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Large and Terrestrial Small Mammal Survey Along the Pampana River, Sierra Leone

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ABSTRACT

A survey of large and terrestrial small mammals was conducted in 2016 along the Pampana River in northern Sierra Leone as part of the biodiversity studies for the proposed Betmai Hydroelectric Project (BHP). Data were collected through direct observations, reconnaissance walks and informal interviews for large mammals and live traps for terrestrial small mammals. Nine species of large mammals belonging to 8 families were recorded, including 4 primates, 3 ungulates and 2 carnivores. Informal interview with local people and guides confirmed another 14 species of large mammals belonging to 8 families, including 5 primates, 4 ungulates, 3 carnivores and 2 scaly ant eaters. Small mammals consisted of 1 shrew and 7 rodents belonging to 7 families. Measures to mitigate impacts of the project activities should, therefore, address the continued existence of the remaining riverine forest and forest regrowth habitats of the resident large and small mammal communities.

Keywords: Betmai Hydroelectric Project, *Pan troglodytes verus*, Pampana River, habitat loss

INTRODUCTION

Sierra Leone is located at the western limit of the Upper Guinea rainforest in West Africa, a region designated as one of the global biodiversity 'hotspots', that is home to several endemic and threatened species which are of global conservation concern (Bakarr *et al.*, 2004). However, this entire range of the Upper Guinea forest has of recent been reduced to relatively small tracts occurring mostly in reserves or protected areas. In Sierra Leone, the extent of forest disappearance and accompanying loss of biodiversity is well recognized (Garnett & Utas, 2000, Wadsworth & Lebbie, 2019).

Although, there is no clear legal definition of forests in Sierra Leone (Wadsworth & Lebbie 2019), however, it is reported that an estimated 75% of the country was once forested (Lebbie 2002). With much of Sierra Leone having

suitable climatic and edaphic conditions for moist evergreen and semi-deciduous forest, only an estimated >5% of the country remained in forest fragments by the mid-1970s, with much of the original forest lost to logging and farming activities (Naughton-Treves & Weber, 2001). Presently, land area in Sierra Leone is dominated by a series of mosaic of vegetation types including farm bush, swamp, savanna, mangrove and fragments of secondary and primary forests mostly restricted to isolated patches on hill tops and sacred groves (Lebbie, 2001, Lebbie 2016), surrounded by agricultural communities, bush fallows, active farms and plantations.

Despite the degree of threat, a few protected areas in Sierra Leone still harbour a significant proportion of rare plant and animal species. For example, Gola Rainforest National Park in the southeast and Loma Mountains National Park in

north, the only two extensive remaining tracts of primary forest in the country harbours several mammal species of conservation concern including the critically endangered Western Chimpanzee (*Pan troglodytes verus*), the endangered pygmy hippopotamus (*Choeropsis liberiensis*), western Red Colobus monkey (*Procolobus badius*) and Diana monkey (*Cercopithecus diana*) (Klop *et al.*, 2008, Kortenhoven, 2008, Brncic *et al.*, 2010, Abu-Bakarr *et al.*, 2013).

We present here results from a survey of large and terrestrial small mammals conducted in northern Sierra Leone. This survey is part of biodiversity studies of the Environmental and Social Impact Assessment (ESIA) for the Betmai Hydroelectric Project (BHP) that was conducted in 2016. It is important to note that, no previous surveys of mammals have been conducted in the BHP area prior to this study. This study, therefore, is an assessment of mammalian composition in the BHP area which will serve as baseline information on large and terrestrial small mammals in the area and will also help inform the project impact on the resident mammalian communities.

