

Status of Blue Duiker (*Cephalophus monticola*) and Bushbuck (*Tragelaphus scriptus*) in Kom - Wum Forest Reserve, North West Region, Cameroon

Akwo Christian Ebu¹, TSI Evaristus Angwafo^{1, 2}, Mvo Denis Chuo¹

¹Department of Forestry, Faculty of Agronomy and Agricultural Sciences (FASA), P. O. Box 222 Dschang, University of Dschang, Cameroon

²Department of Fundamental Science Higher Technical Teacher Training College (H.T.T.T.C.) P.O. Box 39 Bambili University of Bamenda – Cameroon

Abstract— The study titled “Status of Blue duiker (*Cephalophus monticola*) and Bushbuck (*Tragelaphus scriptus*) in Kom-Wum Forest Reserve, North West Region-Cameroon, was realized from the 15th of January to March 31st, 2015. The general objective was to contribute to the conservation of Blue duiker and Bushbuck by establishing a baseline data in Kom-Wum Forest Reserve which will serve as guide for management decisions. The methodology used was “reconnaissance walk, questionnaires, semi structured interviews and focused group discussions. Results obtained indicated that twelve species of mammals were recorded through direct and indirect bio-indicators. The family of Cercopithecidae was the most represented (41.7%) (Putty nosed (*Cercopithecus nictitans*), Vervet (*Cercopithecus aethiops*), Patas (*Erythrobus patas*), Mona (*Cercopithecus mona*) monkeys and Olive Baboon (*Papio Anubis*). The results equally revealed that Chimpanzees (*Pan troglodytes ellioti*), Red duiker (*Cephalophus dorsalis*), Blue duiker and Bushbuck were the most abundant animals with encounter rates of 3.8, 2.91, 2.41 and 1.93 signs per km respectively. The GIS distribution maps showed that Blue duikers and Bushbucks were more in the North East and South West portions of the reserve respectively. The mean encounter rate of anthropogenic activities (hunting, agriculture and logging) stood at 0.94 sign per kilometer. Hunting was most preponderant with an E.R of 1.41 sign per km (50%), followed by agriculture 1.0 sign per km (36%) and lastly logging 0.41 sign per km (14%). Encounter rates of anthropogenic activities plotted against those of mammals gave a coefficient of determination (R^2) = 0.058 hence, mammal distribution is only slightly affected by human activities. Up to 65% of the respondents expressed negative attitudes towards conservation of resources in the reserve for the fact that it is their natural heritage and they should not be restrained

from exploiting them. A majority (80%) of the respondents however agreed that the reserve is owned and controlled by the government. Though plagued by human interference, the reserve still harbours some Bushbuck and Blue duiker. We therefore recommend that the council, government, NGOs and the local community to step up conservation efforts.

Keywords— Anthropogenic activities, Bushbuck, Blue duiker, Conservation, Encounter rate.

I. INTRODUCTION

Following the Earth Summit of Rio de Janeiro in Brazil in 1992, and the recommendation to its parties for tracking progress towards the 2010 target of halting biodiversity loss, the number of protected areas in Cameroon increased substantially (Mesmin, 2001). In 2010, 10.6 percent (5 million hectares) of the area of Cameroon were covered by protected areas. Of these, 45 percent (2.2 million hectares) of protected areas coverage were designated after Cameroon signed the CBD. National parks cover 3.1 million hectares corresponding to 61 percent of the area protected with 11 of the 20 parks classified under IUCN category II (IUCN, 2010). Forest and wildlife reserves comprise 940242 and 869428 hectares or 18 percent and 17 percent of land protected respectively. However, insufficient financial support and weak law enforcement have resulted in encroachment of those protected areas by human activities (illegal logging, poaching unsustainable agriculture) and settlements (COMIFAC, 2005). Bush meat trade, wildlife medicine and habitat loss are considered as the biggest threats to wildlife in tropical forests. For example, it is the root cause of the decreasing of African ape populations (Pearce & Ammann, 1995), the commerce of bush meat is particularly critical in Centre Africa. In the Congo Basin, between 1 million and 3.4 million tons of wild meat are

consumed each year (Wilcox & Nambu, 2007). In West and Central Africa, the amount of antelopes killed for bush meat is widely recognized as unsustainable (Bowen-Jones, 2002). The blue duiker (*Cephalophus monticola*) especially represents a very high percentage of animal species killed for meat across West and Central Africa (Nasi and Vliet, 2011). In his Review of the Commercial Bush meat Trade on Central/West Africa, Bowen-Jones (1998) listed Cameroon as the country with the most references, representing 21% of the literature out of nine countries.

The Bamenda Highlands is the most diversified and important area in Western Cameroon after mount Cameroon and mount Kupe (Sedlacek *et al.*, 2007). Within the eco-region of the Cameroonian Highlands, several taxa are endemic to the Bamenda Highlands (Ingram and Nsom, 2007; Ndenecho, 2009) and particularly to its highest peak: Mt Oku. These mountains are well-known for their richness in birds (Ndenecho, 2011) with several endemic species (Ingram and Nsom, 2007), including the banded wattle-eye (*Platysteira laticincta*) and the Bannermans turaco (*Tauraco bannermani*) an emblematic bird for local communities but highly localized and threatened by hunting (Ingram and Nsom, 2007). Several species of primates, including Nigeria-Cameroon chimpanzees and Preuss's guenons (*Cercopithecus preussi*), (both taxa considered as endangered by the International Union for the Conservation of Nature (IUCN), and endemic to the Bight of Biafra: IUCN, 2013), live in the remaining patches of sub-montane forests of the Bamenda Highlands (Ingram and Nsom, 2007).

The Kom-Wum forest reserve which is a biodiversity hot spot recently handed to the councils of Fundong and Wum by MINFOF and being an integral part of the Bamenda high lands will certainly harbour some of these important species. The Kom-Wum forest reserve (17000 ha) is one of the largest remaining patches of the Bamenda highland montane forest. It is predicted to have the largest population density of chimpanzees and antelopes in the region (Chuo and Tsi, 2017e). It has been described as an exceptional priority conservation site for Nigeria-Cameroon chimpanzees (Morgan *et al.*, 2011). Despite the importance of this reserve, over hunting and habitat loss are the major causes of fauna loss which are

secondarily triggered by the conversion of forest to pasture and agriculture (Chuo and Tsi, 2017e). This conversion has been dramatic and the landscape has changed considerably over the last century, with just a few fragmented forests remaining that hold remnants of flagship species like the Nigerian- Cameroon chimpanzee (*Pan troglodytes ellioti*) and antelope species (CAEPA, 2014). As such, Reconciling development and biodiversity conservation remains a hard nut to crack. Since the inhabitants in and around the reserve depend on the forest for their livelihoods (Chuo and Tsi, 2017c). This therefore means that, sustainable management of such a reserve must involve the support of the local communities through their active involvement in wildlife management operations and hence decision making (Hulme and Taylor, 2000). Despite the fact that research has not been done on medium size mammals like the blue duiker and bushbuck in this reserve and incomplete knowledge on their abundance and distribution exist. The blue duiker and bushbuck are over hunted for subsistence and commercial purposes by local hunters in and around this reserve does the need to adopt necessary means to conserve the remaining species around the study areas.

II. MATERIALS AND METHOD

2.1. Description of Study Area

The Kom –Wum forest reserve is located between latitude 6° N and 7° N and longitude 9° E and 10°E and is situated in Wum Subdivision in Menchum Division and a reasonable portion extends to Boyo Division of the North West Region of Cameroon. Bounded by Wum to the North West, Bafut to the South West and Fundong to the South East and North East. This reserve was created in 1951, and has a surface area of about 17000 hectares (Morgan *et al.*, 2011). It has an altitude of about 900m to 2140m above sea level in the mountains and about 200m to 600m in the valleys. It is situated towards the western boundary of the region which stretches along the international border between Cameroon and eastern Nigeria. The main rivers that flow through this area are the rivers Ivin, Menchum, Nzele and Kimbi. All of these join the Kasina-la, which flows into Kasina-la State, Nigeria. Figure 5 shows the map of Kom–Wum forest reserve in Cameroon.

