

*Full Length Research Paper*

# **An evaluation of poaching and bushmeat off takes in the Ebo Forest Reserve (EFR), Littoral Region, Cameroon**

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**Study on poaching and bush meat off takes /harvest in the Ebo Forest Reserve was carried out in 2012 and 2016 to identify and quantify species poached, poaching methods and seasonal impact on harvest rates and quantity. To achieve this task, purposeful and random sampling methods were used for the selection of respondents for questionnaires administration. In all, 182 from a population of about 461 poachers were sampled for questionnaires administration. Besides the administration of questionnaires, some selected Participatory Rural Appraisal (PRA) tools were also employed for the triangulation of collected data. Biological data were collected using four line transects. Each transect was 1.8 m wide by 2 km long laid 200 m apart in each of the zones. Along each of the established transects within the range of 20 m on both sides, data on encounter rates and human presence were collected. A total of 3768 animals with biomass of 26039.5 kg was harvested from the Ebo Forest Reserve and associated forests areas by 461 poachers. The harvest was made up of 30 species from 17 families of wildlife dominated by blue duikers (19.59%), brush-tailed (18.10%) and red duikers (11.36%). Two main weapons, guns and wire snares were identified as the main poaching weapons in the EFR. Harvest was more in the wet season than in the dry season. Poaching was more intense in zones that were very accessible and close to the market centre of Douala. As income gain remained a driving force to poaching, there is need to check poaching activities in the study area against the present weekly off take rate of 2.87 animals per day.**

**Key words:** Bushmeat, off take, poaching, harvest, species.

## **INTRODUCTION**

Poaching (illegal hunting of wildlife for bushmeat) is a worldwide phenomenon occurring throughout tropical forest ecosystems, especially in Central and West Africa

where it is currently a major source of livelihood to forest dwellers (POST, 2005). To these forest dwellers, bushmeat constitutes an important resource of their

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stable diet and livelihood (Willcox and Nambu, 2007). In the Congo Basin, about 34 million people are still dependent on wildlife as a direct source of protein (Ziegler, 2009; Redmond et al., 2006). Besides food, bushmeat provides a steady source of income to poachers and traders in this region. However, studies over the years have shown that the current levels of exploitation in the Congo basin are unsustainable (Keylock, 2002; Willcox and Nambu, 2007; Mfunda and Røskaft, 2010).

Cameroon is one of the countries in the Congo Basin where bushmeat harvesting is perceived to be a threat to endangered wildlife (Letouzey, 1968; Redford, 1992; Bennett and Robinson, 2000; Koulagna, 2001). Muchaal and Ngandjui (1999) observed an annual extraction rate of 0.635 of blue duikers in the Dja Reserve, Cameroon, whereas the maximum sustainable harvest was calculated to be 0.492. Other studies in Cameroon carried out in Korup, Banyang-Mbo and Lobeke forests, have influenced many wildlife decisions in the sub-region (Nguiffo and Talla, 2010). Despite these research efforts in Cameroon in the area of Wildlife ecology and its dynamics, data are still scanty on bushmeat off take and trade in the sub-region.

The Ebo Forest Reserve is one of the main areas in Cameroon housing many rare and endangered wildlife species (*Pan troglodytes*, *Potamochoerusporcus*, *Mandrillus Leucophaeus*, *Phylocolobuspreussi*) of global conservation importance (Abwe and Morgan (2008). Despite the potential role of the habitat to wildlife species of global importance, these resources are under severe threat due to incessant and unsustainable poaching of wildlife for food, income and traditional medicine by the local people (WWF, 2011). This phenomenon is posing serious challenges to the conservation of wildlife resources in the area. One of such challenges is the lack of information on the off take and trade in the study area. The government of Cameroon has been working with conservation organisations like WWF to ensure the ecological integrity of the Ebo forest. This great collaborative effort is faced with the challenge of uncontrolled poaching of wildlife for bushmeat by the local population (WWF, 2011). Milner-Gull and Akcakaya (2001) noted that a primary step in managing bushmeat crisis is evaluating the sustainability of current harvest rates of wildlife from an area. In recent years, conservation bodies of the EFR have been more concerned with biological surveys with little effort in the understanding of the rate at which wildlife is extracted from the forest (Kingdon (2001). This has contributed to the slowdown in wildlife management decisions in the area (WWF-CF, 2012). As a result of this slowdown, there is an absolute need to examine the rate at which wildlife is harvested for bushmeat in the area and to provide baseline information to assess the impact of

poaching in the reserve. In a strive to contribute to the closure of this knowledge lapses, this research was elaborated with specific objectives, to identify and quantify species poached, poaching methods and seasonal impact on harvest rates and quantity.

