Herpetofauna community diversity and composition of a changing coastal wetland in Ghana

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Abstract

Despite concern about the negative effects of tropical wetland loss and degradation on biodiversity, data on impacts on amphibians and reptiles, remain scarce. Here, we assessed the herpetofauna at the Muni-Pomadze ramsar site for the first time in 14 years and report on the changes in diversity and composition at the coastal wetland. The methodology involved pitfall trapping, refuge examination and acoustic searches in the forest and grassland/thickets habitats, as well as interviews of a cross-section of local inhabitants. Overall, 39 herpetofauna species were recorded at the study area. These comprised 19 amphibian species belonging to six families (Bufonidae, Ranidae, Hemisotidae, Hyperoliidae, Arthroleptidae and Petropedetidae), and 20 reptile species of nine families. The reptiles consisted of four lizard families (Agamidae, Scincidae, Gekkonidae and Varanidae), four snake families (Boidae, Colubridae, Elapidae and Viperidae) and one chelonian family (Pelome dusidae). Three families, Hemisotidae, Arthroleptidae and Viperidae are first records for the study area. Survey at the site in 1998 recorded 28 species, comprising 15 species of reptiles and 13 species of amphibians. Two families (Microhylidae and Testudinidae) recorded in 1998 were not recorded in the present survey. Although we recorded higher species richness in the present study, there was no significant change in the proportion of savanna and generalist species in the forest because of compensatory dynamics. Given that habitat loss at the patch and landscape levels is the main threat to herpetofauna at the ramsar site, conservation managers should focus on preventing further deforestation, particularly at Yenku Block A Forest Reserve to preserve the herpetofana at the Muni-Pomadze ramsar site.

Introduction

Reptiles and amphibians (herpetofauna) are among the most species-rich groups of terrestrial vertebrates, with hundreds of new species still being discovered every year (Köhler et al., 2005; Pincheira-Donoso et al., 2013; Uetz & Hošek, 2015). Herpetofaunal species are essential components of terrestrial and aquatic ecosystems, being major secondary consumers and important prey for many tertiary and quaternary consumers (Raxworthy et al., 2008; Böhm et al., 2013). Factors affecting herpetofaunal species therefore ultimately affect other species throughout the food chain.

Herpetofaunal species are among the most threatened vertebrates world-wide (Stuart et al., 2004). Indeed, this group of vertebrates have already suffered massive declines due to habitat loss and degradation, pollution and climate change (Gibbon et al., 2000; Stuart et al., 2004; Pounds et al., 2006; Whitfield et al., 2007; Stuart et al., 2008;Sinervo et al., 2010). It is estimated that 20% of the world's reptiles are threatened with extinction (Gibbon et al., 2000; Böhm et al., 2013; Tingley et al., 2016). Amphibians have experienced the highest increase in vertebrate species with Red List status during the last decades (Stuart et al., 2008). Currently, more than 30% of all amphibian species are threatened and included on the Red List (Leduc et al., 2012). According to the Global Amphibian Assessment (GAA, 2004), 427 amphibian species are Critically Endangered, of which 122 could be extinct. Indeed, amphibians are the most threatened species in West Africa, with about one-third of amphibians in the forest of southern Ghana and western Togo threatened (Hillers et al., 2009). This highlights the need to conserve the species at local and regional levels.

Herpetofaunal species have specific

habitat and microclimate requirements for metabolism and reproduction, and are thus sensitive to changes in the environment (Huey et al., 2009; Meiri et al., 2013; Tuberville et al., 2015). Amphibians are particularly sensitive to habitat degradation, and are often the first vertebrates to show noticeable declines in areas experiencing environmental alterations (Hillers & Rodel, 2007). Because of their habitat specificity, low mobility, high reproductive capacity and turnover rate, sensitivity to habitat modifications and ease of sampling, amphibians and reptiles can be used as indicators of environmental health and could be monitored to assess the ecological integrity of terrestrial and aquatic ecosystems (Pineda et al. 2005; Raxworthy et al., 2008; Böhm et al., 2013).

