for amphibians (**A**) and reptiles (**B**).

wetland system off Nkozi-Bukasa Road and N20-Nabajjuzi wetland paired at 80 % similarity distance each. As for the amphibians, using cluster analysis, there was no particular site that appeared very unique from the others. Therefore, also the conservation of all reptile species in the area should take an integrated approach through the conservation of the whole area.

DISCUSSION

Lake Nabugabo wetland and other surrounding wetland systems studied were situated in the Lake Victoria Basin (NARO 2002). Although some information on amphibian distribution and diversity from this area has been published (Behangana & Arusi 2004, Behangana & Luiselli 2008), little has been published on reptiles. The only detailed studies on amphibian fauna in the area focused on Lake Nabugabo in the years 2003-2004 (Behangana & Arusi 2004, Behangana & Luiselli 2008), covering both the wet and dry seasons for more than half a year, yielded 24 amphibian species compared to 27 recorded during the recent surveys. The increase in the number of amphibian species during the recent surveys can be attributed to the additional area covered, which in turn meant some additional habitats that cannot be found in Lake Nabugabo ecosystem alone. Note too that the taxonomy of the species has also been refined since then (Channing *et al*. 2013, 2016, AmphibiaWeb 2016, Frost 2017, Zimkus *et al*. 2017). For example, in 2003-2004 the species *Hyperolius nasutus* was thought to be the one inhabiting Lake Nabugabo ecosystem, currently, a cryptic species *H. acuticeps* is the one known to be distributed in this area (Channing *et al*. 2013). Similarly, *Afrixalus quadrivittatus* is now known to be the grassland inhabitant replacing *A. fulvovittatus* that was in 2003-2004 thought to be the inhabitant. These species are cryptic and separation has been aided by modern techniques including molecular analyses: the genus *Bufo* has since changed to *Amietophrynus* and recently to *Sclerophrys*, the genus *Rana* to *Amietia* and *Hylarana* to *Amnirana*. These generic changes are only applicable to African species. The following species recorded by Behangana & Arusi (2004) and Behangana & Luiselli (2008) and in some other unpublished reports were not recorded during the recent surveys: *Sclerophrys steindachneri, Leptopelis bocagei* and *Phrynobatrachus dendrobates*. *Phrynobatrachus graueri* that was reported for this area are supposed to be in high elevations of the Albertine Rift and hence not check-listed. The differences in the number of species recorded at different times could be due to the rapid methods of surveying employed during the survey and due to logistical and temporal challenges as well as the need to take into account carrying out surveys across the different seasons. On the other hand, the species *Phlyctimantis verrucosus* was for the first time added to the checklist of the area during the recent surveys. The additional number of species vindicates the species estimators that a maximum of 30 to 34 species could be distributed in the surveyed area. This is approximately 40 % of the species of Uganda.

Phrynobatrachus rouxi was not recorded. This is a very poorly known species, with a Data Deficient status (Behangana *et al*. 2016, IUCN 2016) and with its type locality being Buddu Forest in southern Uganda along the western shore of Lake Victoria (which should be within the areas surveyed). The location of the site is not absolutely clear, so attempts to map its distribution should be considered as approximate. Specimens were recorded in Uganda and Kenya and have not been recorded in recent times. Its presence in Uganda and its habitat need to be investigated further.