## MATERIALS AND METHODS

### Location and method of study

The Ebo Forest Reserve (EFR) and adjoining forests is situated within the Littoral Region of Cameroon cutting across two Divisions (Nkam and Sanaga Maritime Divisions). Geographically, it is located between latitudes 4°5'3.54" and 4°31'11.19," and longitudes 10°5'38.92" and 10°38'28.11," and covers a total surface area of 2067.78 km<sup>2</sup> (WWF, 2003) (Figure 1).

### Geophysical description of the area

The area is marked by two main seasons (the dry: November -May and wet: June - October) (Ekobo, 2007). The mean monthly temperature ranges between 26 to 28°C with monthly peaks of 28.3 to 28.1°C from December to April. Average annual precipitation ranges between 2496 to 2950 mm with the wettest months between July and October (Ekobo, 2007; Levoyageur, 2012).

Geologically, the study area is located on a sedimentary formation of probably Cretaceous basements that rest on a Precambrian layer and composed of rocks like sandstone, siltstones and clay (WWF, 2001). The topography of the area is undulating with gentle to moderate slopes of 100-500 m to steep slopes of up to 1400 m above sea level. A network of streams flows through the forest and empties into Makombe, Nkam and the Ebo Rivers which are the main tributaries of the Wouri and Dibamba rivers (Dowsett and Dowsett, 2001).

### Description of vegetation

The area is known to cover 1424 km<sup>2</sup> of closed canopy and undisturbed moist forest spanning across three river valleys of lowland and sub-montane rain-forest in the Littoral Region of Cameroon (Morgan and Abwe, 2006). This forest is known to house about 125 species of high conservation value flora and fauna species such as Kola (*edulis*), chimpanzee subspecies (*Pan troglodyteselliotti*), drills (*Mandrillusleucophaeus*), elephants (*Loxondotacyclotis*), Preuss's red colobus (*Procolobuspreussi* and crocodile (crocodilussp). Recent studies have confirmed the presence of a new gorilla population of uncertain taxonomic affinity (Morgan et al., 2003; Morgan and Abwe, 2006; Ekwoge and Morgan, 2008; Whytock and Bethan, 2010).

### Socio-cultural description of the inhabitants

The people residing around this forest constitute two ethnic groups (Bassas and the Banens). There are other ethnic groups of mixed socio-cultural, economic and political identities drawn from other areas like the North West, West, Centre and East: commonly referred to as the Bertouas. They practice small-scale plantation peasant agriculture, fishing, Non-Timber Forest Products (NTFPs)