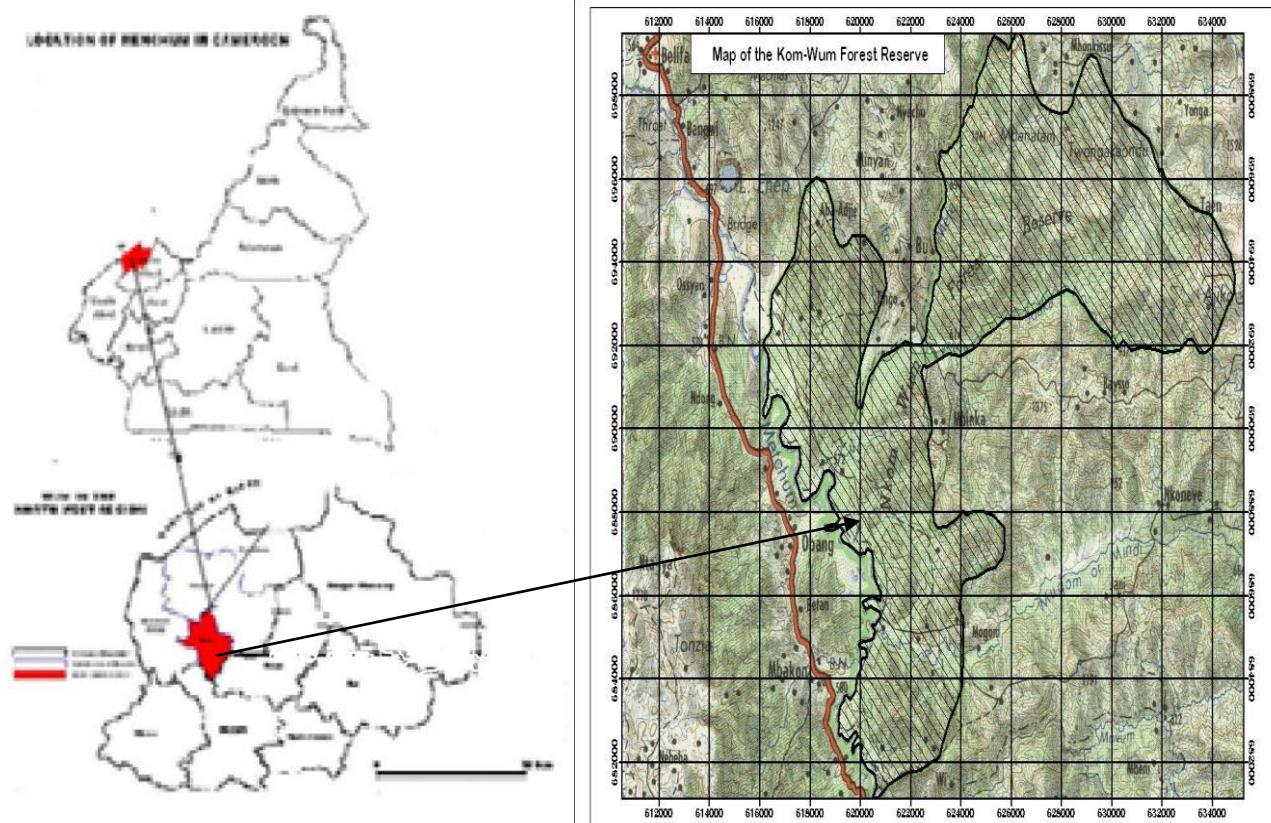


Fig.1: Location of the KWFR in the North West Region of Cameroon (COMINSUD,2011)

2.2. Data collection

Data collection in the Kom-Wum forest reserve was carried out from the 15th of January 2015 to 20th of March 2015. During this period, the “rece walk” was used. A rece is a path of least resistance through an area following a compass bearing (e.g. north-south, southeast-northwest, east-west). The “distance transect method, “despite its wide use (Beck and Chapman, 2008), presents disadvantages which turned to be exacerbated on this study site due to the characteristics of Kom-Wum forest reserve. Firstly, although several factors essential for the transect method (such as the length of line transects, perpendicular distances and their orientation) should be based on data from pilot studies (Buckland *et al.*, 1993), no studies on any other mammals have been done in this forest. Moreover, the terrain is mountainous with steep escarpments which made it difficult for transects to be set up. For these reasons, the rece walk method was preferred for this study. The zone was subdivided into quadrates of 2km x 2km giving a total of

23 quadrates. Inside each quadrate, data was collected on recces of 2km long oriented in the East-West direction. A total of 23 recces of 2km each were covered giving a total distance of 46km as shown on the sampling plan on figure 2. Recces were oriented to cut across major vegetation types (, primary forest, secondary forest, gallery forest and Savannah) and drainages feature (rivers and streams) in order to have a representative sample of the reserve. The starting point of each rece was randomly generated using a random number table. A Global position system (GARMIN 62CSx) was used to determine the start and end point of each rece in the field. The “Tracklog” and “Waypoints” of the device were activated. The first element was programmed to record the location every 500m, creating a track which was later transferred to the software Garmin® MapSource®. It also helped the team not to use the same path twice. Unlike the “Tracklog” feature, the “Waypoints” program allowed the researcher to mark independent points. Figure 2 below shows the sampling plan with distribution on Recces in KWFR.

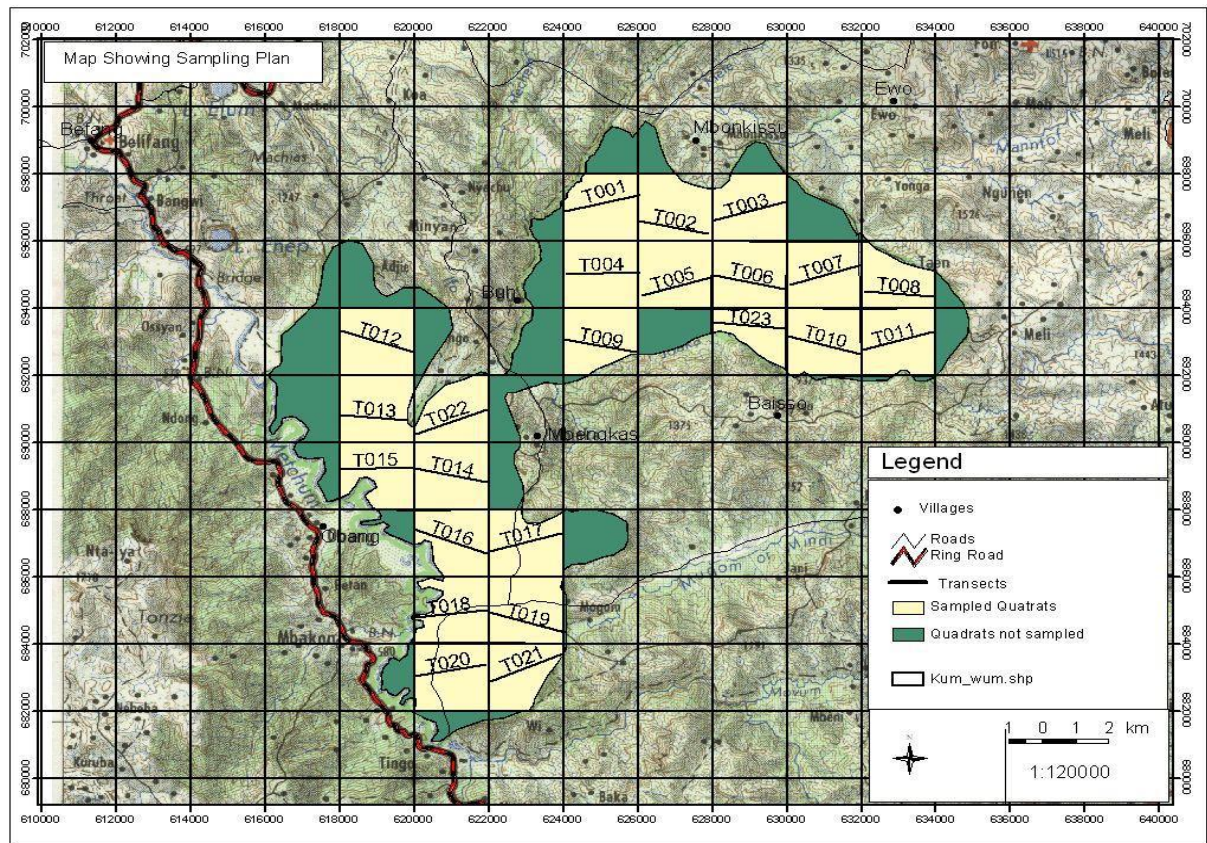


Fig.2: GIS Map showing representation of Recce-transsects for animal inventory in KWFR

Data collection was carried out by a team of four individuals: a team leader, two field assistants and one hunter. The team leader carried a compass and GPS to guide the team along recces, the first field assistant carried a pair of binoculars and recorded all observation in a data sheet, the other field assistant helped the team leader in searching for signs while the hunter helped as field guide due to his familiarity with the forest. All mammals sightings, vocalizations, signs (dung, nests, foot prints, carcasses, tracks and food remains) and the signs of anthropogenic activities such as farms (active or abandoned), machete cuts, snares, shot gun shells, honey extraction sites and hunting camps (active or abandoned) along reccees were recorded.