The Muni-Pomadze wetland is one of the five coastal wetlands designated as ramsar sites in Ghana because of its importance as critical habitat for migratory waterbirds (Ofori et al., 2016). The wetland is biologically diverse, providing many key functions and ecological services to the surrounding local communities. Such functions include storm water detention, flood protection, soil erosion control, fresh and brackish water fisheries, food chain support, carbon storage and climate regulation (Gordon et al., 2000). It also provides habitat for numerous plant and animal species including vertebrates and invertebrates (Raxworthy & Attuquayefio, 2000; Ryan & Attuquayefio, 2000; Kyerematen et al., 2014). The wetland serves as important area for amphibians and reptiles. About 28 herpetofaunal species comprising 15 and 13 species of reptiles and amphibians respectively, were recorded at the site in 1998 (Raxworthy& Attuquayefio, 2000). However, this rich amphibian and reptile diversity is threatened by habitat loss and degradation at the wetland.

Gordon et al. (2000) noted that the Muni-Pomadze ramsar site has huge potential for development as an income-generating and educational nature reserve with an eco-cultural theme. Unfortunately, the socio-economic potential of the wetland remains untapped. The Government of Ghana, through the implementation of the Global Environment Facility (GEF), established and managed the wetland as part of the Coastal Wetland Management Project (CWMP) from 1993 to 1999 (Gordon et al., 2000). Although the CWMP established baseline information on the biodiversity of the wetland, educated the local people and created awareness on the values, benefits and functions of wetlands, it did not adequately involve the local people in the management of the site. The CWMP also failed to promote the Muni-Pomadze ramsar site as a unique ecotourism destination of cultural significance. This, coupled with rapid population growth, has increased the pressure on the wetland ecosystem, due to anthropogenic activities like farming, encroachment for settlement, hunting, firewood harvesting and livestock grazing (Wuver & Attuquayefio, 2006).

The terrestrial vegetation on the elevated ground at the Muni-Pomadze ramsar site comprises of grasslands, thickets, *Eucalyptus* plantations and natural forests. In the early 1990s, 53% of the site was classified as natural vegetation, 32.5% as agricultural land and 12.6% as residential area for the communities within the site (Gordon et al., 2000). However, between 1990 and 2000, the closed forest declined by 24%, while the grassland and built-up areas increased by 20% and 41%, respectively (Atampugre, 2010). The ramsar fact sheet for the site suggests that the degradation level is still high. At the time of the current study, a portion of the forest (Yenku Block A) had been converted into farmland (cassava and maize farms) and subjected to loggjng, leaving only thickets of dense shrubs (Kyerematen et al., 2014). Also, the grassland (Yenku Block B) had been heavily grazed and degraded by rampant and indiscriminate bushfires deliberately set by hunters and farmers, the latter during the clearance and preparation of their farmlands (Ofori et al., 2016). The *Eucalyptus* plantation that bordered the grassland area to the north at the foot of the Egyasimanku Hills had been converted into maize farms (Kyerematen et al., 2014). However, the thickets adjoining the grassland to the south had increased significantly (Ofori et al., 2016).

Habitat disturbance causes declines in the diversity and abundance of native species (Lawton et al., 1998; Cleary et al., 2016; Nowakowski et al., 2018) and may result in habitat specialist communities being replaced by wide-ranging generalist species that are disturbance-tolerant and of least conservation concern (Schulze et al., 2004). This could also enhance invasion by non-native opportunistic species. Indeed, it has been shown that butterfly assemblages at the Muni-Pomadze ramsar site had changed considerably in species composition and diversity. Grassland species and habitat generalists were recorded in high numbers in the degraded portion of the forest (Kyerematen et al., 2014). Ofori et al. (2016) also noted changes in small mammal abundance, diversity and composition at the site, with *Mastomys erythroleucus* having now replaced the previously dominant *Lemnyscomys striatus as* the most-trapped species. The former is an opportunistic species that is known to be tolerant of degraded habitat. *Mastomys erythroleucus* was also recorded in the degraded portion of the forest adjoining maize and cassava farms. Some forest-dependent species like *Malacomys edwardsi* and *Praomys tullbergi* were recorded in the thickets (Ofori et al., 2016).