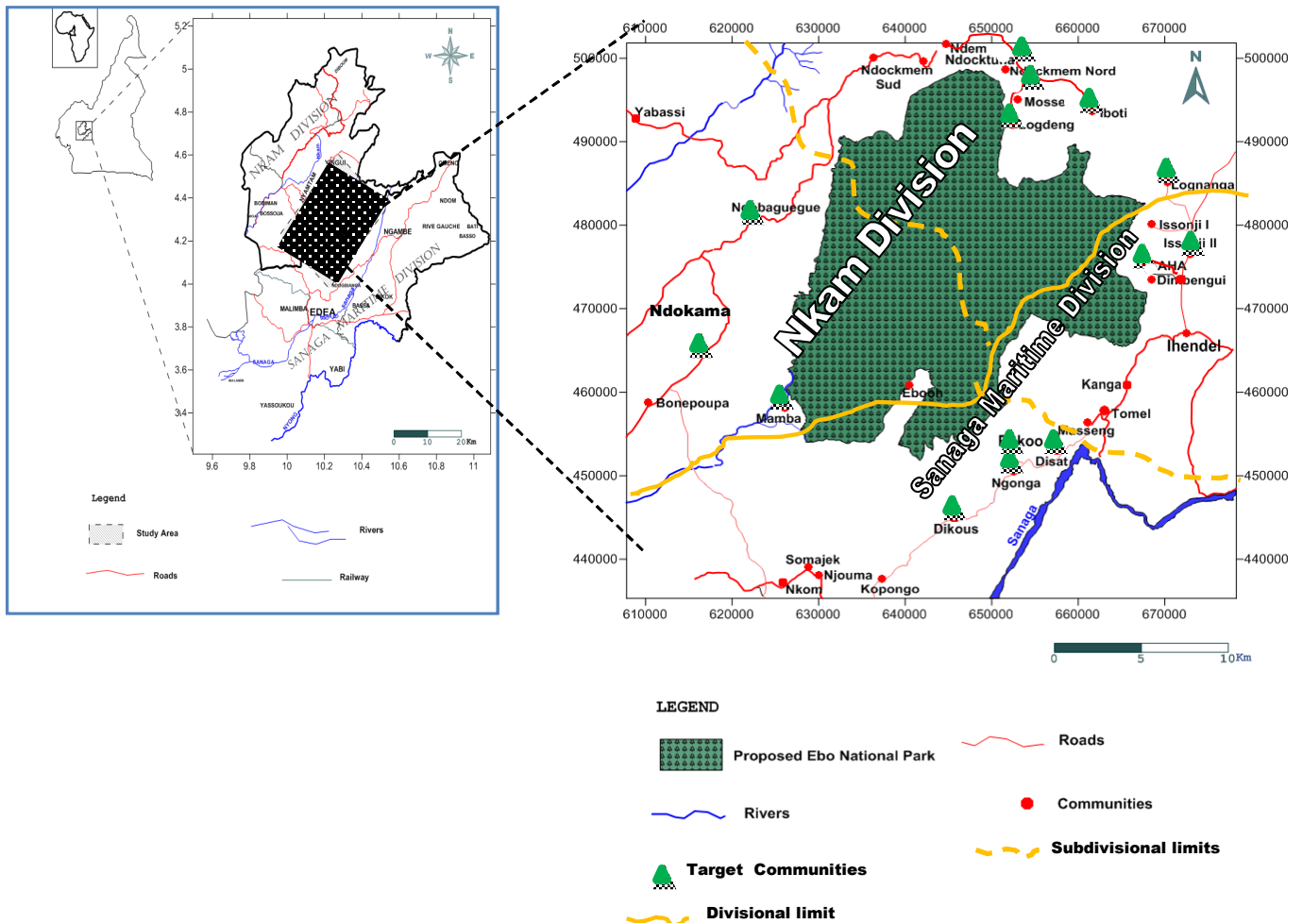


Figure 1. Study area and target communities.

collection and poaching for livelihood. Poaching is documented as the main human activity to people of this area constituting the main source of income and animal protein to the local population. Besides the people's reliance on the forest, a few of the community people keep domestic animals (chicken, pigs and goat) for traditional celebrations.

**Research method**

The study area was purposively divided into four zones (A, B, C and D) based on their proximity to the study area. Zone A was made up of communities in the northern part of the study area belonging to the Yingui subdivision in the Nkam Division; Zone B was made up of communities in the South-western part of the forest in the Yabassi subdivision; Zone C was made up of communities in the southern part of the forest in the Edea II subdivision and Zone D was made up of communities in the eastern part of the forest belonging to Massock-Songloulou subdivision.

From each of the four zones, four communities were randomly selected for socioeconomic and biological data collection.

**Data collection**

The field was divided into zones. Socioeconomic data were collected using purposeful and random sampling methods as described by Fimbel et al. (2000) and Willcox and Nzoyango (2000). Field assistants were trained to collect bushmeat harvest data from poachers using data collection sheets. At every data collection point, a reference list of local and associated scientific names of all animal species known by poachers in the area was generated to facilitate identification by field assistants.

The number of poachers sampled per community was based on the size of the hunting population documented by WWF Cameroon during a poacher's census survey. In all, a total of 182 poachers from a population of about 461 poachers were sampled giving a sample intensity of about 40% in the study area. Alongside the use of data collection sheets, some selected Participatory Rural Appraisal (PRA) tools (Semi-structured interviews, focus group discussions, and ranking) were employed to triangulate questionnaire based data on poaching methods, weapons, local perceptions and alternatives to poaching.