The reptilian diversity of the area was assessed quantitatively for the first time during the present survey. Preliminary data was collected by Behangana from 1996-2002 in the Sango Bay area, but these data were never formally published. Both of these times, the surveys involved rapid assessments. As such, the number of reptile species derived from the data collected can only be a fraction of the total since reptiles can also be seasonal (e.g., Akani *et al*. 2013, 2014) and some are elusive (Akani *et al*. 2007) and would therefore require a longer survey time, probably longer than for amphibians, for one to reach the maximum number of species in an area. Unfortunately, logistic and financial constraints impeded us to continue our survey efforts for reptiles. In addition, several rare species might also have been missed from our surveys. Earlier surveys recorded a diversity of 19 species whereas the recent surveyed had 24 species recorded (Behangana unpubl data). Five species recorded in the past surveys (*Trioceros ellioti* – then mistaken for *T. bitaeniatus* (Behangana pers obs), *Chamaesaura anguina, Adolfus jacksoni, Dasypeltis scabra* and *Thrasops jacksonii*) were not recorded during this study. Further, ten species of snakes, turtles and lizards (*Afrotyphlops lineolatus, Bitis arietans, Hapsidophrys smaragdina, Lycophidion capense, Psammophis mossambicus, Psammophis sibilans, Chamaeleo laevigatus, Trachylepis striata, Hemidactylus angulatus* and *Pelusios williamsi*) were recorded in this study but were not found in the past (Behangana, unpubl data). Collectively, the total reptile diversity in the general study area is 29 species, which is about 16 % of the reptilian diversity of Uganda (Spawls *et al*. 2002). This is in consonance with the species estimators which put the maximum number of reptilian species between 28 and 32 species. The fluctuations in diversity for the different surveys could again be due to time limitations that result in sampling a few select sites.

Some apparently important sites with high or unique diversity were also highly altered. These included Kaziru landing site, where a wetland is dominated by a forest at the edge, graduating into a *Cyperus papyrus-Miscanthus* wetland and merging into Lake Victoria, is being destroyed to pave way for rice farming and sand mining (Behangana pers obs). A large commercial farm is also underway at the edge of Lake Birinzi, and a road is being constructed through the *Miscanthus* dominated wetland at Kituti-Kasaka. Such land uses, that permanently change the landscape and vegetation or hydrological structures of an ecosystem on which such herpetofauna depends, should be thoroughly investigated or even halted if they are found to negatively impact the species and or their habitats.

In addition, our analyses support the concept that there is no one particular site that can be said to be very unique from the others for both amphibian and reptilian fauna. From a conservation perspective, we advocate for an integrated habitat preservation approach. In particular, the habitat of a poorly known amphibian species (*Phrynobatrachus rouxi*), whose type locality was inside our study area, should be explored. Indeed, this frog species has not been recorded in recent times, but the available data are too scarce for assessing whether it has gone extinct or, as it seems more plausible, it has merely been missed due to suboptimal research efforts.

No IUCN species of conservation concern were recorded. All the species are of Least Concern (LC) except *Sclerophrys vittata,* which is said to be Data Deficient (DD) (Appendix 2). However, at National level, the Lake Victoria Toad has been assessed and considered as "Least Concern" (WCS, 2016 unpubl checklist) because the species is abundant along the shores of Lake Victoria and its associated rivers and wetlands. The White-lipped Frog (*A.* cf. *galamensis*), which is listed as Least Concern, has been elevated at National level to Near Threatened (NT) because of the threat it faces through transformation of its habitat into agricultural farmland. In the case of the surveys, it was recorded only once in L. Birinzi.

Most reptile species of East Africa have not recently been evaluated except the chameleons (Tolley & Trape 2014, Tolley *et al*. 2014). In this report, the IUCN (2016) Red List shows that most of the reptiles are Not Evaluated (NE) with very few, i.e., *Acanthocercus atricollis*, *Chamaeleo laevigatus*, *Lycophidion capense*, *Bitis arietans* and *B. gabonica,* assigned to Least Concern (LC) status (IUCN, 2016) (Appendix 3). However, efforts have been underway by WCS (2016), together with local experts, to review the status of reptiles at the National Level and a new National Red List arrived at is also assigned, in which most of the species that were not evaluated now have a status of "Least Concern" (LC) at National Level. A "Data Deficient" (DD) status has been proposed for *Psammophis mossambicus* while *Trachylepis megalura* has been assigned a "Near Threatened" (NT) category (Behangana *et al*. 2016) because its habitat is constantly diminishing and threatened by overgrazing and bush fires. In conclusion, our study showed that, despite heavy habitat alteration at several sites within the study area, a high diversity of species of both amphibians and reptiles is still found, and that, therefore, carefully designed management actions should be taken by the competent authorities in order to avoid these species' further declines. In particular, since the natural habitats at the study area are very fragmented, it could be useful to select species with a role of focal indicators in fragmented landscapes (Battisti & Luiselli 2011), and therefore a more detailed knowledge of the species specific life and history traits of the various species of local herpetofauna is urgently needed.