MATERIAL AND METHODS

Study Area

The study was conducted around the Betmai Falls (N08°43'18.6"/W011°40'50.8") situated along the Pampana River, in Tonkolili District, northern

Sierra Leone (Figure 1) in September 2016. The area is part of the Sula Mountains ecosystem within the 'Guinea Highlands' considered an 'extremely high conservation priority' for mammals in West Africa (Bakarr *et al.*, 2001). The vegetation was characterized by a mosaic of forest (mostly restricted to galleries and steep hills), forest regrowth, farm bush and savanna. The area has a tropical climate with two pronounced seasons that is characteristic of Sierra Leone: a pronounced wet season from May to October, and a dry season from November to April. Economic activities of communities in the area is dominated by rice cultivation.

Data Collection on Large Mammals

Surveys were conducted using a combination of both active methods and Informal interviews (Bennun *et al.*, 2002). The active method included direct observation of species, tracks, dung, calls and nests to determine presence and distribution of large mammals. Direct observations were made during reconnaissance walks across all vegetation types in the study area. At the start of each reconnaissance survey, time and date were recorded. For any detections made during the surveys, about 10 minutes was spent observing and recording the following: name of species, time, number of individuals sighted (in the case of a group), type of habitat and GPS position. At the end of each survey, the time and duration of the survey were recorded.

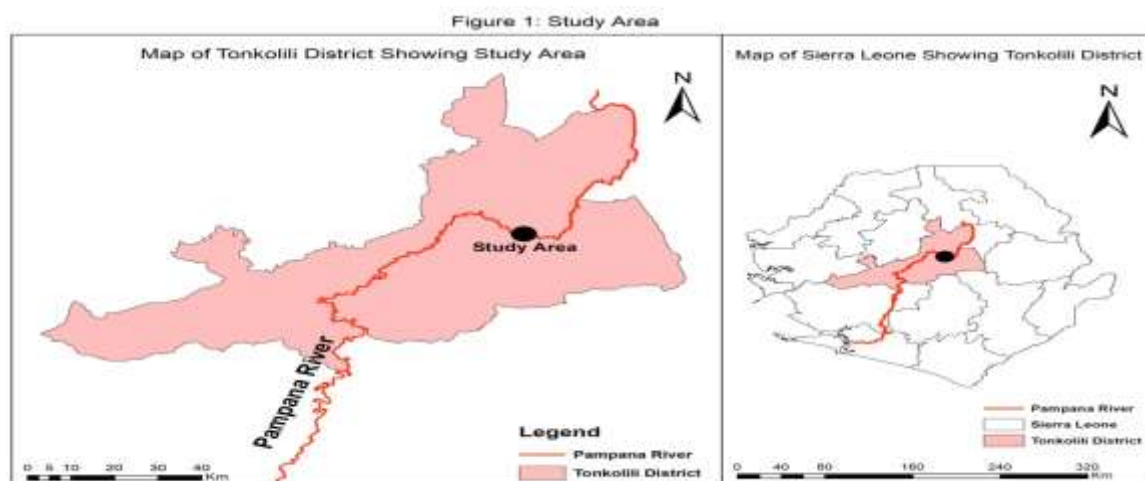


Figure 1: Map of Tonkolili District showing the study area

Data Collection

Informal Interviews

To complement data from reconnaissance walks, informal interviews with local people and field guides were conducted to gain any additional information on the mammal species in the area. During the interviews, the locals and guides were asked to list the species they knew existed in the study area. Utmost care was taken to prevent interviewees from indicating the presence of a species not found in the area. Where necessary, pictures were not used for species identification to avoid local people and field guides fitting animals to pictures thus creating errors as experienced in previous surveys. During the interviews, locals were also questioned on their use of mammal species in the area.