In the present study, we assessed the herpetofaunal community at the Muni-Pomadze ramsar site and made a general comparison of the findings to the baseline data collected in 1998.We hypothesized that there will be higher proportion of grassland and generalist species in the forest, particularly in the degraded portion compared to the baseline data. We also expected some forest species to be attracted by the lush vegetation of the thickets within the grassland.

Material and Methods

Study area

The Muni-Pomadze ramsar site (5^{o} 19’ - 5^{o} 37’ N; 0^{o} 37’ - 0^{o} 41’ W) is located in the Central region of Ghana near Winneba, about 56 km west of Accra, the national capital. The site covers a total management area of 90 km^2,with the Muni lagoon covering an area of 3 km^2 and a maximum depth of 1.5 meters. Two protected areas (Yenku Blocks A and B) fall within the boundaries of the Ramsar site (Figure 1). The area is characterised by a bimodal rainfall pattern of a four-month (April to July) major, and a two-month (September to November) minor rainy season with mean annual temperature of approximately 27^{O}C. The vegetation is Coastal Savanna, with four main types of floral coverage: (i) flood plain (*Sesuvium portulacastrum*, *Paspalum virginicum*, *Sporobolus virginicus*,) (ii) sand bar/dune (*Cyperus maritimus*, *Cocos nucifera*, *Opuntia vulgaris*) (iii) riverine (*Paspalum virginicus, Sesuvium portulacastrum, Sporobolus virginicus*), (iv) elevated and undulating ground (*Azadirachta indica, Baphia nitida, Fagara zanthoxyloides, Panicum maximum, Andropogon canescens, Chromolaena odorata, talinum triangulare*) (Gordon et al., 2000).

Sampling locations

Data on amphibian and reptile diversity, abundance and species composition were gathered from Yenku Block A (YBA) and Yenku Block B (YBB). In order to compare our findings as far as possible to that of the baseline study, we surveyed within the same locations as the baseline study. Thus, at YBA, we surveyed around the geographic coordinates N 05° 22.679' W 00° 42.194' and at YBB we surveyed around N 05° 19.899' W 00° 41.615'.

Survey methods

The herpetofaunal survey was conducted in 2012 during the wet (June 20-24) and dry (January 10-14) seasons. There was a total of eight sampling days, four days in the wet season and four days in the dry season. A three-man search team positioned themselves five metres apart from each other to conduct refuge examinations along a 500 m line transect. Refuge examinations were undertaken by turning over rocks and fallen logs, peeling tree barks, digging through leaf litter, and searching through trees, rotten tree stumps, tree buttresses, termite mounds and burrows (Rödel & Ernst, 2004). Care was taken to ensure minimal disturbance of habitats by returning objects moved to their original positions after searching them. Amphibians were also surveyed in and around ponds and puddles at the study sites during the day and late evening (Heyer et al., 2014). Amphibian calls were recorded at various water bodies (ponds, pools, puddles, and streams) in the study sites. At each water body, the recorder listened carefully to a chorus and was able to distinguish calls of individual species that were clearly heard. Calls were also recorded and played back later for confirmation. In a chorus, only the presence of a species could be reliably recorded, as it is difficult to attach