Table.1: Shows the stages used for the classification of dung

Index	Observation	Age
Dung:	Fresh – boli intact, still warm, strong smell, shiny fatty acid sheen glistening on exterior	1-2days
	Recent – boli intact, odour when boli is break, flies, fatty acid sheen disappear	3-5 days
	Old – no odour, dung form still intact although boli may be partly or completely broken down into anamorphous mass;	6- 14 days

Very old – dispersed, flattened, tending to disappear	14 days and more
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A survey to determine local people perception towards the KWFR was undertaken in five out of the eight villages (Baiso, Mbinkas, Mbonkissu, Bu and Aguilii) with a population of 18.000 inhabitants purposively selected based on their closeness to the reserve. One focus group discussion was conducted per village guided by questions related to animal presence, type of animals hunted, reasons for hunting, animal movement, habitat preference, usefulness of animals, population trend and hunting, traditional role of antelope’s meat, awareness of reserve existence as well as the relationships between people and wildlife. Each focus group had at least 6 participants (2 notables, 2 men, a woman and a youth). The turnout of women was very low. The venues for these discussions were at the chief’s palace where informants were identified by the chief or quarter head of each village, prior to the administration of questionnaires. Focus group discussions were done on traditional Sundays when most villagers were at home. A wildlife guide for central Africa mammals was used to facilitate the identification of animal species in cases where identification was difficult. Semi-structured interviews were later conducted with every 3 households per village

depending on the size of each village with the help of an interview guide this was to obtain information on the importance of the reserve, perception about mammal conservation, techniques of hunting and animals hunted by the local population. Two closed ended test questionnaires were designed and administered to two notables in each village after consultation with the chiefs. The aim of this exercise was to identify difficulties and to ensure that the language used was fully understood by respondents before proper administration. A total number of 216 individual out of a population of 18000 were sampled giving a sampling rate of 1.2% (appendix 1).

2.3. Data Analysis

Data collected from the field were summarized and presented using, abundance indices, maps and frequency tables. The Encounter Rate (ER) or Index of Kilometric Abundance (IKA) which represents the total number of observations per kilometer (IKA total = N/L where N is the total number of observations per transect and L is the transect's length in kilometers) was estimated for mammal signs and human activities. The GPS points of Blue duiker and bushbuck indicators and human activities recorded per quadrant were exported to ArcView computer program 3.3 and geo-referenced to produce different spatial distribution maps. The classes of encounter rate were then defined in order to group similar quadrates and represent zones of different concentrations. Different colour bands and corresponding colour intensities were used to represent different encounter rates on the distribution maps. This permitted us to define important zones for mammal species (duikers, bushbuck, chimpanzees etc) in order to determine management strategies for their conservation.

Regression analyses were carried out to test the relationship between the encounter rate of mammals and anthropogenic activities. Encounter rates of these two variables were exported to SPSS (Version17) to produce fitted regression line. The mathematical formula for the coefficient of determination (R^2) and correlation coefficient (r) are given below.

$$R^2 = \frac{\left(\sum XY - \frac{\sum X \sum Y}{N} \right)^2}{\left[\sum X^2 - \frac{(\sum X)^2}{N} \right] \left[\sum Y^2 - \frac{(\sum Y)^2}{N} \right]}$$

$$r = \sqrt{R^2}$$

Where: X: is Anthropogenic activities. , R^2 : is the Coefficient of determination
 Y: is the Mean encounter rate BD/BB N: is the Number of observation and
 r: is the Correlation coefficient.

III. RESULTS AND DISCUSSION

Relative Abundance of Medium to Large Mammals Recorded in KWFR

After the recce walk of 46km, a total of twelve (12) species of medium to large mammals were recorded within the Kom-Wum forest reserve. They belong to five families. The family of Cercopithecidae had the highest number of species represented by 5 species that are the Putty-nosed monkey, (*Cercopithecus nictitans*) (Vervet monkey (*Cercopithecus aethiops*) Patas Monkeys (*Erythrobus patas*) Mona Monkey (*Cercopithecus mona*) and Olive Baboon (*Papio anubis*). These results agree with those reported by (Afuh, 2013) and (Chuo, 2018) who each recorded 14 different species from the Lebialem-Mone-Banyang-Mbo Landscape S.W.R and Black Bush Area of Waindo N.W. R respectively. The Bovidae family followed with four species; the blue duiker (*Cephalophus monticola*), Bushbuck (*Tragelaphus scriptus*) red duiker (*Cephalophus dorsalis*) and Buffalo (*Syncerus caffer*). The families Pongidae, Suidae and Viverredae were each represented by one species; chimpanzee (*Pan troglodytes ellioti*), Red river hog (*Potamochoerus porcus*) and Africa civet (*Viverra civetta*) respectively as seen on table 2 below. The table equally gives the MINFOF current classification of the various animals.

Table.2: Medium to large size mammal species recorded in the KWFR according to family

Family	Common Name	Scientific Name	MINFOF Classification
Bovidae	Blue duiker	<i>Cephalophus monticola</i>	C
	Bushbuck	<i>Tragelaphus scriptus</i>	B
	Red duiker	<i>Cephalophus dorsalis</i>	C
	Buffalo	<i>Syncerus caffer</i>	A
Pongidae	Chimpanzee	<i>Pan troglodytes ellioti</i>	A

Cercopithecidae	Putty-nose monkey	<i>Cercopithecus nictitans</i>	C
	Vervet monkey	<i>Cercopithecus aethiops</i>	C
	Patas Monkeys	<i>Erythrobus patas</i>	C
	Mona Monkey	<i>Cercopithecus mona</i>	C
	Olive Baboon	<i>Papio anubis</i>	A
Suidae	Red river hog	<i>Potamochoerus porcus</i>	B
Viverredae	Africa civet	<i>Viverra civetta</i>	B

Indices of Mammals Identified in KWFR

The table below summarizes both direct and indirect indices observed in the KWFR.

Table.3: Indices of medium to large mammal species identified in the KWFR

Species	Indirect observations							Direct observations	Total
	D	FP	T	FR	N	C	V		
Blue duiker	111	40	8	–	–	–	–	8	167
Bush buck	89	30	6	–	–	–	–	5	130
Red duiker	134	47	12	–	–	1	–	11	205
Buffalo	11	–	–	–	–	–	–	–	11
Chimpanzee	–	–	–	5	174	–	3	–	182
Putty-nosed monk	–	–	–	–	–	–	43	80	123
Mona Monkey	–	–	–	–	–	–	9	37	46
Patas Monkeys	–	–	–	–	–	–	7	1	8
Vervet monkey	–	–	–	–	–	–	19	–	19
Olive Baboon	–	–	–	–	–	–	32	–	32
Red River Hog	–	6	–	–	–	–	–	–	6
Africa Civet	11	–	–	–	–	–	–	–	7
Total									942

Legend: Dung (D), Nest (N), Foot Prints (FP), Tracks (T), Food Remains (FR), Carcass (C), Vocalisation (V)

Both direct and indirect signs were used to identify mammals in the field. Three antelope species were seen directly (blue duiker, bushbuck and red duiker). Monkeys were recorded via direct sightings and vocalizations while Chimpanzees were identified by nests, vocalizations and food remains. Four species of monkeys were seen directly Putty nosed, Mona monkey Patas and Vervet monkeys. Dung was mostly used to identify antelope species (blue duiker, red duikers and bushbuck) because it was very difficult to distinguish them from their foot prints, food remains and tracks. Vocalisations of Chimpanzees (*Pan troglodytes ellioti*) were heard, five groups of Putty-nosed guenon (*Cercopithecus nictitans*), four groups of Mona monkeys (*Cercopithecus mona*), and 3 groups Olive baboons (*Papio anubis*) were also heard. Dung piles and pellets of blue duiker, Red duiker and bushbuck were

recorded within the Kom-Wum forest reserve. Most dung encountered ranged from the ages fresh, recent, with very few old droppings. For the convenience of identification of duiker's presence by signs, closely related duikers such as the black-fronted, Peter's and bay duikers are grouped as red duikers. 174 chimpanzee nest sites were recorded during the survey. Fresh, recent, old and very old arboreal nests were recorded. Most nests were recorded on Recce transects crossing old abandoned roads. Generally, tracks of *Cephalophus monticola* and *Tragelaphus scriptus* were regularly seen close to marshy forest areas.

Relative abundance of medium and large mammals in study area using direct sighting

This refers to animals that were seen directly during inventory. Their encounter rates are calculated on the table below.