Data collection sheets were designed to collect information on

the species poached, quantity (dry and wet), sex of poached animals, age estimate (juvenile or adult) as well as poaching methods directly from poachers on their return from poaching at forest gates and sales points. The biomass/quantity of bushmeat harvested was established using a scale balance. The questionnaire was designed in the form of a data sheet for field assistants to collect information directly from poachers on their return from poaching, as well as at sales points and forest gates. Information required for filling the data sheets were: the name of the wildlife species killed, its biomass using a spring balance. The sex and age estimation (juvenile or adult) of the animal killed and the method used in killing the animal species was established before weighing the animal.

To estimate the quantity of smoked/fresh bushmeat, a simple proportion method was used. This method assumed that the proportion of each species in the fresh state will be the same as in the smoked state. In light of the above, the sums of all the individual species in the fresh state were calculated and the proportion of each species in the said sum was determined using the simple proportion method.

The average quantity of bushmeat of each species (in fresh form) classified in terms of sex and age was calculated. The average quantity of bushmeat of each species (in smoked form) was derived from the latter by a simple multiplication of the respective outcome of the simple proportions.

### Biological data

In order to complement the socio-economic data, biological data were collected using the line transects technique as described by WWF (2003). Four line transects each 1.8m wide by 2km long were purposefully laid 200 m apart in each of the zones. Along each of the established line transects within the range of 20m on both sides, data on encounter rates of species and human presence were collected. This made use of direct observations of footprints, tracks, dung, feeding signs, temporal nest, as well as signs of human presence (poaching camps, sounds of gun shots, shell of cartridges, carbide dust, wire snares, foot prints) for the collection of biological data.

### Data analysis

Collected data were analysed using Microsoft Excel version 2010.

Data on encounter rates were analysed using the formula shown;

$$\text{Encounter rate} = \frac{\text{Total number of observations per species}}{\text{Transect length}} \quad (1)$$

$$\text{Mean encounter rate} = \frac{\text{Sum of ER per species}}{\text{Total length of transects surveyed}} \quad (2)$$

$$\text{Frequency (\%)} = \frac{\text{Mean ER per species} \times 100}{\text{Sum of mean ER of species present}} \quad (3)$$

The study lasted for 32 weeks (4 weeks during the dry season (November to March) and 4 weeks in the wet season (May-October) in 2012 and repeated in 2016.

## RESULTS

### Bushmeat harvest

A total of 3768 animals with biomass of 26039.5 kg dry weight were harvested from the study area between 2012 (16 weeks) and 2016 (16 weeks). The harvest was composed of 30 different species grouped into 17 families of mammals and reptiles. This is presented in Table 1.

The harvest according to species was made up of 30.94% duikers, 28.50% primates, 25.03% rodents, 4.46% reptiles, 4.06% carnivores, 3.82% pangolins, and 3.13% swine. In terms of biomass, the harvest was dominated by duikers (41.08%), primates (36.50%), swine (16.28%), rodents (11.07%) and reptiles (5.79%) respectively.

Figure 2 represents the relationship between the total number of species harvested and the total biomass at p-value = 0.02,  $F_{1,6} = 10.29$ .

### Sex and age distribution of species harvested

Of the 3768 animals harvested, 2220 were identified to be males and 1548 were females representing 57.38 and 38.16% respectively. According to age grouping of the harvest, 3272 were adults while 496 were juvenile, representing 86.84 and 13.16% respectively.

### Total harvest according to communities

Of the 3768 animals harvested during the study period (32 weeks), approximately 182 poachers randomly distributed in the 14 communities of the study area were responsible for the harvest. Appendix Table 1 gives a statistical summary picture of quantity harvested from each of these communities within the four zones.

Using the ANOVA–Single Factor test for significance, there was no significant difference in the number of species captured per zone at p-value = 0.15

### Seasonal variation in bushmeat harvest

A total of 1460 animals (biomass of 9213.5 kg) and 2308 animals (biomass of 16765.5 kg) were recorded as bush meat harvest for the dry and wet seasons respectively while mean poacher bush meat harvest per week were 2.28 and 3.47 for the dry and wet seasons respectively (Appendix Table 2).