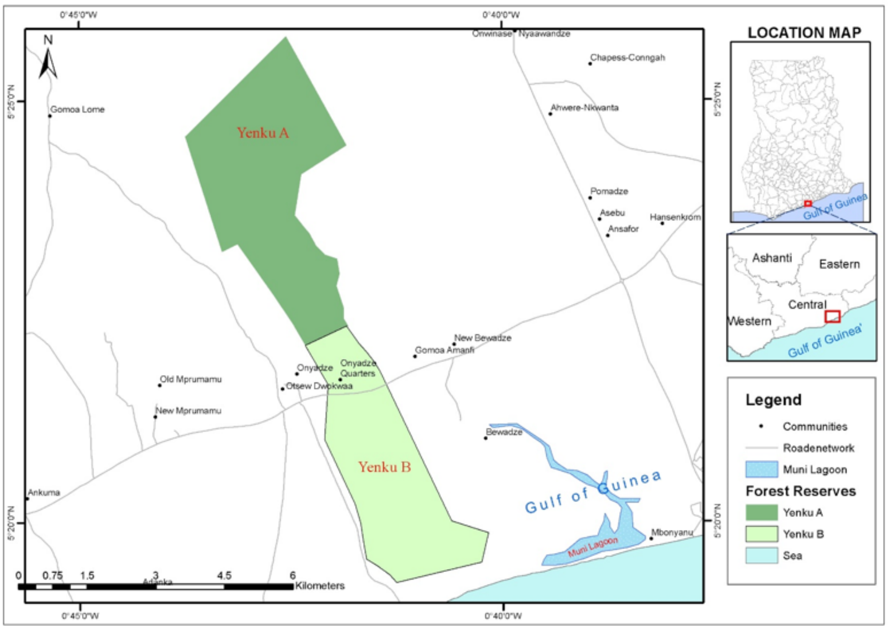

Figure 1 Map of the Muni-Pomadzeramsar site in the Central Region of Ghana

numbers. However, at each water body, individuals begin calling and are later joined by others to form a chorus. Hence, the position of those that begin the calls can be pinpointed, usually along the edges of the water body. Callers whose positions were clearly identified were recorded.

Pitfall traps made from 17-litre plastic buckets (175 mm depth, 290 mm top internal diameter, 220 bottom internal diameter) were sunk in the ground with their rims flush with the ground. A drift fence made of one metre-high mosquito netting stapled in a vertical position to wooden stakes, ran across the middle of the surface of each pitfall bucket. Each bucket had 2 cm diameter drainage holes at the bottom to prevent flooding during rains. The fences were sealed deep in the ground with soil and leaf litter to prevent animals passing underneath (Raxworthy & Nussbaum, 1996). Each study site had a 100-metre long pitfall trap with 21 buckets buried at 5-metre intervals. The traps were checked daily in the morning (06:00 hr GMT) and in the evening (18:00 hr GMT).

Interviews were conducted with a cross-section of inhabitants to supplement information obtained from the other methods. A manual was shown to the respondents to help them identify the various animals known to occur in the area and to answer some questions about those animals. Questions asked included whether the respondents knew a particular animal, and whether they had seen that animal before, how often they saw it and the last time the animal was seen. Herpetofaunal identification followed Hughes (1988), Rödel and Ernst (2002), Rodel and Agyei (2003), Onadeko and Rödel (2009), Leaché et al. (2006), and Rödel et al. (2005). Snake identifications were based on Chippaux (2006) and Trape and Mané (2006), while skink identification followed Hoogmoed (1974).

Data Analyses

We estimated species diversity using the Shannon-Wiener index. For both amphibians and reptiles, species richness was defined as the number of species recorded at each site. Similarity of species composition among sites and season was estimated using the Sorensen's index as:

$$2C / (a + b)$$

where:

a = number of species recorded at the first site

b = number of species recorded at the second site

C = number of species common to both sites.

The differences in number of individuals, species richness and diversity among the wet and dry seasons were tested for significance at $\alpha = 0.05$ using the Fisher' Exact test.