Table.4: Encounter rate of medium to large mammal species sighted in kom-Wum forest reserve

Common Name	Family	Scientific Name	NS	TDC(km)	ER
Blue Duiker	Bovidae	<i>Cephalophus monticola</i>	8	46	0.17
Bush Buck	Bovidae	<i>Tragelaphus scriptus</i>	5	46	0.11
Red Duiker	Bovidae	<i>Cephalophus dorsalis</i>	11	46	0.24
Mona Monkey	Cercopithecidae	<i>Cercopithecus mona</i>	50	46	1.10
Putty-nosed monkeys	Cercopithecidae	<i>Cercopithecus nictitans</i>	80	46	1.74
Patas monkey	Cercopithecidae	<i>Erythrobus patas</i>	1	46	0.02
Mean			155	46	0.56

Legend: Encountered rate (ER), total distance covered (TDC), Number of species (NS) 0 = No observation, 0.1- 0.5 = Weak, > 0.5 = High

Up to six species of small to medium size mammals were seen directly in Kom-Wum forest reserve. Eight blue duikers were seen while five bushbucks were seen, 4 groups of Putty-nosed (*Cercopithecus nictitans*) of at least eight individuals, 2 groups of at least 20 individuals and one group of at least 2 individuals were seen during the survey. Other species seen were Patas monkey and three species of duiker. In all, the total numbers of duikers seen were higher for red duiker then blue duiker while the total number of individual primates seen per kilometre was highest for Putty-nosed, followed by Mona monkey and then Patas monkeys. Vervet monkey and chimpanzee were not seen, there were only heard. The encounter rate

of blue duiker (0.17) and bushbuck (0.11) from direct sighting is therefore weak in KWFR since the ER is Weak between 0.1- 0.5 and high when ER > 0.5 = (Tsi *et al*, 2006). Generally, the mean encounter rate of medium to large size mammals seen directly was high (0.56 Sign/km).

Relative abundance of medium to large mammals using indirect indices

After 46 km survey effort on these recces, a total of 774 indirect signs were recorded. The table below shows the relative abundance of medium to large size mammals in Kom- Wum Forest Reserve.

Table.5: Encountered rate of indirect signs of medium to large mammal species recorded in KWFR

Common Name	Family	Scientific Name	TNI	TDC (km)	ER
Blue Duiker	Bovidae	<i>Cephalophus monticola</i>	111	46	2.41
Bushbuck	Bovidae	<i>Tragelaphus scriptus</i>	89	46	1.93
Red Duikers	Bovidae	<i>Cephalophus dorsalis</i>	134	46	2.91
Buffalo	Bovidae	<i>Syncerus caffer</i>	11	46	0.24
Chimpanzee	Pongidaea	<i>Pan troglodytes ellioti</i>	174	46	3.78
Putty-nosed monkeys	Cercopithecidae	<i>Cercopithecus nictitans</i>	43	46	0.93
Mona Monkey	Cercopithecidae	<i>Cercopithecus mona</i>	37	46	0.80
Vervet monkey	Cercopithecidae	<i>Cercopithecus aethiops</i>	19	46	0.41
Olive baboon	Cercopithecidae	<i>Papio anubis</i>	32	46	0.70
Red river hog	Suidae	<i>Potamochoerus porcus</i>	6	46	0.13
Africa civet	Viverredae	<i>Viverra civetta</i>	11	46	0.24
Patas monkey	Cercopithecidae	<i>Erythrobus patas</i>	7	46	0.15
Mean			774	46	1.22

Table 5 above shows that chimpanzees (3.78sign/km) were most abundant mammals in KWFR followed by the red duikers (2.91sign/km), blue duiker (2.41sign/km) and then bushbuck (1.93sign/km). The red river hog was the least abundant mammal with an encounter rate of 0.1sign/km. The red duiker was the most abundant species in the family Bovidae. While the chimpanzee was the most abundant primate recorded in the KWFR. The overall Relative Density of large mammals in the Kom-Wum forest reserve was estimated to be 1.22 signs per km (Table 5). In other words, one would identify at least one medium to large mammal sign for every kilometer covered in the study area. Kom-Wum Forest Reserve appears therefore to be poor in mammals.

Geo-Spatial Distribution of Medium to Large Size Mammals in KWFR

Generally, the distribution of medium to large Mammals species in KWFR is highly affected by vegetation type (primary forest, secondary forest, gallery forest and open savannah). Chimpanzees, Mona and Putty-nosed monkeys prefer mature forest; most chimpanzee nests were sighted at high altitudes with very poor topography. Blue duiker, Patas and Vervet monkeys prefer open savanna, forest edges and gallery forest edges while Bushbuck prefer secondary forest with thick under growth gallery forests, they could also be sighted along water sources. According to Tsi *et al.*, (2006) determining animal distribution permits managers and researchers to locate protected and unprotected areas of high biological diversity targeting specific areas for protection or areas to allow improved management.

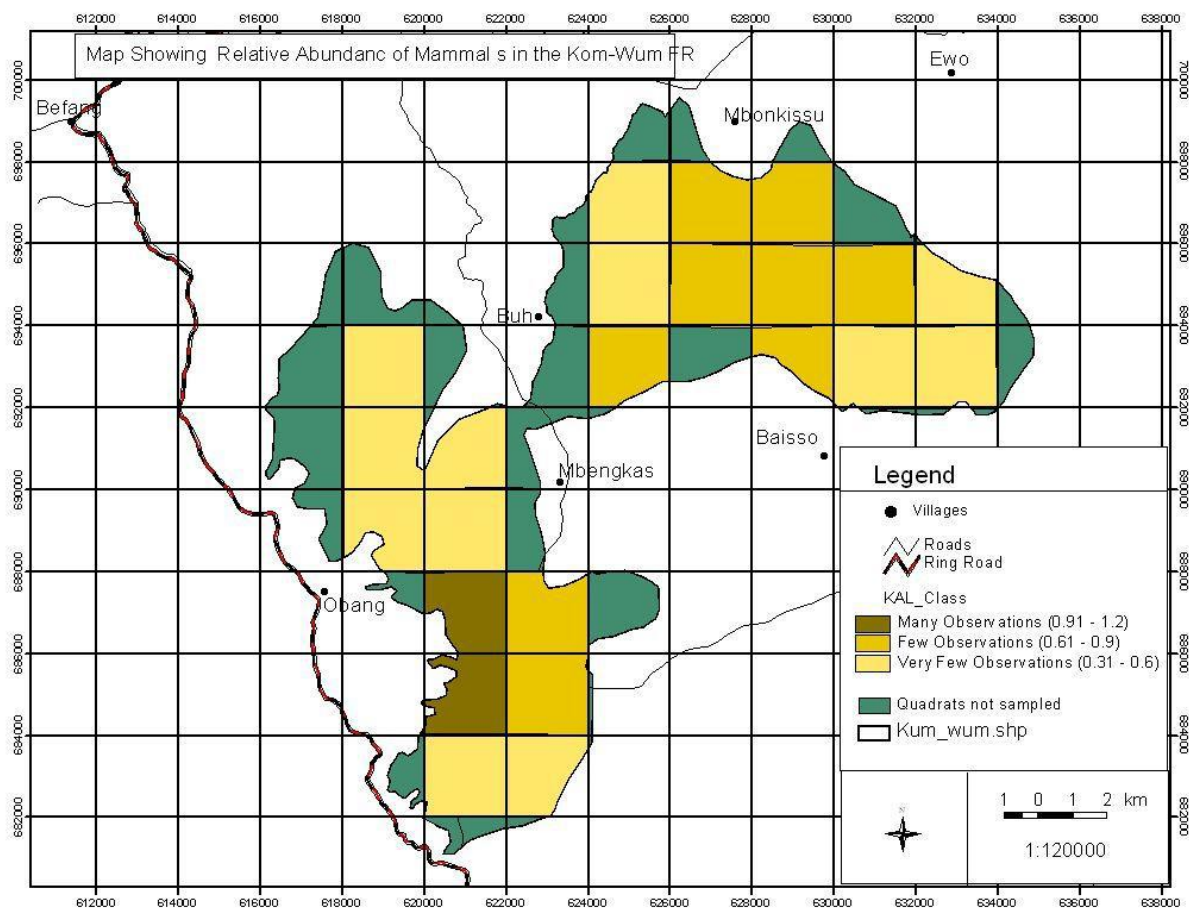


Fig.3: GIS map showing geo-spatial distribution of medium to large mammals in KWFR

Figure 3 shows that most mammals' species are abundant in the North East section of the reserve. The highest population concentration is found in a small portion in the South West section of the KWFR. This is a biodiversity 'hotspot'. High concentrations here could be attributed to the rough nature of the terrain that limits human interference, the presence of River Menchum that acts as a natural barrier confining animals around this

area. The North West portion is generally poor in animals probably due to high anthropogenic activities from the high population of Bu village (8000 inhabitants).

Spatial Distribution of Blue Duiker in KWFR

Food availability, habitats and preponderance of predators greatly affected the distribution of blue duiker and bushbuck in KWFR. Figure 4 below the spatial distribution of Blue duiker in KWFR.