Significant differences were observed in weekly harvests of most species between zones and seasons. Appendix Figure 1a and 3b show the result of a t-test

**Table 1.** Species and quantity harvested for bushmeat in the study area.

Species	Family	Scientific names	Common names	Class	N°Ani	Biomass
	Homidae	<i>Pan troglodytes</i>	Chimpanzee	A	8	312
	Cercopithecidae	<i>MandrillusLeucophaeus</i>	Drill	A	52	677.5
	Colobinae	<i>Phylocolobuspreussi</i>	Red Colobus	A	2	22
		<i>Cercocebustorquatus</i>	Mangabey	C	91	777
		<b>Guenons</b>				
Primates		<i>Cercopithecuspongonia</i>	Crown Monkey	C	124	362.5
		<i>Cercopithecusmona</i>	Mona Monkey	C	231	954
		<i>Cercopithecuspreussi</i>	Preuss Monkey	A	209	1077
		<i>Cercopithecusnictitans</i>	Putty Nosed Monkey	C	249	1124
		<i>Cercopithecuserythrotis</i>	Red Eared Monkey	A	99	325
		<i>Cercopithecustantalus</i>	Tantalus	C	5	22
		Loridae	<i>Perodicticuspotto</i>	Potto	A	4
	Thryonomyidae	<i>Thryonomysswinderianus</i>	Cane Rat	C	45	236
Rodents	Cricetomyinae	<i>Criceetomys spp.</i>	Giant Rat	C	212	304.5
	Hystricidae	<i>Antherurusaficanus</i>	Porcupine	C	682	2339.5
	Sciuridae	<i>Funisciurus spp.</i>	Squirrel	C	4	3
	Viverridae	<i>Civettictiscivetta</i>	African Civet	B	34	394.5
Carnivores		<i>Genetta spp.</i>	Genet	C	11	17
	Nandinidae	<i>Nandiniabinotata</i>	African Palm Civet	C	83	212
	Herpestidae	<i>Herpestis spp.</i>	Mongoose Species	C	25	44.5
Scaly Ant eaters	Manidae	<i>Manis spp.</i>	Pangolin	A	144	376.5
Hyraxes	Procavidae	<i>dendrohyrax spp.</i>	Tree Hyrax	A	2	6.5
	Suidae (swines)	<i>Potamochoerusporcus</i>	Red River Hog (bushswine)	B	118	4239
Ungulates		<i>Cephalophus spp.</i>	Red Duikers	B	428	6646
	Antelopinae (duikers)	<i>Cephalophusmonticola</i>	Blue Duiker	C	738	4051
Proboscids	Proboscidae	<i>LoxodontaCyclotis</i>	Elephant	A	6	Not Recorded
		<i>Naja spp.</i>	Black Snake	B	5	24.5
		<i>Crocodylus spp.</i>	Crocodile	A	41	601.5
Reptiles		<i>Veranusniloticus</i>	Monitor Lizard	B	49	502.5
		<i>Python sebae</i>	Python	B	11	214.5
		<i>Chelonia spp.</i>	Toitose	B	53	137
		<i>Bitisgabonica</i>	Viper	C	9	27.5

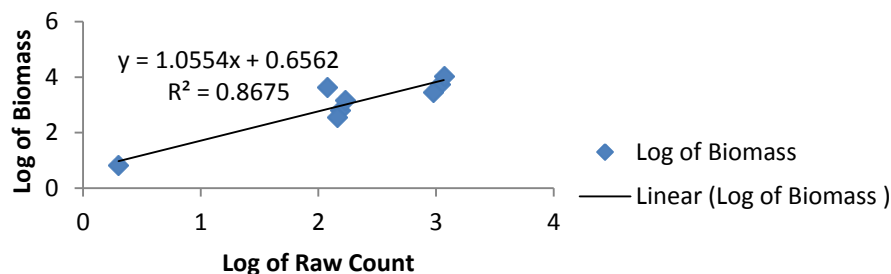
performed to test this significance, difference in the number of species harvested as bush meat per week per season at p-value = 1.52 level of significance.

### Poaching methods

Bush meat harvested (animals killed) during the study period were captured by the use of guns, wire snares, dogs, machetes, nets and hands.

As shown in Table 2, bush meat harvesting in the study area was achieved first by the use of guns while the net was identified to be the least harvesting method. Both modern and artisanal (den) guns were identified to be used by poachers. 19 (23.17%) of these poachers used exclusively modern guns, 38 (46.34%) used den (artisanal) guns while 25 (30.49%) used both modern and den guns.

Two types of wire snare traps were identified to be used by poachers in this area (the free and barrier traps).



