



Ecological status of large mammals of a moist semi-deciduous forest of Ghana: implications for wildlife conservation

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Abstract

A preliminary survey was conducted in the Gyeni River and Gyemera Forest Reserves and an off-reserve area within the Moist Semi-Deciduous forest of the Amansie West District of the Ashanti Region, Ghana, to assess the ecological status of large mammals at the area. The study involved transect-walks and interviews with local people. Overall, a total of 23 large mammal species were considered to be potentially present at the study area. Nineteen (83%) of these species belonging to five orders, Pholidota, Carnivora, Hyracoidea, Artiodactyla and Primates were confirmed. The relative abundance of large mammal species (Ar) was low, with high similarity of species composition between study sites (Sorenson Index $SI > 0.7$). Thirteen of the mammals were of conservation concern; six species, including olive colobus monkey (*Procolobus verus*), Pel's anomalure (*Anomalurus peli*), black duicker (*Cephalophus niger*), tree-, giant-, and long-tailed pangolins (*Phataginus tricuspis*, *Smutsia gigantea* and *Manis tetradactyla*) are Near Threatened, one species, Geoffroy's pied colobus monkey (*Colobus vellerosus*) is Vulnerable and the rest, including bay duicker (*Cephalophus dorsalis*), Maxwell's duicker (*Cephalophus maxwelli*), royal antelope (*Neotragus pygmaeus*), African civet (*Civettictis civetta*), African palm-civet (*Nandinia binotata*) and red river hog (*Potamocheorus porcus*) are nationally protected. The threats to large mammals included hunting and habitat loss and fragmentation via slash-and-burn agriculture, illegal logging and small scale mining operations. Initiation of biodiversity conservation education, awareness and training programmes for the local people is recommended for conservation and management of wildlife and their habitats at the study area.

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Introduction

Tropical forest ecosystems host about two-thirds of the earth's terrestrial biodiversity (Gardner *et al.*, 2009) and provide a variety of socioeconomic goods and ecological services such as soil formation and conservation, hydrological and energy cycles, and stabilization of micro- and macro-climate (Wright, 2005). Yet the future of tropical forest ecosystems and their rich biodiversity has never been more uncertain. Despite increasing concern over the loss of tropical forests, and despite significant local, regional and international efforts to find solutions to the problem, the rate of deforestation in the tropics continues unabated (Meijaard *et al.*, 2007; Owusu *et al.*, 2006).

The highest rates of tropical deforestation yet recorded occurred during the 1980s and 1990s (Wright, 2005). By 1980, approximately 25% of the productive closed-canopy moist forest in tropical Africa, 10% in the Neotropics and 50% in tropical Asia had been logged (FAO, 2007). The 1990 Global Forest Resource Assessment (FAO 1993) indicated that the annual deforestation rate across tropical countries from 1981 to 1990 was approximately 0.8% or 15.4 million hectares (ha) per annum, as compared to 0.6% during 1976 to 1980. Between 2000 and 2005, the net forest loss was estimated to be about 4 million hectares per annum (FAO, 2007).

The rate of deforestation in Ghana (1.3% per annum) (Allotey, 2007) is one of the highest in Africa. The original high forest zone of the country extended over 145,000 km². However, the current area of intact forest is now estimated to be between 10.9 and 11.8% of the original cover (Allotey, 2007). The only remains of original forest are found in remote and inaccessible areas of the forest reserves established between 1919 and 1939 (Oates, 1999) in three high forest National Parks (Bia, Kakum and Ankasa Conservation Areas), and in "sacred groves" (traditionally protected forest patches ranging in size from a few trees to several hundred hectares) (Decher and Abedi-lartey, 2002).

Mammals are excellent indicators of biodiversity and state of a habitat, and represent an important biological and functional component of tropical forest ecosystems (Nicolas *et al.*, 2010; Davies and Hoffmann 2002). They play a crucial role in the ecology of tropical forests, especially in the reproductive biology of flowering plants through activities such as pollination, seed dispersal and predation (Pearson, 2000). The rarity and extinction of mammals could thus have grave consequences for the structure, composition and diversity of tropical forests (Chapman and Onderdonk, 1998).