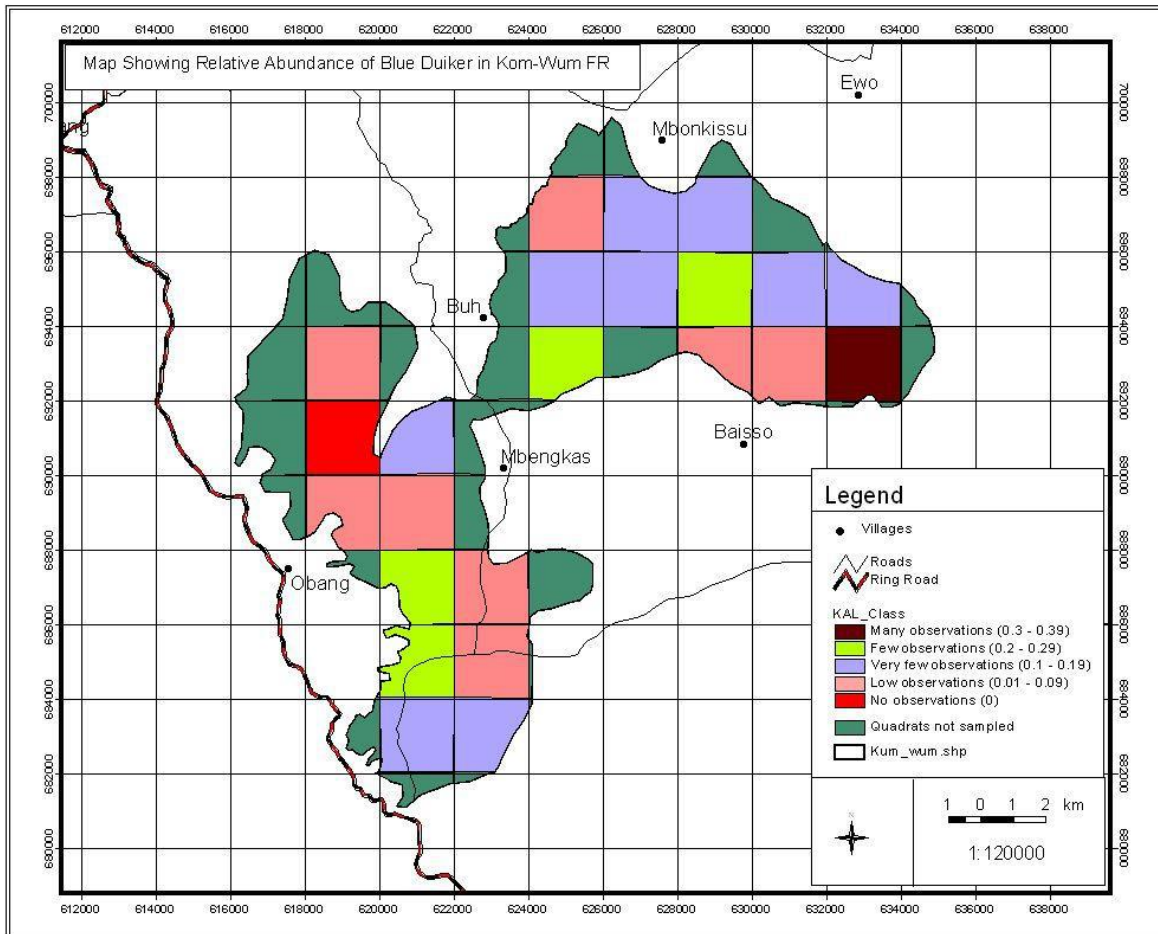


Fig.4: GIS map showing spatial distribution of Blue duikers in the KWFR

Figure 4 above shows that blue duikers have high relative densities in the North east (ER=0.3-0.39). Few observations were recorded in the South West and central portions of the reserve. This could be attributed to the presence of their food, habitat suitability and absence of predators. They have high relative densities in open savanna vegetation bordering gallery forests with fruit

trees. Blue duikers showed low densities in primary forest.

Geo-Spatial Distribution of Bushbuck in KWFR

The spatial distribution of bushbuck in Kom-Wum forest reserve was also influenced by availability of food, habitat presence and preponderance of predators (figure 5).

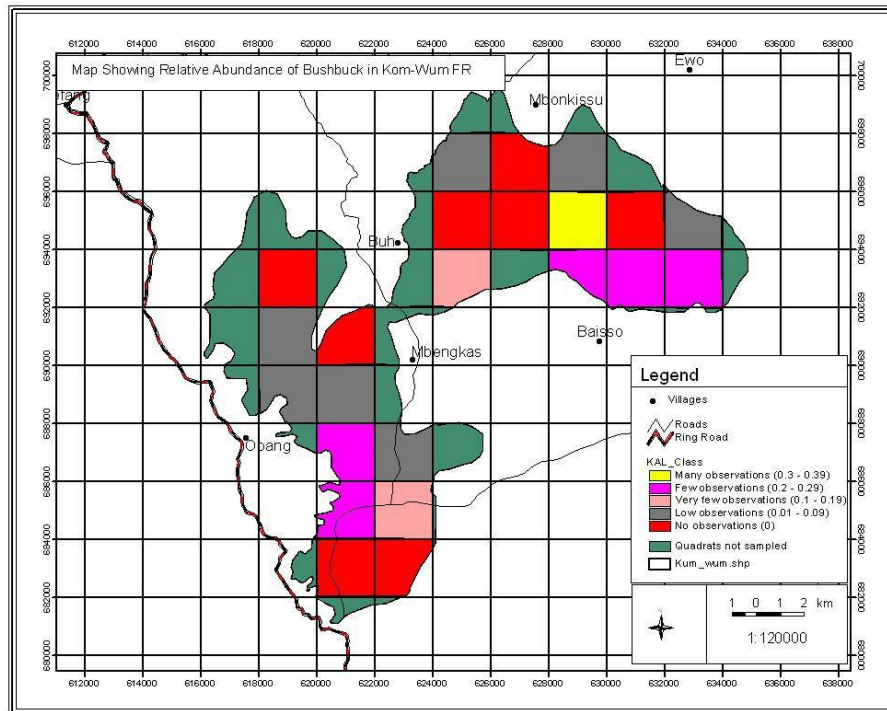


Fig.5: Geo-spatial distribution of Bushbuck in KWFR

Bushbuck had high densities in the North East mostly around swampy areas and in vegetation dominated by young to mature trees, with an under storey more or less dense. Few observations were also noticed around the peripheries of the East and South West. They could also be found in the swampy forest galleries and along water courses.

Anthropogenic Activities in KWFR
Abundance of Anthropogenic

Rapid population increase in and around the reserve over the past two decades has as consequence an increase demand for forest wood, NTFP, animals for food, farming land etc this has tremendously increase the rate of forest degradation. Anthropogenic activities were grouped into three main types, hunting, agriculture and logging. Figure 6 shows the different anthropogenic activities recorded in the KWFR

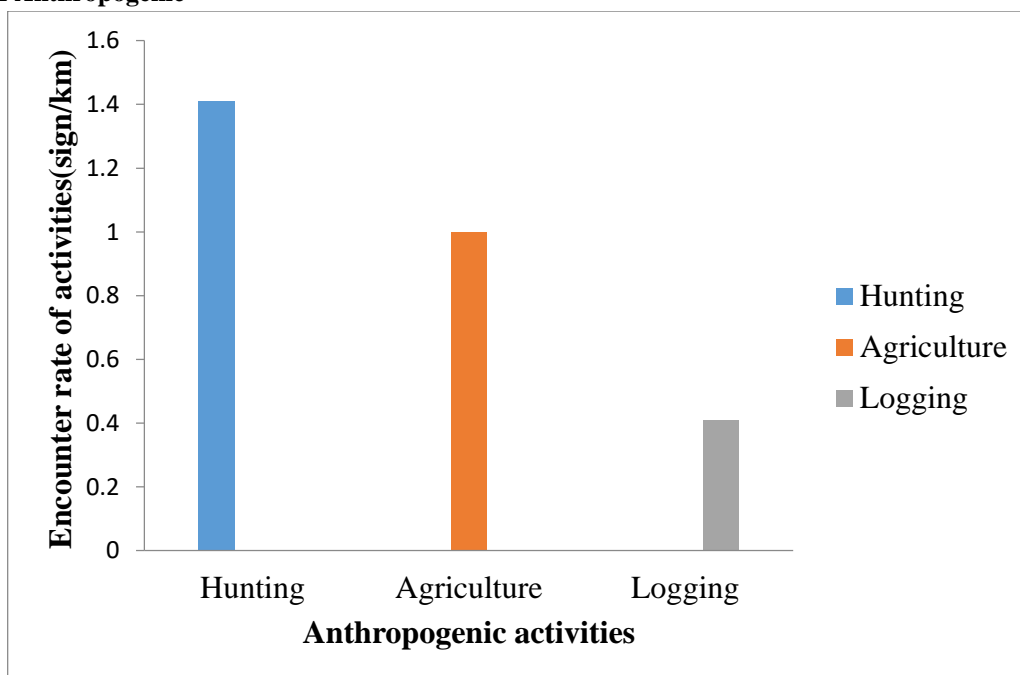


Fig.6: Anthropogenic activities recorded in KWFR

Figure 6 above shows that hunting (1.41sign/km) (50%) was the most prevalent activity in the KWFR closely followed by agriculture (1.00sign/km) (36%) and then logging (0.41sign/km) (14%). The setting of snare traps was the most common form of hunting in the kom-Wum forest reserve. It is followed by the presence of shotgun shells, and then hunting camps, other signs (abandoned dresses, fireplaces, dishes, and honey extraction sites) and logging activities. Hunting is at the moment the only lucrative means through which the local people derive direct economic benefits from the forest. Wildlife species do not only provide an important source of protein but also a major source of income for the local people surrounding the concession. Wire snare trapping