**Figure 2.** Relationship between number of animals harvested and biomass.

**Table 2.** Weapons and their volume of capture.

Ranks	Weapons	Number	Percentages
1	Guns	2187	55.39
2	Wire snares,	1377	35.27
3	Dogs,	174	4.62
4	Hand	148	3.93
5	Machetes	21	0.56
6	Nets	9	0.24
Total	0	3768	100

Free traps consisted of a wire noose connected to a bent-over sapling under tension and placed on the animal's trail. The barrier traps were in the form of short fences of about 70cm high with varying lengths constructed with palm fronts and wire noose placed at various intervals. It was recorded that a single poacher established on average 166 and 1,242 free and barrier traps annually.

Seasonally, animals killed by guns were more in the dry season whereas in the wet season, animal killing was more by the use of wire snares traps. T-test analysis showed no significant difference in the number of animals killed per season at  $p = 0.62$ .

Poachers were found to enter the forest 2-3 times a week to poach depending on the season. Both night and day poaching were observed in the study area. Records have it that diurnal species were mostly poached in the day while nocturnal species were mostly harvested in the night.

At the end of every poaching operation, the poachers either came out to sell their harvest at the forest-gate or hire porters to transport harvest to sales point where they sold directly to urban bush meat traders from Douala and Edea towns. Some few poachers (11), after poaching transported their harvest directly to Douala for sale to big bush meat buyers who in some cases pre-financed the poaching exercise by giving the poacher a loan which is paid with bushmeat.

## Biological survey

Results from the large mammal survey as shown in Table 3 confirmed the presence of five major wildlife families in the study area. These include Proboscidae, Homidae, Suidae, Cercopithecidae and Bovidae.

Human presence identified in the study included snare lines, gunshot shells, human used trails and active or abundant camp sites. As illustrated by Appendix Figure 2, a mean encounter rate of 0.4 was calculated for the survey with no statistical relationship between human and animal signs at  $p = 0.71$  level of significance.

## DISCUSSION

### Bush meat harvest

The rate of wildlife off-take/harvest is very high in the Ebo Forest Reserve (EFR). This is as a result of the fact that the EFR with its high biodiversity value is located very close to Douala town which is one of the biggest bushmeat market centers in Cameroon. This is not unconnected to the city's high population and the multiplicity of feeder markets that depend on it for bush meat supplies. This explains why total bush meat harvest from the study area is usually dominated by key

**Table 3.** Large mammal families present in the study area.

Family	Species/scientific name	Common name
Proboscidae	<i>Loxodontacyclotis</i>	Elephants
Homidae,	<i>Pan troglodytes</i>	Chimpanzee
Suidae,	<i>Potamochoerusporcus</i>	Red river hog
Cercopithecidae	<i>Cercocebustorquatus</i>	Mangabey,
Bovidae	<i>Cephalophusmonticola</i>	Blue duikers

consumer driven species such as brush-tailed porcupines, blue duikers, and red duikers. This is in line with Melle and Nkwatoh (2016) who in their study of bushmeat off takes in the Korup National Park of South west Cameroon, observed that brush-tailed porcupines and blue duikers were species of high consumer preference. However, grouping the animals into sub groups of consumer preference; primates were observed to be the second group of animals on the harvest table of poachers in the EFR. As Okiwelu et al., (2009) put it, primates are not only for their food value but also for their medicinal and traditional value. On the other hand, data on primate's species like the *Phylocolobuspreussi* (red colobus) and *Cercopithecustantalus* (tantalus monkey) were rare on the harvest table of poachers. This could be as a result of the unsustainable off take of these species in the EFR (WWF, 2011; Gally and Jeanmart, 1996; Fa and Yuste, 2001; Kümpel, 2006; Carpaneto et al., 2007; Ziegler, 2010).

Poachers in the EFR were found to have a weekly average harvest of 2.87 animals; this in comparative terms is relatively lower than 5.18 animals per week registered in Monte Mintra Forest, Equatorial Guinea (Fa and Yuste, 2001). However, Willcox and Nzouango (2000) with their record of 1.03 animals per poacher in the Bayang-Mbow Wildlife Sanctuary (BMWS) is a confirmation that results from the EFR is relatively high in the Cameroonian context when juxtaposed with results from other conservation hot spots in Cameroon such as the Bayang Mbow Wildlife Sanctuary, Korup National Park, Mount Cameroon National Park and the Dja area.

