A rapid assessment of the amphibians and reptiles of Akagera National Park, Rwanda

Report

VW Summer school

HERPETOLOGY GROUP (FOCUS AMPHIBIANS)

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Summary

We assessed herpetofaunal diversity in Akagera National Park, Rwanda during nine independent Rapid Assessment (RAP) field days between October 25 and November 2, 2023, at the beginning of the rainy season. Herpetofaunal diversity was recorded both during the day and at night by visual and acoustic (amphibians only) encounter surveys (VES and AES). VES and AES were supplemented by opportunistic dip netting for anuran larvae. These surveys represent a spatially explicit re-survey of amphibians and reptiles for the park and thus provide (1) confirmation of previous records including specific locality information and (2) new records of taxa not previously recorded in the park. We recorded a total of 16 species of anurans, among those *Phrynomantis bifasciatus*, a peculiar microhylid known in Rwanda from only two localities in the eastern lowlands, outside Akagera NP and not recorded in the country for almost 30 years after its first discovery. With only 11 (13) species (including 3 (5) lizards, 5 snakes and 3 turtles), the reptile diversity recorded during the study period was remarkably low. It is unclear whether this is due to unfavorable seasonal conditions (beginning of the rainy season) or reflects the actual low diversity of reptiles in the park. Whether uncontrolled fires and regular burning are a factor contributing to the low abundance and diversity of reptiles in the park needs to be investigated in the future. The amphibian species recorded in the park occur across a wide range of habitats from open savanna plains to marshlands and mid-elevation rocky outcrops. Given their peculiar biology and microhabitat association, they may serve as a useful indicator group to assess the status, potential and perspectives of the larger Akagera NP ecosystem.

Introduction

Despite the fact that herpetological field research has been conducted in Rwanda for more than a century, our knowledge of the country's herpetofauna must be considered incomplete. Recent surveys and research have led to the discovery and description of several species new to science (e.g. Greenbaum et al. 2022, Dehling 2023), and further descriptions are in progress. Although herpetofaunal diversity in Rwanda appears to be moderate compared to other African countries (e.g. Cameroon with 223 listed amphibian species), the country's species richness may be underestimated. The current species lists for amphibians in Rwanda contain between 57 (56 anurans, 1 caecilian, Frost 2023) and 62 (61 anurans, 1 caecilian, Dehling and Sinsch 2023) species. A comprehensive country list for reptiles is still pending. Intensive and long-term field studies have already been conducted in the two montane rainforest national parks Nyungwe NP (Dehling et al. in prep.) and Volcanoes NP (Roelke and Smith 2010), which together have the highest species richness and the highest number of endemics in all surveyed areas of Rwanda. Savanna ecosystems are underrepresented, but the few sites that have been the subject of previous surveys, such as Akagera NP, show moderate species richness. The most recently published revision (Dehling and Sinsch 2023) lists 19 anuran species for the park, most of which are listed as either "data deficient" (DD) or "least concern" (LC) according to global and national Red List criteria. There is currently no similar published list for reptiles.

The aim of the field surveys conducted as part of the VW summer school was therefore to **(1)** re-assess previous records and provide spatially explicit occurrences **(2)** establish a reference collection including tissue samples that will be available for subsequent analysis of questionable taxa and species complexes. All vouchers will be shared between the CoEB collection located at the Huye campus of the University of Rwanda and the Senckenberg Natural History Collection Dresden under the terms and conditions defined in the existing MoUs and MTAs established between the two institutions

Amphibians and reptiles are amongst the world's most threatened organisms (Stuart 2004, 2008; Böhm et al. 2013). The reasons for their dramatic decline are multifaceted but unarguable the most important factor is land use change followed by climate change, direct exploitation and pollution (IPBES 2019). Several of these factors are likely to affect the herpetofauna diversity in Akagera National Park and this will ultimately have consequences for informed and efficient conservation measures. Due to their peculiar biology and particular diversity of reproductive strategies (Wells, 2007), amphibians are particularly affected by small changes in their microhabitats, e.g. changes in microclimate or habitat structure, and should therefore be particularly prone to the effects of land-use change. They can thus be used to predict the response of other, less sensitive taxonomic groups (Roque et al., 2018) and they have previously been proven to be a suitable, sensitive organismal model system for analyzing the impacts of environmental change on community structure, composition, and diversity at both taxonomic and functional levels (Ernst et al., 2006; Ernst and Rödel, 2008; Hölting et al., 2016). They would therefore by a good choice as a model indicator group to assess the status, potential and perspectives of the larger Akagera NP ecosystem, particularly but not exclusively the vast wetland sites, with respect to safeguarding and developing biological diversity in this exceptional ecosystem.