Data Collection on Small Mammals

This involved trapping mainly shrews and small rodents in different habitats (Decher *et al.* 2010). Observations were also made for signs of the presence of large rodents such as squirrels, porcupines and cane rats. Trap sites were

established in all habitat types in the study area (Table 1). Each site was sampled with a 200-meter trap line that had 10 Sherman live traps baited daily with palm kernel fruit and located 20 meters apart and checked daily in the mornings and evenings. One trap line of 10 pitfall bucket traps connected by 50 meters of plastic drift fence with 5 meters spacing was also set at the edge of a swamp. At each trap site, sampling was done for 2 consecutive days and nights except for the pitfall trap line that had 4 consecutive days and nights of sampling. Each live animal trapped was identified and immediately released back to their habitats. Field identification was based on Kingdon (2004). Trap nights for the Sherman live traps and pitfall bucket traps were calculate using the following formula:

$$\text{Trap nights} = \text{number of traps} \times \text{number of nights}$$

Table 1. Trap types, sampling effort, GPS coordinates and habitat description of trap sites

Trap Line (Trap Type)	No. of Traps	No. of Nights	Trap Nights	Coordinates (N, W)	Habitat
T1 (Sherman)	10	2	20	084318.6, 0114050.8	Forest edge
T2 (Sherman)	10	2	20	084339.4, 0114115.8	Forest edge
T3(Sherman)	10	2	20	084339.7, 0114104.7	Forest interior
T4 (Sherman)	10	2	20	084335.3, 0114105.7	Forest interior
T5 (Sherman)	10	2	20	084325.0, 0114100.1	Farm bush and swamp
6 (Pitfall)	10	4	40	084335.3, 0114105.7	Swamp
Total			140		

RESULTS

Large Mammal Species Diversity

A total of 9 species of large mammals belonging to 8 families were recorded during this study (Table 2). These include 4 primate, 3 ungulate and 2 carnivores. In addition to the 9 species of large mammals recorded, the informal interviews further confirmed an additional 14 species of large mammals belonging to 8 families in the study area (Table 2). This includes 5 primates, 4 ungulates, 3 carnivores, and 2 of scaly ant-

eat. Three primate species, *Cercopithecus campbelli*, *Cercocebus atys* and *Cercopithecus petaurista* were sighted and heard, while 1 species, the Critically Endangered *Pan troglodytes verus* was recorded based on evidence of their nests. For the ungulates, two species, *Cephalophus maxwelli* and *Tragelaphus scriptus* were recorded based on their feeding, track and dung evidence while *Potamochoerus porcus*, *Civettictis civetta* and *Mungos gambianus* were recorded based on their feeding evidence only.

Pan troglodytes verus nests were encountered on 2 separate occasions. In the first instance, we recorded recent nests on 7 different palm trees in farm bush less than 100m from the Pampana River and less than 1 km from the water intake area upstream. In addition, pith removal was observed on 5 palm trees as feeding evidence of chimpanzees in the same area. Secondly, 3 rotten nests were observed in forest patches along stream close to the base camp. Considering the fact that these two encounters occurred at different locations indicate that each encounter may have been a separate group or possibly the same group occupying the 2 locations at different times. However, this cannot be ascertained given that each group's home-range is unknown

and would require an extensive long-term study to determine. Mixed groups of *Cercopithecus campbelli* and *Cercopithecus petaurista* were sighted on 3 different occasions, twice in forest fragments close to the area where the project powerhouse will be located and once in farm bush north of the base camp. On each occasion, each species had >3 individuals including young and adults. Only 1 group of *Cercocebus atys* (>4 individuals) was sighted in farm bush along the main footpath leading from the base camp to Ropiti village. Members of the plant team also reported seeing more than 2 individuals in a forest fragment close to the Pampana River south of the base camp.

Table 2. Large mammals recorded in the study area.