This notwithstanding, West African mammals including those of Ghana continue to decline at alarming rates. As a result of deforestation caused mainly by slash-and-burn agriculture and logging, and unsustainable hunting, wildlife resources in Ghana have dwindled drastically (Sam *et al.*, 2007; Decher and Abedi-Lartey, 2002; Bakarr *et al.*, 2001; Kingdon, 1997). Many of the country's wildlife species have become increasingly rare and locally extinct. For instance, the Miss Waldron's red colobus (*Piliocolobus badius waldroni*) is believed to be locally extinct in Ghana (Oates *et al.*, 2000), while the forest elephant, royal antelope, pangolins (*Smutsia gigantea*, *Manis tetradactyla* and *Phataginus tricuspis*), crested porcupine (*Hystrix cristata*), and duickers (*Cephalophus* spp.) have become increasingly threatened (Sam *et al.*, 2007).

At a time when the future of tropical forests and their associated biodiversity is uncertain, it is of utmost importance to conduct surveys, especially in previously unsurveyed forest reserves and off-reserve areas to assess the status of tropical wildlife species. The present study assessed the status of large mammals of the Moist Semi-Deciduous Forest of the Amansie West District of the Ashanti Region of Ghana. The aim of the study was to provide the requisite baseline data that is needed to inform wildlife conservation and management decisions at the study area.

The specific objectives were to document for the study area (i) Large mammal species richness, abundance and distribution, (ii) Conservation status of large mammals, (iii) Threats facing large mammals and their habitats; and (iv) Make recommendations for the conservation and management of large mammals and their habitats at the study area.

Materials and methods

Study Area

The study area (6°28'- 6°38'N; 1°53'- 2°01'W) (Fig. 1) is located in the Amansie West District, in the Ashanti Region of Ghana, approximately 35 km southwest of the regional capital, Kumasi. The area, which covers about 165 km² total land area with altitude ranging from 200 to 500 meters above mean sea level (Amsl), lies within the Moist Semi-Deciduous Forest and Wet Semi-Equatorial Climatic zones, with a bimodal rainfall distribution and mean annual rainfall ranging from 1500 to 1700 mm. The major rainy season occurs from April to July/August, peaking in June, while the minor rainy season runs from September to October. The major dry season runs from December to March, with mean annual temperature ranging from 22 °C in August to 36 °C in March. The relative humidity ranges from 70% to 90%.

The area is drained by the southwesterly flowing Bonte River. The geology of the area is dominated by the Birimian Supergroup metasedimentary and metavolcanic rocks and various granitoid intrusions (Dickson and Benneh, 1980). The vegetation consists of dense undergrowth and forest tree species of the *Celtis-Triplochiton* Association, dominated by *Celtis mildbraedii*, *Triplochiton scleroxylon* (wawa), *Ceiba pentandra* (silk cotton), *Milicia excelsa* (odum), *Khaya ivoriensis* (mahogany), *Terminalia ivoriensis* (emire), *Terminalia superba* (ofram) and *Bambusa* sp. (bamboo) (Taylor, 1960).

The estimated population of the District was 128,533 in 2006 with the main ethnic group being Akan, but

with a large influx of other ethnic groups, mainly farmers from the northern regions of the country. The main economic activities in the area are agriculture and small-scale mining. Major food crops cultivated include plantain, corn, cassava, yam and tomatoes, along with cash crops such as cocoa.

Selection of study sites

The study sites included two forest reserves, Gyeni River (GRFR) and Gyemira Forest Reserves (GFR) and an Off-reserve Area (ORA) composed largely of a mosaic of small forest remnants, thickets, grassland, shrubland, and farmbush (Table 1).

Table 1. Description of study sites.