Results

Diversity and abundance of herpetofaunal species

A total of 180 individuals of 39 species comprising 19 amphibian and 20 reptiles were recorded, giving overall species diversity of 2.76 for the study area. Two species of snakes *Naja nigricollis* (black-necked spitting cobra) and *Bitis gabonica* (gaboon viper) were recorded through interview only. The amphibian species consisted of two toads and 17 frogs belonging to eight families, Bufonidae (true toads), Ranidae (true frogs), Hemisotidae (shovel-nosed frogs), Hyperoliidae (leaf-folding, reed and running tree frogs), Arthroleptidae (screeching frogs), Petropedetidae (puddle frogs), Dicroglossidae (crowned bullfrogs) and Ptychadenidae (grass frogs) (Table 1). The reptile were made up of nine lizards belonging to four families, 10 snakes of four families and one chelonian (family Pelomedusidae) (Table 2). Three families, Hemisotidae, Arthroleptidae and Viperidae are first records for the study area.

One hundred and one individuals consisting of 28 species (16 amphibians and 12 reptiles) were recorded in YBB, whiles 79 individuals consisting of 20 species (10 amphibians and 10 reptiles) were recorded in YBA. The families Scincidae and Arthroleptidae had the highest numbers of species with five each, followed by Petropedetidae, Hyperoliidae and Colubridae with four species each. *Amietophrynus maculatus* dominated the species recorded at YBB with 25% of the total number of individuals recorded, while *A. maculatus* and *Trachylepis affinis* were the two dominant species at the YBA. The two species contributed 48% of the total number of individuals recorded at this site. Fifteen species (seven amphibians and eight reptiles were common to YBA and YBB, giving similarity of species composition (Sorensen's index) of 0.6 between the two sites.

Seasonal effects on diversity and abundance of the herpetofaunal community

The total number of individuals recorded during the wet season was significantly higher (Fisher's Exact Test, $p < 0.01$) than those recorded in the dry season at both YBA and YBB. The species richness and diversity (H')

TABLE 1
Relative abundance, diversity and distribution of amphibians at Muni-Pomadzi ramsar site

SPECIES	YENKU BLOCK A (YBA)		Total	YENKU BLOCK B (YBB)		Total
	Wet Season	Dry Season		Wet Season	Dry Season	
Amietophrynus maculatus	12	2	14	22	3	25
A. regularis	0	0	0	3	1	4
Hemisus marmoratus	7	0	7	7	0	7
H. guineensis	1	0	1	0	0	0
Amnirana galamensis	0	0	0	4	0	4
Ptychadena longirostris	0	0	0	1	0	1
P. bibroni	7	0	7	0	0	0
Hoplobatrachus occipitalis	1	0	1	6	0	6
Phrynobatrachus plicatus	0	0	0	1	0	1
P. calcaratus	0	2	2	2	0	2
P. latifrons	0	0	0	7	0	7
P. francisci	0	0	0	5	0	5
Hyperolius concolor	0	0	0	1	0	1
Afrixalus vittiger	0	0	0	1	0	1
A. dorsalis	3	0	3	5	0	5
Kassina senegalensis	1	0	1	1	0	1
Leptopelis spiritusnoctis	3	0	3	1	1	2
L. viridis	0	0	0	0	1	1
Arthroleptis poecilonotus	0	16	16	0	0	0
Total number of individuals	35	20	55	67	6	73
Total number of species	8	3	10	15	4	16
Shannon Index	1.74	0.64	1.89	1.24	1.00	2.26

TABLE 2
Relative abundance, diversity and distribution of reptiles at Muni-Pomadzi ramsar site