Order	Family	Species	Common Name	O	N	H	F	T	D	I	IUCN Status
Primates	Loridae	<i>Peridicticus potto</i>	Potto							X	LC
		<i>Galagoides demidoff</i>	Demidoff's							X	LC
	Galagonidae		Galago								
	Hominidae	<i>Pan troglodytes verus</i>	Western Chimpanzee		X					X	CR
	Cercopithecidae	<i>Cercopithecus campbelli</i>	Campbell's Monkey	X		X				X	LC
		<i>Cercocebus atys</i>	Sooty	X		X				X	NT
		<i>Cercopithecus petaurista</i>	Mangabey Spot-nosed Monkey	X		X				X	LC
	Colobidae	<i>Procolobus badius</i>	Red Colobus Monkey							X	EN
		<i>Colobus polykomos</i>	Black and White Colobus							X	VU
		<i>Papio papio</i>	Guinea Baboon							X	NT
Artiodactyla	Antelopinae	<i>Philantomba maxwelli</i>	Maxwell's duiker				X	X	X	X	LC
		<i>Tragelaphus scriptus</i>	Bushbuck				X	X	X	X	LC
	Bovidae	<i>Neotragus pygmaeus</i>	Royal antelope							X	LC
	Antelopinae	<i>Cephalophus niger</i>	Black duiker							X	LC
		<i>Hyemoschus aquaticus</i>	Water Chevrotain							X	LC
	Tragulidae										
	Bovidae	<i>Syncerus caffer</i>	African Buffalo							X	LC
	Suidae	<i>Potamochoerus porcus</i>	Red River Hog				X			X	LC

Pholidota	Manidae	<i>Phataginus tricuspsis</i>	Tree Pangolin		X	LC
		<i>Smutsia gigantea</i>	Giant Pangolin		X	LC
Carnivora	Viverridae	<i>Civettictis civetta</i>	African civet	X	X	LC
	Nandininae	<i>Nandinia binotata</i>	African Palm Civet			LC
	Herpestidae	<i>Mungos gambianus</i>	Gambian mongoose	X	X	LC
		<i>Herpestes sanguinea</i>	Slender Mongoose		X	LC
		<i>Crossarchus obscurus</i>	Cusimanse		X	LC

Total Species = 23

Note: O=observed, N=nest, H=heard, F= feeding evidence, T=tracks, D=dung, I=interviews
CR= Critically Endangered, VU=Vulnerable, LC = Least Concern, NT=Near Threatened

Small Mammal Species Diversity

A total of 11 individuals comprising of 1 shrew species and 7 species of rodents were recorded (Table 3) during a total of 140 trap nights (Table 1). Two other rodents, *Funisciurus pyrropus* and *Xerus erythropus* were sighted while a third rodent species, *Hylomyscus alleni* was caught by local guides at the base camp. Only 1 shrew species, *Crocidura nimbasyllanus* was captured in the pithfall trap during this study.

Result from the informal interviews also confirmed the presence of 3 species of rodents already recorded during this study (*Funisciurus pyrropus*, *Paraxerus poensis* and *Xerus erythropus*) and an additional 4 species of rodents including *Atherurus africanus*, *Hystrix cristata*, *Cricetomys gambianus* and *Thryonomys swinderianus* (Table 3). Result from the informal interviews also revealed that local people in the BHP area only utilize mammals for bush meat consumption.

Table 3. Terrestrial small mammals recorded in the study area.

Order	Family	Species	Common Name	O	N	H	F	T	D	I	IUCN Status
Rodentia	Hystriidae	<i>Atherurus africanus</i>	Brush-tailed porcupine							X	LC
		<i>Hystrix cristata</i>	Crested porcupine							X	LC
		<i>Funisciurus pyrropus</i>	Fire-footed Rope Squirrel	X		X				X	LC
	Sciuridae	<i>Paraxerus poensis</i>	Green Squirrel	X						X	LC
		<i>Xerus erythropus</i>	Stripped Ground Squirrel	X						X	LC
		<i>Hylomyscus sp.</i>	African wood mice	X							LC
		<i>Dephomys defua</i>	Dephua Rat	X							LC
		<i>Hylomyscus alleni</i>	Wood mouse	X							LC
		<i>Malacomys longipes</i>	Common Long-footed Rat	X							LC
		<i>Hybomys</i>	Hump-nosed	X							LC
	Muridae										