Study Site	Geo-Coordinates	Area (km ²)	Habitat Types
GFR	6°36'N; 1°55'W	63	farm, grassland, shrubland, <i>Terminalia</i> sp., Teak.
GRFR	6°30'N; 1°55'W	22	<i>Celtis</i> sp., <i>Triplochiton scleroxylon</i> , <i>Milicia excelsa</i> , <i>Terminalia</i> sp.
ORA	6°32'N; 1°58'W	80	Grassland, shrubland, thicket, farmbush, forest patches, marshy areas.

Large mammal survey

Large mammals were surveyed during the dry and minor wet seasons from 15 March to 7April and from 11 September to 2 October 2011, respectively, using the line-transect method and interviews with local people. Animals were recorded using direct observation (actual sighting) of species, identification of animal spoor (foot prints, tracks, dung/pellets/scat, feeding sites, etc.) and calls/vocalization along line transects. Two transects were employed per site for the GRFR and GFR, and four transects at the ORA. Each transect, which was about 3 km long, was walked twice in the dry season and twice in the wet season during the day from 06:00 to 10:00 and 16:00 to 19:00 hours GMT by

three observers including the investigator and two assistants, one of whom was an experienced hunter. The total effective distance walked for the survey was 96 km (Table 2). The average walking speed was about 1 km/h, and involved scanning and listening for sounds and calls of large mammals and recording signs and evidence of their presence (spoor). Night surveys were undertaken to detect the presence of nocturnal mammals especially prosimians.

Table 2. Summary of transect-lines employed at the study sites.

PARAMETER	STUDY SITES			
	GFR	GRFR	ORA	TOTAL
Number of transects employed	2	2	4	8
Length of each transect	3 km	3 km	3 km	
Number of times each transect was walked in the Dry Season	2	2	2	
Number of times each transect was walked in the Wet Season	2	2	2	
Effective length of transect walked	24 km	24 km	48 km	96 km

Interviews with local people were conducted at forest-fringe communities to compile a checklist of the potential large mammals present at the study area. Respondents, mainly hunters and farmers, were shown pictures of mammals known to occur in Ghana and expected to be present at the study area, and were asked to indicate animals that were known to be present at the study sites and the last time such animals were encountered. Information provided by respondents was supported by identification of hunting trophies.

The number of spent cartridges/old shotgun shells, wire snares and hunters (usually with gun and/or dogs) was used to assess local hunting pressure

within the study area. Illegal logging activities, slash-and-burn agricultural practices and mining operations (galamsey) that are known to cause habitat loss and fragmentation and, thus, are threats to Wildlife and their habitats were directly observed, and visually assessed along the transects.

Analysis of data

Species richness (S)

The species richness, defined as the total number of species of a taxonomic group that were encountered at the study area during the survey, was compiled from direct encounters (actual sightings), spoor and information gathered from the local people.

Relative abundance (Ar)

Many mammals leave unambiguous signs (spoor) that verify their presence and relate to their abundance (Wemmer *et al.*, 1996). Indices of abundance can be developed from these spoor. However, to relate indices of abundance to actual abundance requires knowledge of the natural history of the species in question. Such information is often lacking or incomplete in tropical forests (Boddicker *et al.*, 2002).

For this study, the relative abundance (*Ar*) was estimated as the total number of encounters of a species, its calls and/or spoor per 1 km transect-walk (encounter rate) at the study area. Thus,

$$Ar = (Sa_t + Ca_t + Sp_t) / Tl_t$$

Where,

Sa_t = total number of actual sightings of the species,

Ca_t = total number of calls heard from the species,

Sp_t = total number of the species' spoor encountered and

Tl_t = total length of transect walked.

The assumption was that the greater the number of individuals of a particular large mammal species present in the study area, the greater the number of spoor left behind by the species and the greater the encounter rate of spoor of the species in question.

Species distribution

The similarities amongst large mammal communities occurring at the three study sites were estimated using Sorenson Index (**SI**) as follows:

$$\mathbf{SI} = 2C/A+B$$

Where,

A = number of species first study site,

B = number of species at second study site and

C = number of species common to the two sites.