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SUPPLEMENTARY MATERIALS

Appendix 1. – Sites surveyed for herpetofauna with habitat descriptions.

Site code	Habitat description
N1	Seasonally wet woodland/bushland; papyrus and sedges
N2	Seasonally wet grassland/woodland; papyrus and sedges
N3	Seasonally wet grassland/bushland/woodland; papyrus and sedges
N4	Permanently/seasonally wet grassland; papyrus and sedges
N5	Permanently/seasonally wet grassland; papyrus and sedges
N6	Permanently/seasonally wet grassland; papyrus and sedges, seasonally wet subsistence land
N7	Non wet Tropical High Forest (THF)
N8	Seasonally wet THF/grassland/subsistence land
N9	Permanently/seasonally wet grassland; papyrus and sedges
N10	Permanently/seasonally wet grassland; papyrus and sedges
N11	Non wet Tropical High Forest (THF); permanently/seasonally wet THF
N12	Seasonally wet THF; seasonally wet grassland
N13	Seasonally wet THF; permanently/seasonally wet grassland; papyrus and sedges
N14	Permanent/seasonally wet THF; permanently wet grassland; papyrus and sedges
N15	Permanently/seasonally wet grassland; papyrus and sedges
N16	Permanently/seasonally wet grassland; papyrus and sedges
N17	Permanently/ seasonally wet grassland; papyrus and sedges; seasonally wet subsistence land
N18	Permanently/seasonally wet grassland; papyrus and sedges; seasonally wet subsistence land
N19	Seasonally wet woodland; permanently/seasonally wet grassland; papyrus and sedges; seasonally wet subsistence land
N20	Seasonally wet grassland/subsistence land
N21	Seasonally wet woodland/woodland; permanently wet grassland; papyrus and sedges

Appendix 2. – Checklist of amphibian fauna recorded in the Greater Nabugabo Ramsar Area. Abbreviations: DD = Data Deficient; LC = Least Concern; NT = Near Threatened.

Family	Species and subspecies	Author	Common name	IUCN global threat	Proposed Uganda threat
Bufonidae	*Amietiophrynus vittatus*	Boulenger, 1906	Lake Victoria Toad	DD	LC
	Amietophrynus gutturalis	Power, 1927	Gutteral Toad	LC	LC
	Amietophrynus regularis	Reuss, 1833	African Common Toad	LC	LC
Phyxicephalidae	*Amietia angolensis*	Boacage 1866	Angola River Frog	LC	LC
Dicroglossidae	*Hoplobatrachus occipitalis*	Günther, 1858	Crowned bullfrog	LC	LC
Arthroleptidae	*Leptopelis* sp				
Hyperoliidae	*Afrixalus quadrivittatus*	Werner, 1907	Four-lined Spiny Reed Frog	LC	LC
	Hyperolius acuticeps	Ahl, 1931	Sharp-headed Long Reed Frog	LC	LC
	Hyperolius cinnamomeoventris	Bocage, 1866	Cinnamon-bellied Reed Frog	LC	LC
	Hyperolius kivuensis	Ahl, 1931	Kivu reed Frog	LC	LC
	Hyperolius langi	Noble, 1924		LC	LC
	Hyperolius viridiflavus bayoni				
	Hyperolius viridiflavus variabilis				
	Hyperolius viridiflavus viridiflavus	Dumeril & Bibron, 1841	Common Reed Frog	LC	LC
	Kassina senegalensis	Dumeril & Bibron, 1841	Senegal Land Frog	LC	LC
	Phlyctimnatis verrucosus	Boulenger, 1912		LC	LC
Ranidae	*Amnirana albolabris*	Hallowell, 1856	White-lipped Frog		LC
	Amnirana galamensis	Dumeril & Bibron, 1841	Galama White-lipped Frog	LC	NT

Appendix 2. –Continued.