Methods

Study sites

Herpetofaunal diversity of Akagera National Park was opportunistically assessed in 13 distinct localities (Figure 1), during nine independent Rapid Assessment (RAP) field days between October 25 and November 2, 2023, at the beginning of the rainy season. Field surveys covered various habitats from wetlands to open savanna and rocky outcrops at mid-elevations. Approximately half of the survey time was spent in the southern part of the park and the remainder in the northern part.

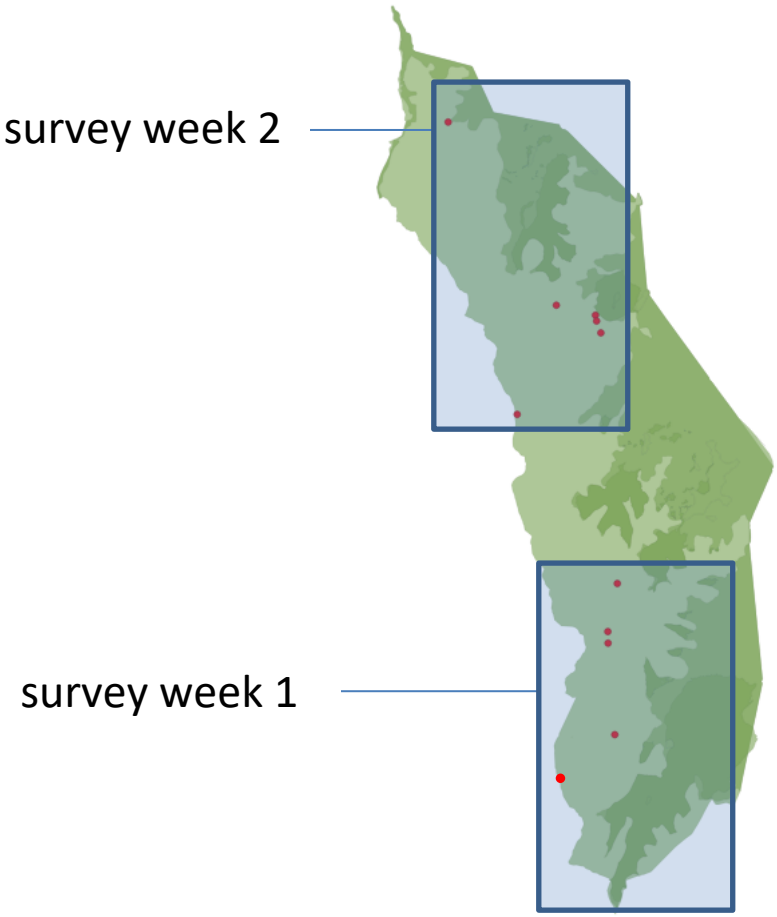

Figure 1. Study area with sampled localities (red dots). Boxes represent broader area covered during respective survey weeks.

Data acquisition and processing

We used opportunistic visual and acoustic encounter surveys (VES & AES) both during the day and at night supplemented by opportunistic dip-netting for anuran larvae (Rödel & Ernst 2004) to obtain basic faunistic data. Voucher specimens and tissue samples were collected for ex situ identification of problematic taxa that cannot unambiguously be identified in the field or based on morphological and acoustic data, using a DNA-barcoding approach. All collected specimens were euthanized using commercially available toothache pain relief gel containing 20% Benzocaine and subsequently preserved in 70% ethanol (Figure 2). Specimens are shared between the herpetological collection of the Museum für Tierkunde, Senckenberg Natural History Collections Dresden (MTD) and the Zoological Collection at CoEB located at the Huye campus of the University of Rwanda. Tissue samples used for molecular analyses are additionally stored in the tissue bank of the MTD. The combination of RAP methods and lab-based molecular identification techniques is crucial to resolve basic taxonomic questions and provide baseline data on actual species richness and distribution within and among the focus localities and the wider national and cross-regional context. In addition to EtOH-preserved collection vouchers, a small live breeding group (one female and two males) of the microhylid *Phrynomantis bifasciatus* were transferred to the captive breeding facility maintained by H. Hinkel, Kigali for ex-situ breeding. By agreement, these live vouchers will eventually have to be transferred to the CoEB collection.