was observed as the most common form of hunting where mostly artiodactyls (duikers, bushbucks and brush-tailed porcupines) are captured and represent the most important species in terms of income. Encounter rates of abandoned cable snares were high especially along hunting tracks. However, the highest percentage of all primate captured in KWFR is made by the use of shotguns. These results agree with those recorded by Fotang, (2014) from Mbi crater and Ekobo (2008) 1.46 sign/km from Nguti Council forest S.W.R of Cameroon.

Geo-spatial distribution of anthropogenic activities

Figure 7 shows the spatial distribution of the different anthropogenic activities identified in the KWFR

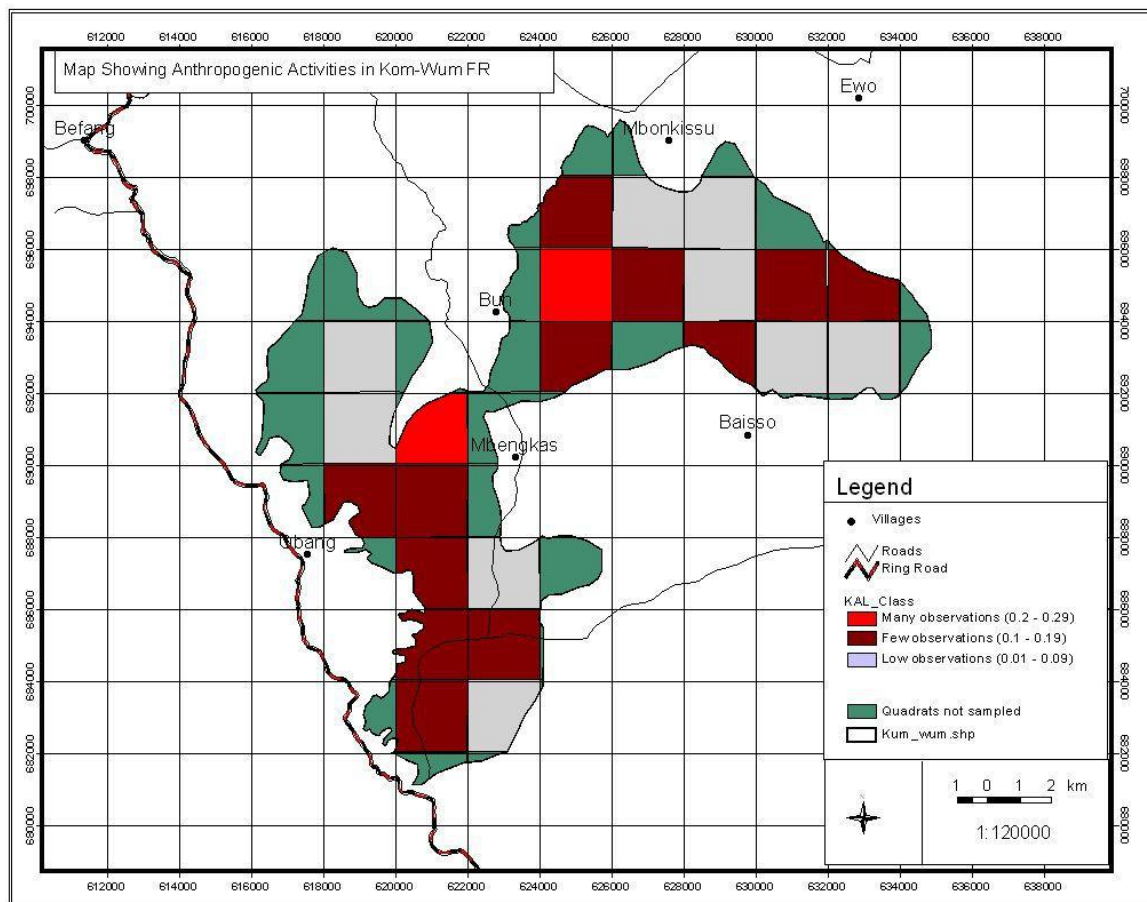
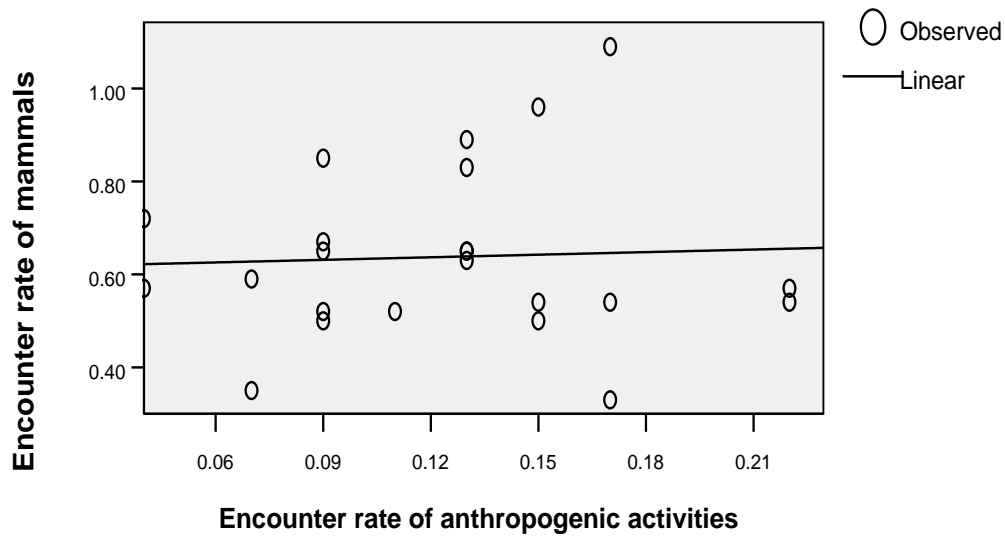


Fig.7: GIS map showing spatial distribution of anthropogenic activities in KWFR

The map above shows that anthropogenic activities are high in the South West and North of the KWFR. Logging had high densities in the Centre Southwest around Moghom while trapping and gun hunting had high relative densities in the North East of the reserve around the villages of Obang and Mbakong (lower Bafut). This could probably be explained by the high population density on the Bamenda-Wum stretch of the ring road. Cocoa, banana, corn and plantation farms were common in the north east of in the reserve.

Effects of anthropogenic activities on the distribution of mammals in the KWFR

Using the encounter rate of mammals and anthropogenic activities, the coefficient of determination R^2 was calculated. The scatter diagram of the fitted regression line for the encounter rates of medium to large size mammals and anthropogenic activities is presented on figure 8.



The equation= $a+b1X+B2X+B3X + \text{Error}$
 $Y = 0.587 + 0.885X1 - 0.294X2 + 0.498X3 + 0.107$
 Where Y=Mammal, X1=Hunting, X2=Agriculture, x3=Logging

Fig.12: Fitted regression line of the encounter of mammals and anthropogenic activities in the KWFR

Figure 8: above shows a weak relationship between the medium to large size mammals and human signs in KWFR. This coefficient of determination ($R^2 = 0.058$) shows that only 5.8% of changes in mammals distribution are provoked by changes in hunting, agriculture and logging. Fonkwo *et al.* (2011) also had slightly similar results in the Bakossi landscape where only 2.33 % of variation in mammal distribution was provoked by a variation in anthropogenic activities. Fotang (2014) reported an R^2 of 0.375 from Mbi crater in the North West region. Among these anthropogenic activities, hunting has the highest effect on the distribution of medium to large size mammals in KWFR followed by logging and then agriculture as shown on the regression equation. Hunting using snares had the highest influence

with an ER of 1.4sign/km (50%).This is in line with Ekobo (2008) who reported an. 1.46 sign/km for hunting from the Nguti Council forest S.W.R of Cameroon.