Dendromurinae	<i>Vnivittatus</i>	mouse			
	<i>Dendromus sp.</i>	Climbing mice	X		LC
	<i>Praomys tullbergi</i>	Tullberg's Soft-furred Rat	X		LC
	<i>Cricetomys gambianus</i>	Giant Poached Rat		X	LC
Thryonomyidae	<i>Thryonomys swinderianus</i>	Grass cutter/Cane Rat		X	LC
Soricidae	<i>Crocidura nimbasylvanus</i>	Shrew	X		-
Insectivora					
Total Species = 15					

Note: O=observed, H=heard, F= feeding evidence, T=tracks, D=dung, I-interviews LC = Least Concern

DISCUSSION

Evidence of the diversity and abundance of large mammals recorded during this survey was considerably high while for small mammals (rodents and shrews) was generally low. All large mammal species recorded during our surveys are included in the 71 large mammal species previously documented for Sierra Leone (Grubb *et al.* 1998, Nippon Koei UK 2007, Kortenhoven 2008, Brncic *et al.* 2010, Abu-Bakarr *et al.* 2013). Therefore, 42% of the large mammal species previously listed for Sierra Leone is known to occur in the study area while 12 are endemic to the Upper Guinea region.

A group of chimpanzee nests with the same age usually gives an insight into the number of individuals within the group (Nippon Koei UK 2007, Kortenhoven 2008). Therefore, the seven recent nests encountered during this study is probably an indication that a group with at least 7 individuals occurs in the study area and are utilizing the mosaic of habitats along the Pampana River. All the seven nests were of the same age and no re-use nests were observed. Previous studies in the watershed of the Bumbuna Hydroelectric Project area, further south of the BHP area, recorded 4 chimpanzee communities and an estimated total population of 33 – 38 individuals based on nest counts (Nippon Koei UK 2007). In an environmental offset study at Loma for biodiversity losses resulting from inundation of the Bumbuna Hydroelectric Project catchment area, Kortenhoven (2008) estimated a chimpanzee density of 5.75 individuals per km² using nest counts. Also, the evidence of pith removal from palm trees for feeding by

chimpanzees observed during this study was also observed in the Bumbuna area (Nippon Koei UK 2007) and elsewhere in Africa (Humble 2003).

Although, nest sites and feeding evidence were focused on forest patches and farm bush, responses from local people however, indicated that chimpanzees were often seen in the study area especially in forest patches prior to the start of project activities. They maintained that chimpanzees were frequently encountered in all habitat types in the area but have now become less common probably due to the increased farming activities in the project vicinity and possibly due to potential human-chimpanzee conflict in the area.

Two other primate species, *Cercopithecus campbelli* and *Cercopithecus petaurista* were frequently encountered through direct sighting or calls in forest patches and regenerating farm bush indicating that they are widely distributed in the area. *Cercocebus atys* were encountered less. Responses from local people also confirmed this to be true. There was no evidence of two forest dependent species, *Procolobus badius* and *Colobus polykomos* despite both species being reported to occur in the area by local people. However, the presence of other forest dependent species could probably prove a justification and also indicate that the patches of forest ecosystem found in the study area are still healthy to harbour forest dependent species. Other species such as *Pan troglodytes verus*, *Cercopithecus campbelli*, *Cercocebus atys*, *Galagoides demidoff*, *Peridicticus potto* and *Cercopithecus petaurista* are adapted to changes in the forest ecosystem.

Potamochoerus porcus, *Tragelaphus scriptus* and *Cephalophus maxwelli* tracks were frequently encountered in all habitat types throughout this study. Responses from the locals also confirmed their presence in all sections of the study area. Similar records of these species have been made in Outamba-Kilimi National Park (Harding 1984), Gola Rainforest National Park (Klop *et al.* 2008), Bumbuna (Nippon Koei UK 2007) and Loma Mountain Forest Reserve (Kortenhoven 2008). All rodents and shrew recorded during this study are known to occur in Sierra Leone (Grubb *et al.* 1998). No threatened or new species for Sierra Leone was recorded. In comparison, more species of rodents and shrews were recorded in these other studies probably because of the duration and the number and different types of traps used. Anadu and Djosso (2008) recorded 14 species in the Loma mountains area, including 2 musk shrews and 94 mice; Decher *et al.* (2010) in a survey of small mammals conducted on the upper Seli River in central Sierra Leone recorded 11 rodents and 3 shrews including *Crocidura nigeriae*, which was new shrew record for Sierra Leone. About 9 years later, in a similar study along the same Seli River further north, Weber *et al.* (2019) recorded 3 shrews and 11 rodents during a baseline study for the Bumbuna Phase II hydroelectric project. Monadjem (2010) also recorded 9 species of shrews and 11 species of rodents (including *Colomys goslingi*, also a new rodent record for Sierra Leone) during a weeklong survey in the corridor areas between the Gola Rainforest National Park in Sierra Leone and the Gola National Forest in Liberia.