Figure 2. CoEB team member Salim Kabano preparing voucher specimens and tissues samples.

Results and Recommendations

While we were able to obtain a very solid overview of the park's amphibian fauna (13 of 19 previously recorded species, three previously unreported species, two of which require taxonomic identification, Table 1), reptiles were largely underrepresented with only 11 (13) species in our sample, and the reptile data must be considered too incomplete to allow comprehensive conclusions (Table 2). Nevertheless, we identified several unique species and species with potential conservation needs in both taxonomic groups. The most abundant and widespread reptile species was the Scincid *Trachylepis striata*, which occurred in a variety of habitats, including anthropogenically disturbed areas. Juveniles of this species were frequently encountered, especially among rocks on the slopes of the escarpments. A single juvenile of the viper species *Causus rhombeatus* was recorded as DOR at the access road to the campsite at Lake Mihindi. These records are an indication of the reproduction of these species at the beginning of the rainy season. The large monitor lizard *Varanus niloticus* was frequently seen in wetlands and on the lakeshore both in the south (park entrance at Ruzizi and shores of Lake Ihema) and north (near Lake Mihindi) of the park. Juveniles were only seen on the lakeshore. A single sighting of another large-bodied lizard, *Gerrhosaurus* sp. was made in the north of the park on the plains of the Magashi Peninsula. Previous anecdotal observations suggest the presence of a possibly undescribed species of the dwarf gecko genus *Lygodactylus* in the park. Although we did not encounter any individuals during our survey, a photograph taken during a previous botanical survey of the park on the platform of Ruzizi Lodge shows a *Lygodactylus* sp. that is likely consistent with these earlier observations (Fig. 3). The occurrence and identity of these animals needs to be clarified in future, more intensive surveys. A total of six reptile specimens (three snakes, three lizards) including corresponding tissue samples were collected during the survey. All other evidence corresponds to sightings. Turtles and tortoises will be dealt with in a separate report (PI M. Vamberger).

Figure 3. *Lygodactylus* sp. photographed at Ruzizi Lodge. Photo © Quentin Luke

While several amphibian species are widespread throughout the park (e.g. *Kassina senegalensis*, *Phrynobatrachus natalensis*), others were found to be restricted to either the south (*Ptychadena oxyrhynchus*, *Phrynomantis bifasciatus*) or the north of the park (*Ptychadena* sp., *Xenopus* sp.). Whether this reflects an actual species turnover or simply gaps in the sampling remains to be clarified in more intensive surveys. Particularly noteworthy is the occurrence of *Phrynomantis bifasciatus* (Fig. 4), which was reported from a single site on the southern escarpment. The species is known in Rwanda from only two locations in the eastern lowlands outside the Akagera National Park and has not been observed since 1994, the year in which it was first recorded in Rwanda (H. Hinkel pers. comm.). The males call hidden in small holes and burrows, often in association with termite mounds. They are notoriously difficult to detect, which may partly explain why the species has not yet been recorded, but their calls are very conspicuous and can be easily recognized. The related West African species *Phrynomantis microps* is known to be associated with ponerine ants (Rödel and Braun 1999), as is the arthroleptid *Arthroleptis xenochirus*, which has similar habitat associations (Ernst et al.2020). In both species, the individuals are not attacked by the otherwise aggressive ants, which is probably due to a chemical camouflage mechanism. *Phrynomantis bifasciatus* was also found in association with ants in Akagera National Park, but unlike their West African congeners, they shared burrows under rocks containing colonies of yet unidentified formicine ants (Fig. 5 and short movie sequence available from the authors). The observed adult female (RWRE2338) was located under a large stone surrounded by ants. An adult male (RWRE2327) was found under a smaller stone only 10 cm away. Other calling males were found in the surrounding matrix, mostly calling covertly from holes and burrows. The species may be locally common and may be more widespread in the park. More intensive surveys should focus specifically on this species. In their recent first proposal for a national Red List of amphibians in Rwanda, Dehling and Sinsch (2023) suggest classifying the species as vulnerable (VU), mainly due to its rarity and absence in protected areas. Based on the new findings in Akagera, this classification needs to be corrected and we therefore propose to classify the species as least concern (LC) according to the IUCN Red List criteria. However, the historical records urgently need to be re-visited and the actual occurrence in Akagera National Park should be systematically mapped. Due to its limited distribution in Rwanda, we nevertheless consider the species to be particularly worthy of protection. As Akagera National Park apparently harbors a large population, it could well be considered a priority amphibian species for Akagera National Park. Two species could not be assigned to known nominal species (*Ptychadena* sp. and *Xenopus* sp.) and require thorough morphological and molecular analysis to clarify their taxonomic status. A total of 66 amphibian specimens and corresponding tissue samples were collected during the survey. All other records correspond to sightings.