SPECIES	YENKU BLOCK A (YBA)		Total	YENKU BLOCK B (YBB)		Total
	Wet Season	Dry Season		Wet Season	Dry Season	
Pelomedusa subrufa	0	0	0	1	0	1
Trachylepis perrotetti	0	1	1	5	0	5
T. affinis	12	2	14	0	0	0
T. albilabris	1	0	1	0	0	0
Lygosoma sp.	1	0	1	1	0	1
Panaspis togoensis	0	0	0	1	0	1
Lygodactylus conraui	0	0	0	1	0	1
Agama agama	0	0	0	12	0	12
Varanus niloticus	0	0	0	2	0	2
V. exanthematics	0	0	0	1	0	1
Python regius	0	0	0	1	0	1
Psammophis sibilans	0	1	1	1	0	1
Thelotornis kirtlandii	2	0	2	0	0	0
Mehelya poensis	1	0	1	0	0	0
Philothamnus irregularis	1	0	1	1	0	1
Naja melanoleuca	1	0	1	0	0	0
Dendroaspis viridis	1	0	1	0	0	0
Causus maculatus	0	0	0	1	0	1
Total number of individuals	20	4	24	28	0	28
Total number of species	8	3	10	12	0	12
Shannon Index	1.44	1.04	1.58	1.93	0	1.93

at both sites were also higher in the wet than dry season (Table 1 & 2). Of the 20 species encountered at YBA, 14 were recorded in the wet season only and four in the dry season. Also, 24 out of the 28 species recorded at the YBB occurred in the wet season only. The similarity of the composition of species recorded in the wet and dry seasons was low for both YBA (SI = 0.17) and YBB (SI = 0.19).

Response of the herpetofaunal community to ecological changes in the wetland ecosystem
Two families (Microhylidae and Testudinidae) that were recorded in the baseline survey were not encountered in the present survey (Table 3). The relative abundance of savanna species recorded in the forest during the baseline and present surveys were 50% (three out of six species) and 45% (10 out of 22 species), respectively. Also, the relative abundance of forest species recorded in the grassland/ thickets during the baseline survey was 11.5% (three out of 26), while that for the present study 10.7% (3 out of 28 species) between 1998 and 2012.

Table 3:Herpetofaunal species list and habitat associations (as obtained from the literature) at the Muni-Pomadze ramsar site (* = species present; for capture methods, Dc = direct capture, C = recorded using calls, Pt = captured in pitfall traps, Si = sighted, I = recorded by interviews, Fc = forest clearings, G = generalist, S = savannah, F = forest)

Species	Locality				Habitat	Capture Method
	2012		1998			
	YBA	YBB	YBA	YBB		
Amphibia						
Bufonidae						
Amietophrynus maculatus	*	*		*	S, Fc	Dc, Pt
A.regularis		*			S	Dc, Pt
Hemisotidae						
Hemisus marmoratus	*	*			S, Fc	Pt
H.guineensis	*				G	Pt
Ranidae						
Amnirana galamensis		*		*	S, Fc	Dc
Ptychadenidae						
Ptychadena longirostris		*		*	F	Dc
P. bibroni	*				S, Fc	C
P. oxyrhynchus				*	G	Dc
Dicroglossidae						
Hoplobatrachus occipitalis	*	*		*	S, Fc	C
H. galamensis				*	S, Fc	
Petropedetidae						
Phrynobatrachus plicatus		*			F	
P.calcaratus	*	*		*	G	Dc
P. latifrons		*		*	S, Fc	C
P. francisci		*			S	C
Hyperoliidae						
Hyperolius concolor		*		*	G	C
H. nasutus				*	S	Dc
Afrixalus vittiger		*			S	C
A. dorsalis	*	*		*	G	C
Kassina senegalensis	*	*		*	S, Fc	C
Microhylidae						
Phyrnomerus microps				*	S	Dc
Arthroleptidae						
Leptopelis spiritusnoctis	*	*			F	Dc
L. viridis		*			S, Fc	Dc
Arthroleptis poecilonotus	*				Fc, F	Dc, Pt
Arthroleptis sp.1	*				Fc, F	Dc, Pt
Arthroleptis sp.2	*				Fc, F	Dc, Pt
Reptilia						
Chelonia						
Pelumedusidae						
Pelomedusa subrufa		*		*	S, Fc	Dc
Testudinidae						
Kinixyshomeana			*	*	F	Dc
Lacertilia						
Scincidae						
Trachylepis perrotetti	*	*		*	S	Dc