Family	Species and subspecies	Author	Common name	IUCN global threat	Proposed Uganda threat
Phrynobatrachidae	*Phrynobatrachus acridoides*	Cope, 1867	Eastern puddle frog	LC	LC
	Phrynobatrachus mababiensis	FitzSimons, 1932	East Frican Puddle Frog	LC	LC
	Phrynobatrachus natalensis	Smith, 1849	Natal dwarf puddle frog	LC	LC
Ptychadenidae	*Ptychadena anchietae*	Bocage, 1868	Anchieta's Ridged Frog,	LC	LC
	Ptychadena chrysogaster	Laurent, 1954		LC	NT
	Ptychadena mascareniensis	Dumeril & Bibron, 1841	Mascarene Grass Frog	LC	LC
	Ptychadena oxyrhynchus	Smith, 1849	Sharp-nosed Ridged Frog	LC	LC
	Ptychadena porosissima	Steindachner, 1867	Grassland Ridged Frog	LC	LC
Pipidae	*Xenopus victorianus*	Ahl, 1924	Lake Victoria Clawed Frog	LC	LC

Appendix 3. – Checklist of reptilian fauna recorded in the Greater Nabugabo Ramsar Site. Abbreviations: NE = Not Evaluated; DD = Data Deficient; LC = Least Concern; NT = Near Threatened.

Order	Family	Species and subspecies	Author	Common name	IUCN global threat	Proposed Uganda threat
Chelonii	Pelomedusidae	*Pelusios williamsii*	Laurent, 1965	William's Hinged Terrapin	NE	LC
Sauria	Agamidae	*Acanthocercus atricollis*	A. Smith 1849	Common Tree Agama	LC	LC
	Gekkonidae	*Hemidactylus brookii*	Hallowell, 1852	Brook's House Gecko	NE	LC
	Gekkonidae	*Hemidactylus mabouia*	Moreau de Jonnes, 1818	Tropical House Gecko	NE	LC
	Scincidae	*Trachylepis maculilabris*	Gray, 1845	Speckle-lipped Skink	NE	LC
	Scincidae	*Trachylepis megalura*	Peters, 1878	Grass-top Skink	NE	NT
	Scincidae	*Trachylepis striata*	Peters, 1844	Common Striped Skink	NE	LC
	Chamaeleonidae	*Chamaeleo laevigatus*	Gray, 1863	Smooth chameleon	LC	LC
	Varanidae	*Varanus niloticus*	Linnaeus, 1766	Nile Monitor	NE	LC
Serpentes	Typhlopidae	*Typhlops lineolatus*	Jan, 1864	Lineolate Blind-snake	NE	LC
	Colubridae	*Bothropthalmus lineatus*	Peters, 1863	Red and Black Striped Snake	NE	LC
	Colubridae	*Lycophidion capense*	Boulenger, 1893	Cape Wolf-snake	LC	LC
	Colubridae	*Philothamnus heterolepidotus*	Günther, 1863	Slender Green-snake	NE	LC
	Colubridae	*Philothamnus semivariegatus*	A. Smith, 1847	Variegated Bush-snake	NE	LC
	Colubridae	*Philothamnus* sp.				
	Colubridae	*Psammophis mossambicus*	Peters, 1882	Olive Sand Snake	NE	DD
	Colubridae	*Psammophis sibilans*	Linnaeus, 1758	Hissing Sand-snake	NE	LC
	Colubridae	*Hapsidophrys smaragdina*				
	Boidae	*Python sebae*	Gmelin, 1789	African Python	NE	LC
	Elapidae	*Dendroaspis jamesonii*	Traill, 1843	Jameson's Mamba	NE	LC
	Elapidae	*Naja melanoleuca*	Hallowell, 1857	Forest Cobra	NE	LC
	Viperidae	*Bitis arietans*	Merrem, 1820	Puffadder	LC	LC
	Viperidae	*Bitis gabonica*	Dumeril & Bibron, 1845	Gaboon Viper	LC	LC
	Viperidae	*Bitis nasicornis*	Shaw, 1802	Nose-horned Viper	NE	LC