Results*Large mammal species richness, relative abundance and distribution*

Overall, a total of 23 large mammal species belonging to five orders were considered to be potentially present at the study area. The order Carnivora had the highest number of species with seven species, followed by the order Artiodactyla and Primata with six species each, and the order Pholidota with three species. The order Hyracoidea had the least number of species with one species (Table 4). Nineteen (83%) of the potentially present large mammals at the study area were confirmed through actual sightings, vocalization and spoor. The GRFR recorded the highest number of confirmed species with 18 species, whilst the GFR and ORA recorded 14 species each (Table 3)

In general, the abundance of large mammals at the study area was low. For most of the confirmed species, the relative abundance (A_r) was less than 1 species per 10 km transect-walk per site (Table 3). However, the study area remained important for many mammals including bushbuck (*Tragelaphus scriptus*), Maxwell's duiker (*Cephalophus maxwelli*), Demidoff's galago and Western tree hyrax (*Dendrohyrax dorsalis*), most of which occurred at the GRFR and GFR. The similarity of large mammal communities between sites was high (Sorenson Index $SI > 0.7$) (Fig. 2).

Large mammal species of conservation concern

Thirteen of the large mammals present at the study area were of conservation importance (Table 4). Six species, including olive colobus monkey (*Procolobus verus*), Pel's anomalure (*Anomalurus peli*), black duicker (*Cephalophus niger*), tree-, giant-, and long-tailed pangolins (*Phataginus tricuspis*, *Smutsia gigantea* and *Manis tetradactyla*) are Near Threatened (IUCN, 2010). The Geoffroy's pied colobus monkey (*Colobus vellerosus*) is listed as Vulnerable, while black duiker (*Cephalophus niger*), bay duicker (*Cephalophus dorsalis*), Maxwell's duicker (*Cephalophus maxwelli*), royal antelope (*Neotragus pygmaeus*) and red river hog (*Potamocheirus porcus*), are listed as Lower Risk/Near Threatened/ (IUCN, 2010) and are completely protected at some period of the year in Ghana. The African civet (*Civettictis civetta*) and palm-civet (*Nandinia binotata*) are also nationally protected (Ghana Wildlife Regulation Act).

Threats to large mammals and their habitats at the study area

Evidence of hunting, logging, encroachment by farming and small-scale mining operations (galamsey) were observed throughout the study area. Spent cartridges (shotgun shells) and wire snares were found in all the sites, with the latter being particularly abundant at the GRFR. Hunters seemed to have unrestricted access to the forest reserves.

Evidence of recent logging activities were highest in the GFR, followed by the ORA and the GRFR. Even though the boundaries of the forest reserves had been clearly demarcated and respected by cocoa farmers, large portions of the reserves especially the GFR, have been converted into plantain plantations. Small scale mining ("galamsey") activities were observed only at the ORA. The threats to large mammals and their habitats at the study area, thus included unsustainable hunting and habitat destruction and fragmentation caused mainly by slash-and-burn agriculture and illegal logging activities.

Table 3. Confirmed Large Mammals and their Relative Abundance at the Study Area.