T. affinis	*			*	G	Dc
T. albilabris	*				Fc	Dc
Lygosoma sp.	*	*				Dc, Pt
Panaspis togoensis		*	*	*	G	Dc
Gekkonidae						
Lygodactylus conraui		*			S	Pt
Hemidactylus brookii				*	G	Dc
Lygodactylus conraui				*	S	Dc
Agamidae						
Agama agama		*			S, Fc	Si
Varanidae						
Varanus niloticus	*	*		*	G	Dc, I
V. exanthematicus		*	*	*	S	Si
Serpentes						
Pythonidae						
Python regius		*	*	*	S, Fc	Si, I
Boidae						
Clabaria reinhardti			*		F	I
Colubridae						
Psammophis sibilans	*	*			G	Si
Thelotornis kirtlandii	*				Fc, F	Si
Mehelya poensis	*				S, Fc	Si
Philothamnus irregularis	*	*		*	S, Fc	Dc
Bothrophthalmus lineatus			*		F	Dc
Elapidae						
Naja melanoleuca	*				Fc, F	Si, I
N. nigricollis	*	*		*	G	I
Dendroaspis viridis	*			*	Fc, F	Si, I
Viperidae						
Causus maculatus	*	*			S, Fc	Dc,I
Bitis gabonica	*	*			Fc, F	I

Discussion

Despite the importance of biodiversity monitoring and assessment for wildlife conservation and population management, this is rarely done in developing countries because of lack of funds and human capacity. We surveyed the herpetofaunal community at the Muni-Pomadze ramsar site in Ghana for the first time in 14 years. Although direct comparison between the present study and the baseline study cannot be made because of differences in sampling effort and personnel, some generalizations could be made. We recorded a higher number of amphibian and reptile species than the baseline survey. This could be due to sampling artifact. Significantly higher number of species and individuals recorded during the wet season than dry season, suggested a seasonal effect on the herpetofaunal community at the study area.

Contrary to our expectation, the observed changes in vegetation of the study area had no significant effects on the distribution of savanna and forest obligate species in the study area. Although the present study recorded higher species richness in the forest than the baseline study, the relative abundance of savanna species in the forest remained fairly similar for the two study periods. Similarly, the relative abundance of forest specialists in the grassland/thickets was not significantly different between the two study periods.

Hughes (1988) recorded 98 herpetofaunal species in the coastal thickets of Ghana. The 39 herpetofaunal species recorded at Muni-Pomadze in this study represents about 40% of the known total coastal thicket herpetofauna for Ghana. Most surveys in Ghana have recorded between 10 and 20 amphibian species per site (Rödel et al., 2005). Therefore, the 19 amphibian species recorded at Muni-Pomadze falls within the average number of species usually recorded in Ghana. Leaché et al. (2006) recorded 65 herpetofaunal (26 amphibians and 39 reptiles) species in a more extensive survey in the Kyabobo National Park in Ghana. Overall, more species were encountered in Yenku Block B (grassland) than Yenku Block A (forest), probably because of ease of sighting and capturing of herpetofauna in open areas than in forest. Also, amphibians breed in pools, ponds and puddles and therefore had more breeding sites in Yenku Block B because of the presence of more temporary water bodies. Herpetofaunal species, particularly amphibians, undergo population explosions during the rainy season, providing more food for snakes and monitor lizards (Omogbai et al., 2002). This probably explains why the number of herpetofaunal species encountered was higher in the wet season than dry season.