Perception of Local Population towards KWFR

Understanding local peoples’ perception is key to improving relationship between people living in protected areas or reserves and management because it can provide a guide for policy decisions (Hill, 1998). The Kom and Wum people have their own picture on KWFR.

Educational Level of respondents

The level of education of a respondent has a remarkable effect on his/her perception of the conservation of biodiversity (Mc Clanahan *et al.*, 2005) Figure 9 below analyses the level of formal education of respondents.

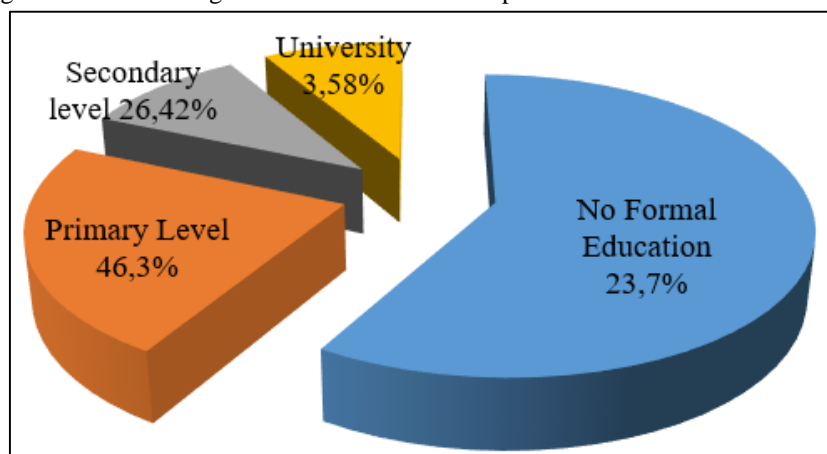


Fig.9: Educational level of the Respondents

From figure 9, 76.3% of the respondents were literate. The bulk of the literate people ended at the level of primary school. This was noticed in their inability to fill questionnaires. This result agrees with those reported by Fotang (2014) from Mbi Crater who recorded 80.7%.

Occupation of Respondents

The occupational structure of the people living in and around the KWFR has an effect on the people's activities and perception vis-à-vis the forest. Figure 10 below shows the occupation of respondents below.

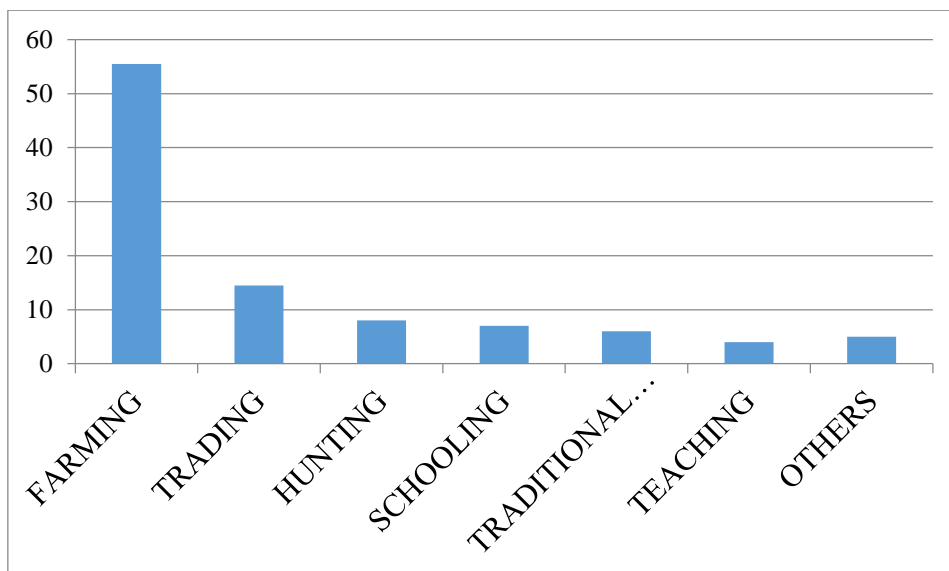


Fig.10: Distribution of respondents by occupation

More than half of the population in and around the reserve is farmers (55.5%). This reveals that farming is an important economic activity in the area. Encroachment into the reserve is therefore eminent if appropriate measures are not taken. After farming, the next economic activity is trading (14.5%). Hunting is equally an important activity although is represented by only 8% of the respondents. This could probably be because some hunters did not want to identify themselves as hunters for

fear of the unknown. 7% were students this depicts the high illiteracy levels that were noticed during discussions with the population.

Awareness, ownership and control of KWFR

What the people of Fundong and Wum perceive as to who owns and control the KWFR is very important for its conservation. Figure 11 below shows findings concerning the Kom-Wum indigenes perceptions on awareness, ownership, and control of the reserve.

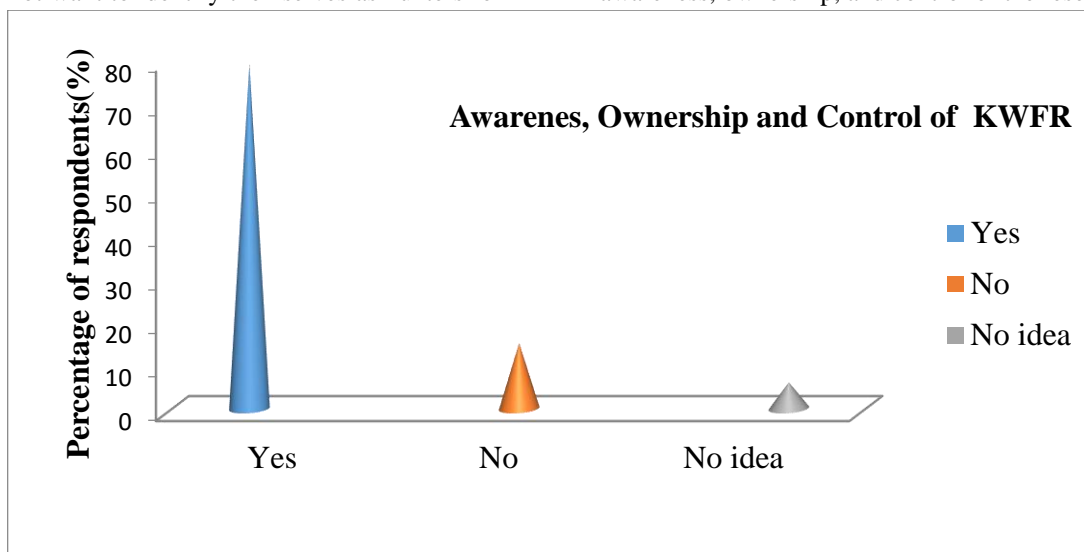


Fig.11: Awareness, ownership and control of KWFR as perceived by local population

Figure 11 reveals that a vast majority of respondents (80%) were aware that the reserve is owned

and controlled by the government of Cameroon. They also indicated that they have access but do not respect the

boundaries which prohibit entering and hunting in the reserve. Access here is due to the absence of law enforcement officers in the reserve (Forest guards). Focus group discussions further revealed that ownership of the reserve was perceived as vested on the government though the presence of government authorities is not felt. The recent handing over of the reserve to the councils of Wum and Foundong has however changed the situation as boundary demarcation has been done and reforestation in the degraded North West portion.

Attitude and willingness to participate in the conservation of mammals in KWFR

Free acceptance of indigenous people in conservation ventures usually facilitates the task of management (Tsi *et al.*, 2006) as objectives are easily attained. Unwillingness of some stakeholders like indigenes frustrates conservation efforts. The figure 12 summarizes the attitudes of people in and around the KWFR.

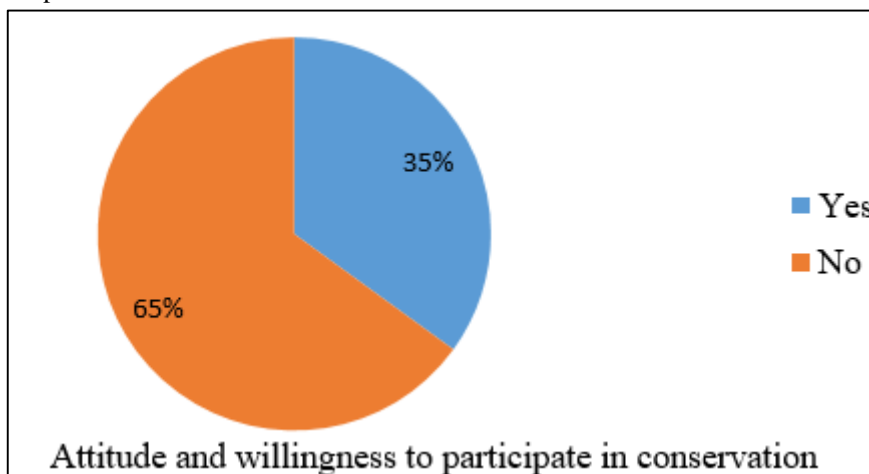


Fig.12: Attitudes of the respondents towards conservation

The results show a most (65%) of the respondents held negative attitudes towards the conservation of resources in KWFR. This could be attributed to high levels of illiteracy, increased number of crop farmers demanding more farmland, low participation in conservation awareness programs and past experience of human wildlife conflicts. Many crop farmers complained that animals especially monkeys (destroy maize) and civet (eat up domestic fowls around the village) are destructive.