SCIENTIFIC NAME	COMMON NAME	GFR		GRFR		OFA	
		No. of obs.	Ar	No. of obs.	Ar	No. of obs.	Ar
PHOLIDOTA							
<i>Phataginus tricuspis</i>	Tree pangolin	1	0.042	1	0.042	4	0.083
<i>Smutsia gigantea</i>	Giant pangolin	2	0.083	2	0.083	0	0
<i>Manis tetradactyla</i>	Long-tailed pangolin	0	0	1	0.042	1	0.021
CARNIVORA							
<i>Herpestes sanguineus</i>	Slender mongoose	1	0.042	2	0.083	4	0.083
<i>Atilax paludinosus</i>	Marsh mongoose	0	0	1	0.042	2	0.042
<i>Crossarchus obscurus</i>	Cuisimanse mongoose	5	0.208	3	0.125	3	0.063
<i>Nandinia binotata</i>	African palm civet	0	0	1	0.042	1	0.021
<i>Civettictis civetta</i>	African civet	3	0.125	2	0.083	0	0
HYRACOIDEA							
<i>Dendrohyrax dorsalis</i>	Western tree hyrax	2	0.083	3	0.125	13	0.271
ARTILODACTYLA							
<i>Tragelaphus scriptus</i>	Bushbuck	12	0.5	17	0.708	24	0.5
<i>Cephalophus maxwelli</i>	Maxwell's duiker	7	0.292	5	0.208	13	0.271
<i>Cephalophus dorsalis</i>	Bay duiker	2	0.083	2	0.083	2	0.042
<i>Neotragus pygmaeus</i>	Royal Antelope	1	0.042	3	0.125	1	0.021
<i>Potamochoerus porcus</i>	Red river hog	0	0	2	0.083	0	0
PRIMATA							
<i>Cercopithecus petaurista</i>	Lesser Spot-Nosed monkey	1	0.042	1	0.042	0	0
<i>Cercopithecus mona lowei</i>	Lowe's mona monkey	0	0	0	0	1	0.021
<i>Colobus vellerosus</i>	Geoffroy's pied colobus	2	0.083	4	0.167	0	0
<i>Perodicticus potto</i>	Bossmann's potto	1	0.042	1	0.042	1	0.021
<i>Galagoides demidovii</i>	Demidoff's galago	7	0.292	15	0.625	36	0.75

Discussion

The result of the present survey indicated that the Moist Semi-Deciduous forest of the Amansie West District of the Ashanti Region of Ghana supported diverse large mammalian fauna. According to local people who had lived in the area for a long period (more than 20 years), the study area harbored very rich and abundant large mammal species. However, as a result of widespread loss and fragmentation of the original closed-canopy moist forest and unsustainable hunting, many species especially primates have now become rare. This assertion was consistent with our observations. The once lush vegetation cover of the study area has been reduced to a mosaic of farmbush, thickets, grassland,

shrubland and marshy areas as a result of anthropogenic activities such as “slash-and-burn” agriculture, logging and small scale mining (“galamsey”). The only forest fragments left at the study area are restricted to the forest reserves.

Ungulates like bushbuck and Maxwell’s duiker are adapted to and persist in secondary forests and human-dominated landscapes. These species normally do not appear to suffer to the same extent as primates when forests are fragmented and modified through logging and farming, but are rather favoured by opening of mature forests and an increase in secondary growth (Struhsaker and Oates, 1995). Even though hunting may have reduced

bushbuck and duikers population at the study area, these species probably may have withstood hunting

Table 4. Distribution and Conservation Status of Large Mammals Potentially Present at the Study Area.