About 33% of the approximately 40 species of lizards occurring in Ghana belong to the family Scincidae (Hoogmoed, 1974). Thus, it was not surprising that more reptile species from this family were recorded than from any other reptile family. The Arthroleptidae (screeching frogs), which are adapted to live independently of waterbodies (Adeba et al., 2010), had the highest number of species recorded. As expected, most of the species of the Arthroleptidae were recorded in Yenku Block A which was drier and had fewer water bodies even in the wet season. In contrast, the Petropedetidae prefer small temporary waterbodies such as ponds, pools and puddles, and hence most were recorded in Yenku Block B which had more pools and puddles during the wet season.

The rapid loss and degradation of tropical wetlands threatens the maintenance of biodiversity across different spatial scales. Indeed, habitat disturbance has been implicated in the declines of species abundance and diversity (Lawton et al., 1998; Schulze et al., 2004; Cleary et al., 2016; Nowakowski et al., 2018). However, the declines in disturbance-sensitive species may be compensated for by the proliferation of habitat generalists and opportunistic species (disturbance-adapted species), preserving community level attributes such as species richness and abundance in human-modified landscapes (Russildi et al., 2016). There was evidence of forest degradation due to farming encroachment in Yenku Block A and overgrazing, hunting and bushfires in the grassland in Yenku Block B. However, the thickets within the grassland were lush at the time of the present survey.

Kyerematen et al. (2014) found higher number of grassland and habitat generalist butterfly species in the degraded forest. Ofori et al. (2016) also noted changes in the small mammal community at the site. These authors reported shift in the dominant species in the grassland from *Lemnyscomys striatus* to *Mastomys erythroleucus,* with the latter being an opportunistic disturbance-tolerant species. *Mastomys erythroleucus* was also recorded in the degraded portion of the forest. Additionally, some forest-dependent species like *Malacomys edwardsi* and *Praomys tullbergi* were recorded in the thickets within the grassland in Yenku Block B.

In this study, we recorded higher species richness in both the forest and grassland/ thickets, but there was no significant change in the proportion of generalist and savanna species in the forest. Also, despite the lush thickets, there was no significant change in the proportion of forest species in the grassland/thickets. This could be explained by the compensatory dynamics in herpetofauna, which made the group show weak responses at the community level (Russildi et al., 2016). Our findings support studies (Lawton et al., 1998; Schulze et al., 2004) that suggested that different taxonomic groups or guilds respond differently at the community level to human-modified landscapes.

Most of the herpetofaunal species recorded in this survey are listed in the IUCN Red List of Threatened Species as "Least Concern" and thus are under no immediate threat. No amphibian is listed for protection under Ghana Wildlife Conservation Regulations. Monitor lizards (*Varanus* spp.) are listed under Schedule I of the Ghana Wildlife Regulations for complete protection. The marsh terrapin (*Pelomedusa subrufa*) and the royal python (*Python regius*) are listed under Schedule II (for partial protection). The venomous snakes are listed under Schedule V and can only be killed when their population expands to make them dangerous to humans and/or their livestock.

Herpetofaunal species are suitable for long-term monitoring due to their sensitivity to a broad range of environmental stressors (Raxworthy & Attuquayefio, 2000). Reedfrogs (*Hyperolius* spp.) are well-suited for monitoring ponds because they require freshwater to breed (Raxworthy & Attuquayefio, 2000). Large reptile species like *P. regius, Varanus exanthematicus* and *V. niloticus that* occupy burrows, are also suitable for long-term monitoring. *Amietophrynus* spp. which are savanna species that colonize degraded forests (Leaché et al., 2006) and can be used to monitor both Yenku Block A and B in both rainy and dry seasons. The frequency of encountering this species in a forested area indicates the level of forest disturbance.

Forest loss at the patch and landscape levels is the major threat to herpetofauna (Russildi et al., 2016). Although a portion of the forest in our study area has been converted into maize and cassava farms, there remains a substantial area of forest that serves as refuge for the biodiversity of the area. Therefore, to preserve herpetological communities in the Muni-Pomadze wetland, conservation managers should focus on preventing further deforestation, particularly at Yenku Block A.

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