Almost all hunters interviewed had negative impressions concerning conservation. Conservation of wild life according to them will deprive them of their livelihood as they cannot have access to the fertile soils in the forest.

Animal frequently hunted in KWFR

A question was designed to find out the animals commonly hunted for bush meat. The results are presented on figure13 below.

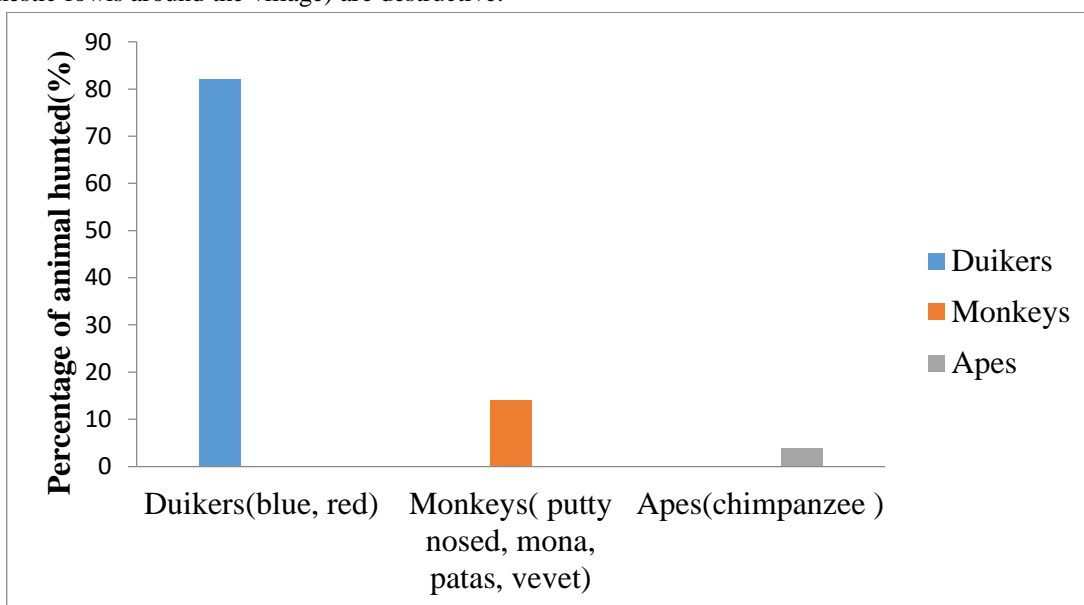


Fig.13: Animals hunted for bush meat in KWFR

From the figure above, duikers (blue duiker and red duikers) were the most hunted animal species. This was followed by Monkeys (putty nosed, mona, and patas) and then chimpanzee appearing as the least hunted animals species. Results during focus group discussions revealed that the duikers were ceremonial species, highly demanded during the royal hunt festivals where they are used in rituals and in the preparation of special dishes. This high demand was also related to their use in marriage, death and birth celebrations. Similar results were recorded by Lahm, (1993) in three villages of North-eastern Gabon where artiodactyls (Bushbuck and Blue duiker) accounted for 57.5% of animal hunted with the Blue duiker being the most common species hunted by villagers. During focus group discussions, respondents said that Chimpanzees are not hunted because the penalty reserved for culprits is exile in the villages of Mbengcas

and Mbakong .A few also mentioned the firm prison sentence some responding said the chimpanzee flesh is very hard, very difficult to cook and has a lot of long bones. This may be the reason for viable populations of chimps in the area. Others regard monkeys as totems and that when killed the person concern will die. Other reasons like chimpanzee and monkeys are difficult to die and have human feelings were also raised. Therefore, taboos, taste and availability are factors that greatly affect bush meat preference and consequently hunting level for wild animals in the study area.

Perceptions on the economic potentials of the KWFR

The people of the KWFR perceive three major economic benefits from the KWFR. Table 6 below shows the economic benefits perceived by the population living around the KWFR.

Table.6: Economic benefits perceived by respondents

Economic benefits	Percentage (%)
Trees for timber	38.8
Non timber forest products	31.2
Touristic potential	18.65
Provision of meat (protein source)	11.35

The table above reveals that most respondents (38.8%) consider timber products as the most important economic benefit they derived from the KWFR. Thirty percent (31.2%) said they harvest bush pepper, rattan cane, Jangsang, bush mango, medicinal plants. They also hunt animals like chimpanzee, monkeys and antelopes in general for their protein source. They build houses with timber from the forest. They don't buy timber from elsewhere. There are numerous touristic attractions that are likely to boost the development of tourism in the area. It has the famous waterfalls and cascades in highlands, a rich, unique and diverse cultural heritage in neighboring villages, attractive landscape and flagship species. It is one of the best reserve still harbouring suitable habitats for chimps with the highest number of chimpanzee (Morgan *et al.*, 2011; Chuo and Tsi, 2017e) in the North West region as compared to Fungom, Mbember and Kimbi game reserve. Flagship species are species that can be used as the focus of a broader biodiversity conservation marketing campaign based on its possession of one or more traits that appeal to the target audience. Though ecotourism flagships are frequently charismatic megafauna, which are aimed at attracting tourists such as the giant panda (*Ailuropoda melanoleuca*) and the African elephant (*Loxodonta africana*), Kom and Wum people tend to appreciate species that have strong cultural or local values. These include primates such as the chimpanzee (*Pan troglodytes elliotti*) and birds such as

Barnama tauroco (*Tauroco bannermani*) and green tauroco (*Tauroco persa*). Feathers of the Tauraco are widely used in the region for cultural activities such as traditional dances.

IV. CONCLUSION

The results of this study show that 12 species of medium to large mammals were recorded with one flagship species, the Chimpanzee. Chimpanzees, Red duikers and Blue duikers are the most abundant animals in the reserve with encounter rates of 3.78, 2.91 and 2.41 respectively. The mean encounter rates of mammals in the reserve stood at 1.22 sign/km meaning that one will expect to see at least one mammal for every kilometer covered in the reserve. The relative densities of Blue duikers and Bushbucks were high in the North East and South west respectively. Anthropogenic activities were classified under hunting, agriculture and logging and with an encounter rate of 0.94 sign per kilometer. Hunting was most preponderant with an E.R of 1.41 sign per kilometer (50%). Encounter rates of Anthropogenic activities plotted with those of mammals through regression analyses gave a coefficient of determination of R²=0.058 (5.8%) meaning mammals distribution is only slightly affected by human activities. These results revealed that the local people in and around the KWFR (65%) have negative attitudes towards wildlife conservation. They expressed strong utilitarian attitude with little or no

ecological sentiments towards the reserve. As a result, local people perceive wildlife conservation as a problem rather than an economic and social status advantage, thus making wildlife conservation efforts to be perceived as contradictory to socio-economic welfare of the local communities. In fact, some youths in Baiso and Mbonkessu villages vehemently declared that “conservation is the white man’s idea”. The species richness of this forest is low thus the status as a community forest is okay for now. More conservation effort has to be mobilised so as to conserve the natural resources in this reserve.

V. RECOMMENDATIONS

To research institutions

- Research on the ecology and distribution of chimpanzee in the Kom- Wum Forest Reserve should be carried out since they are the most abundant mammals.
- Study the status of blue duiker and bush buck in the rainy season to compare the results with those obtained during the dry season.

To the government

- The management status should be reviewed because KWFR has recently been handed over to the councils of Wum and Fundong. The surface area is too big for the council to effectively manage.
- Train and deploy forest guards and related forest management staffs so as to enforce legislation.

To non-governmental organization

- Income generating activities should be sponsored so as to diversify the economy and deter local inhabitants from encroaching into the forest.
- Encourage the rearing of domestic animals like goats, cattle, fowls etc.

CONFLICT OF INTEREST STATEMENT

We declare that there is no conflict of interest regarding the publication of this paper.

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Appendix: Field Pictures



Old dung bushbuck



Fresh dung of Bush buck



Fresh dung of blue duiker



Chimpanzee nest



Researcher with used cartridges



Discussions at Baisso village