Comparing results of this study with other studies in the Upper Guinea forest region also indicates the importance of the study area for terrestrial small mammal diversity. A total of 11 individuals comprising of 1 shrew species and 7 species of rodents were recorded during this study. In the Cavally forest of Ivory Coast, Decher *et al.* (2005a) recorded 6 shrews and 11 rodents during a ten-night survey. In a similar study in southwest Ghana, Decher *et al.* (2005b) recorded 6 shrews and 10 rodents during a two-week survey. A long-term survey of the National Park of Upper Niger in Guinea reported 9 insectivores and 24 rodents among the total mammal species recorded (Ziegler *et al.*, 2002). This survey reported the White-toothed shrew, *Crocidura denti* as a new record for Guinea, and the second record for West Africa. A similar study of terrestrial small mammal species richness and abundance in Liberia recorded 5 species of rodents and 6 shrews of which 3 species,

Crocidura juvenetae, *Hylomyscus simus* and *Hybomys planifrons* were the most dominant (Akpato 2019). Omogbeme and Oke (2018) reported 17 species of rodents and 3 species of insectivores from their small mammal surveys in Okomu National Park, Edo State, Nigeria.

Hunting using shotguns was observed and increasing contact and conflict between humans and wildlife may result in an escalation of hunting. Primates and other large mammals are the primary targets of hunters (Eves & Bakarr 2001, Brncic *et al.* 2010) and hunting pressure drastically affects their population in the Upper Guinea forest region (Bakarr *et al.* 2004, Eves & Bakarr 2001). Davies (1987) reported that hunting probably affected primate populations to a greater extent than timber extraction in the Gola Forest Reserves. The use of snares especially around farms and the forest interior was also observed in the study area and this activity can also impact the resident wildlife in the area.

Bush meat consumption is the only utilization of mammals by local people in the project area. They kill their animals using shot guns or snares. Although no established bush meat market exists in the area, however, a dead animal is either taken home for household consumption or sold to anyone who can afford to buy.

The presence of the critically endangered western chimpanzee indicates that the study area is of considerable concern for the conservation of biodiversity. Generally, mammal species are reasonably distributed especially in existing forest patches and forest regrowth throughout the project area. Although the project activities will negatively impact mammals in the form of habitat loss, most of the species can tolerate a variety of habitat types (Hanson-Alp *et al.* 2003, Brncic *et al.* 2010). Measures to mitigate impacts of the project activities should, therefore, address the continued existence of these riverine forest and forest regrowth habitats of the resident large and terrestrial small mammal communities.

CONCLUSION

In conclusion, the study indicates that much damage has already been done to the mammal assemblage in the BHP area due to long term farming activities resulting to habitat loss in form of deforestation and hunting by the local community. However, wildlife monitoring and conservation awareness programme can be

initiated in the area and the surrounding communities. Because the mammal assemblage is already adapted to the present nature of the environment, there may be no need to interfere with this situation. A programme could be developed to monitor the mammal populations and their habitat. Together with this monitoring, an environmental awareness programme should be carried on a regular basis to educate people on everything from sustainable hunting to wildlife laws. The monitoring activity, in conjunction

with the environmental awareness programme, may help prevent further pressure on the mammals and their habitat.

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