LARGE MAMMAL SPECIES		STUDY SITES/LOCALITY			CONSERVATION STATUS		
SCIENTIFIC NAME	COMMON NAME	GFR	GRFR	OFA	IUCN	NATIONAL	CITES
PHOLIDOTA							
<i>Phataginus tricuspis</i>	Tree pangolin	*	*	*	NT	I	III
<i>Smutsia gigantea</i>	Giant pangolin	*	*	*	NT	I	III
<i>Manis tetradactyla</i>	Long-tailed pangolin		*	*	NT	I	III
CARNIVORA							
<i>Herpestes sanguineus</i>	Slender mongoose	*	*	*	LC	II	
<i>Atilax paludinosus</i>	Marsh mongoose		*	*	LC	II	
<i>Crossarchus obscurus</i>	Cuisimanse mongoose	*	*	*	LC	II	
<i>Nandinia binotata</i>	African palm civet	*	*	*	LC	I	
<i>Civettictis civetta</i>	African civet	*	*	*	LC	I	
<i>Genetta genetta</i>	Common genet	*	*	*	LC	II	
<i>Genetta tigrina</i>	Blotched genet	*	*		LC	II	
HYRACOIDEA							
<i>Dendrohyrax dorsalis</i>	Western tree hyrax	*	*	*	LC	II	
ARTILODACTYLA							
<i>Tragelaphus scriptus</i>	Bushbuck	*	*	*	LC	II	
<i>Cephalophus niger</i>	Black duiker	*	*	*	LR/NT	II	
<i>Cephalophus maxwelli</i>	Maxwell's duiker	*	*	*	LR/NT	II	
<i>Cephalophus dorsalis</i>	Bay duiker	*	*	*	LR/NT	II	II
<i>Neotragus pygmaeus</i>	Royal Antelope	*	*	*	LR/NT	II	
<i>Potamochoerus porcus</i>	Red river hog		*	*	LR/NT	I	
PRIMATA							
<i>Cercopithecus petaurista</i>	Lesser Spot-Nosed monkey	*	*	*	LR	II	III
<i>Cercopithecus mona lowei</i>	Lowe's mona monkey	*	*	*	LR	II	II
<i>Colobus vellerosus</i>	Geoffroy's pied colobus	*	*		VU	I	III
<i>Procolobus verus</i>	Olive colobus monkey		*		NT	I	II
<i>Perodicticus potto</i>	Bosman's potto	*	*	*	LC	I	III
<i>Galagoides demidovii</i>	Demidoff's galago	*	*	*	LC	I	III

Legend

Conservation Status- IUCN: LC = Least Concern, LR = Lower Risk, NT = Near Threatened, VU = Vulnerable; National: I = completely protected, II = partially protected; CITES: I = Threatened species and cannot be trade, II = limited levels of trade, III = Nationally Threatened.

pressure better than the more susceptible primate further reduced by logging, which destroy tall timber tree species that serve as habitats for primates (Struhsaker, 1993). The Demidoff's galago, which is rather not a target for hunters because of its small size, seemed to be better adapted to secondary forests and cocoa farms.

In general, the forest reserves recorded higher species richness and abundance than the off-reserve area. This result buttressed the importance of protected areas as refugia for wildlife, and in the conservation of biodiversity (Bruner *et al.*, 2001; Lu *et al.*, 2003; Struhsaker *et al.*, 2005). The fewer number of species recorded in the GFR compared to the GRFR was probably due to high levels of degradation of the former. The GFR has been heavily logged, with large portions of the reserve has been converted into plantain farms by local farmers. The presence of *C. petaurista*, *C. mona lowei* and *P. potto* in the GFR, however, signified that the reserve still contained important habitats such as tall timber tree species for primates.

Large mammal species of conservation concern at the study area included olive colobus monkey (*Procolobus verus*), Pel's anomalure (*Anomalurus peli*), black duicker (*Cephalophus niger*), tree-, giant-, and long-tailed pangolins (*Phataginus tricuspis*, *Smutsia gigantea* and *Manis tetradactyla*) that are considered as Near Threatened (NT), Geoffroy's pied colobus monkey (*Colobus vellerosus*) that considered as Vulnerable (V) and bay duicker (*Cephalophus dorsalis*), Maxwell's duicker (*Cephalophus maxwelli*), royal antelope (*Neotragus pygmaeus*), African civet (*Civettictis civetta*), African palm-civet (*Nandinia binotata*) and red river hog (*Potamocheirus porcus*) that are considered as Least Concern/Near Threatened by the IUCN redlist of endangered species (IUCN, 2010) and are nationally protected in Ghana. The presence of these mammals underscore the importance of the study area for wildlife conservation. It is therefore recommended that various education, awareness and training

programmes focusing on wildlife conservation and undesirable anthropogenic activities like bad agricultural practices, chain-saw logging, unsustainable hunting and mining should be initiated for the local people, especially the youth. Alternative and additional livelihood ventures should also be introduced after a detailed socio-economic study has been conducted at the communities within the study area. Finally, it recommended that access to the forest reserves be monitored and rigidly regulated, with stringent application of deterrent sanctions to offenders.

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