Figure 4. Female of *Phrynomantis bifasciatus* collected on the southern escarpment near Kitabili.

Figure 5. Female *Phrynomantis bifasciatus* in association with formicine ants, hidden under a stone.

Table 1. Amphibian species recorded in Akagera summer school in comparison with published list in Dehling and Sinsch (2023) including global, previously proposed and sug
Red List status.

Family/Species	Global Red List Satus	National Red List Status	Suggested NRL status	Summer school survey 23	Dehling and Sinsch 2
Arthroleptidae					
Leptopelis bocagii	LC	LC	LC	x	x
Bufonidae					
Sclerophrys gutturalis	LC	LC	LC	x	x
Hyperoliidae					
Afrixalus quadrivittatus	LC	LC	LC	x	x
Hyperolius cinnamomeoventris	LC	LC	LC	x	x
Hyperolius kivuensis	LC	LC	LC	x	x
Hyperolius rwandae	LC	LC	LC	x	x
Hyperolius viridiflavus	LC	LC	LC	x	x
Kassina senegalensis	LC	LC	LC	x	x
Microhylidae	LC	LC	LC		
Phrynomantis bifasciatus	**LC**	**VU**	**LC**	x	
Phrynobatrachidae					
Phrynobatrachus kakamikro	LC	LC	LC	x	x
Phrynobatrachus natalensis	LC	LC	LC		x
Phrynobatrachus scheffleri	LC	DD	-		x
Pipidae					
Xenopus victorianus	LC	LC	LC	x	x
Xenopus sp.			DD	x	

Table 1 continued

Ptychadenidae					
Ptychadena anchietae	LC	LC	LC	x	x
Ptychadena nilotica	LC	LC	LC	x	x
Ptychadena oxyrhynchus	LC	LC	LC	x	x
Ptychadena sp.			DD	x	?
Ptychadena sp.A		DD	-		x
Ptychadena sp.B		DD	-		x
Pyxicephalidae					
Cacosternum plimptoni	LC	DD	-		x
Ranidae					
Amnirana galamensis	LC	DD	-		x
Total number of species				**16**	**19**

Table 2. Reptile species recorded in Akagera summer school including global Red List and CITES status.

Family/ Species	Global Red List Satus	CITES
Testudinidae		
Kinixys spekii	NA	WA II
Pelomedusidae	NA	
Pelusios sp.	NA	
Pelomedusa sp.	NA	
Crocodylidae		
Crocodylus niloticus	*LC*	WA I
Gekkonidae		
Hemidactylus mabouia	LC	
Lygodactylus sp.	NA	
Gerrhosauridae		
Gerrhosaurus sp.	LC	
Scincidae		
Trachylepis striata	LC	
Varanidae		
Varanus niloticus	LC	WA II
Colubridae		
Crotaphopeltis hotamboeia	LC	
Elapidae		
Dendroaspis polylepis	LC	
Typhlopidae		
Afrotyphlops angolensis	LC	
Viperidae		
Bitis arietans	LC	
Causus rhombeatus	LC	

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