### Seasonality and harvest

The rainy season was associated with more off take than the dry season. This is in line with the work of Muchaal and Ngandjui (1999); Fimbel et al. (2000), and Wilcox and Nzouango (2000), who in their separate studies have it that, the rainy season is the fruiting season for most forest plants. As a result, most animals move about during this period in search of food. Secondly, they ascertained that the wetness of the forest floor during this period makes it easier to locate animal paths and footprints to set traps than in the dry season. This makes

animals more vulnerable to poachers especially common ground dwelling animals like rodents and ungulates. On the other hand, primates, reptiles, and pangolins were relatively captured more in the dry season due to the dryness and openness of the forest floor which favoured the movements of these animals thereby predisposing them to poacher. Melle and Nkwatoh (2017) affirm that the dry season is a season where poachers can easily penetrate the forest floor from any angle as forest undergrowth and water levels of most rivers are at their lowest at this period of the year in most forest areas in Cameroon. On the other hand, weekly variation in harvest between seasons might not follow this general trend as some weeks in both seasons could result in great variation due to the different poaching pressures mounted on species harvest between seasons (Okiwelu et al., 2009). However, the similarities in the animals captured with guns and wire snares between seasons showed that a combination of poaching weapon were employed in both seasons

### Poaching methods

Weapons used by poachers were found to have varying impacts on the quantity of bushmeat harvested. Two types (guns and wire snares) were observed to be the most commonly and widely used weapons in the study area. The gun was recorded as the highest killer of wildlife, in the study area while the wire snare came second. This is in line with Willcox and Nambu (2007) who in their study observed that there is a gradual shift from traditional practices (non-selective techniques like trapping) the use of modern sophisticated weapons by poachers in and around protected areas in sub Saharan Africa. They further observed that the frequent use of the gun in bushmeat harvesting was highly encouraged by the fact that harvests from the gun attracted a higher market price than that same harvest from a trap. Iddi and Eivin (2010) in their survey of bushmeat hunting in Tanzania revealed that buyers prefer bushmeat harvests from guns to harvests from traps because of the odourless nature of the bushmeat in response to consumers' preference. Nguiffo and Talla (2010)

confirmed that bushmeat harvest from traps are most often associated with odour due to the fact that animals caught by traps stay overnight before removal giving the harvest a room for odour development from microbial action.

### Zonal bushmeat harvest

The number of species captured per zone did not vary significantly, suggesting that, pressure exerted on various species were similar in all the zones. However, the significant differences in the number of animals captured per poacher between zones revealed that poachers from some zones exerted different pressure on the wildlife in the forest. The ability of poachers to exert remarkable pressure was observed to be a function of the poacher's economic ability to buy sophisticated guns (Iddi and Eivin, 2010).

### CONCLUSION AND RECOMMENDATION

Poaching has been the major problem in Cameroon protected areas due to poverty level of villages around protected areas. Most household income and protein source are from bushmeat. A total of 3768 species from 17 families were harvested from the EFR. Blue duikers, brushed tailed porcupine and guenons were the most harvested species. Poaching intensity was observed to be relatively higher due to the location of the EFR to the Douala bushmeat market centre. Poachers were observed to use a diversity of poaching weapons with guns and wire snares being the principal weapons in use. More bush meats were harvested in the rainy season than in the dry season. Based on this, we highly recommend that the government and other NGOs in their conservation efforts should first build capacities of poachers on alternative income sources. Secondly, alternative income sources should be introduced to poachers to reduce their dependence on poaching as a major source of income. Thirdly, strict law enforcement should be put in place after the introduction of the alternative income sources to poachers. We also recommend a participatory and total involvement of all stakeholders in the management of the Ebo Forest Reserve.

### CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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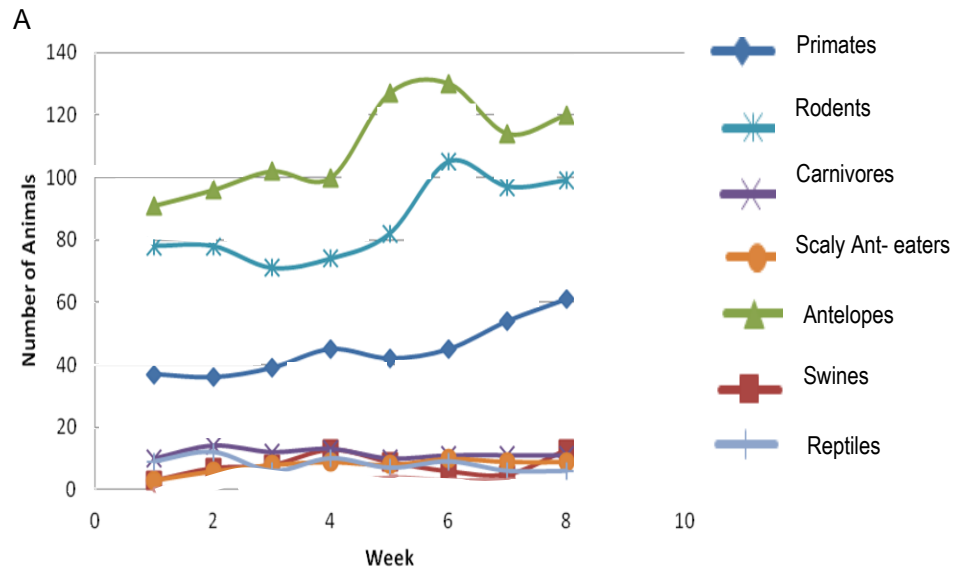
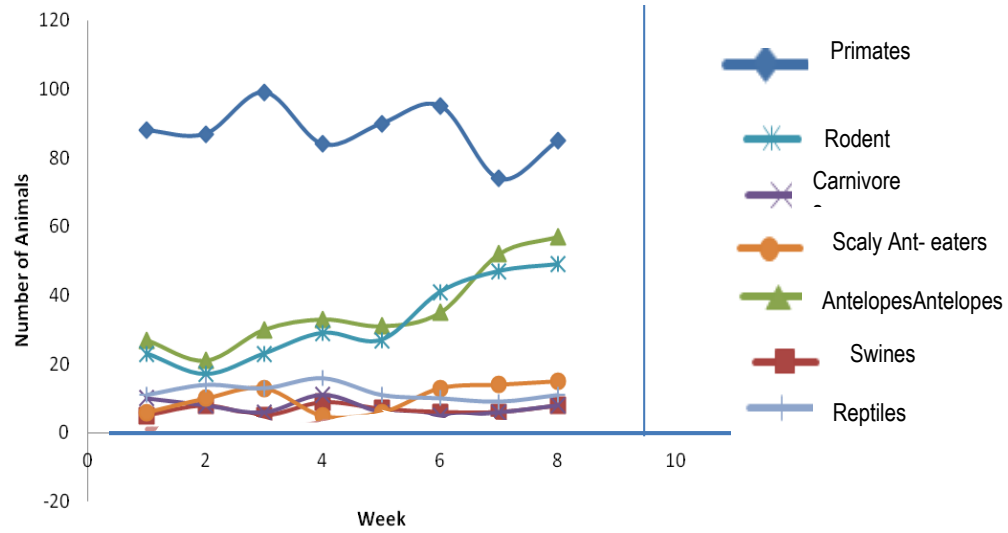
**Appendix Table 1.** Statistical summary of harvest in each community during the study period.

Measurement	Com.	Total Offtake	Number of hunters	Hunter Mean	Standard Deviation	Sample Variance	Standard Error	Median	Mode	Skewness	Range	Confidence Level (95.0%)
Zone A	Ibt	622	13	47.85	13.18	173.81	3.66	47	47	1.05	49	7.97
	Mos	101	3	33.67	5.03	25.33	2.91	33	#N/A	0.59	10	12.5
	Lnd	733	16	45.81	14.79	218.7	3.7	41	35	0.43	42	7.88
	NdmN	123	3	41	4	16	2.31	41	#N/A	0.00	37	9.94
Zone B	Ndbg	188	5	37.6	2.88	8.3	1.29	37	37	0.66	34	3.58
	Ndk	178	5	35.6	4.83	23.3	2.16	34	#N/A	1.94	12	5.99
	Mam	611	6	101.83	49.73	2473.37	20.3	87.5	#N/A	1.73	139	52.19
Zone C	Ngg	318	6	53	13.87	192.4	5.66	56.5	#N/A	-0.28	35	14.56
	Dks	91	3	30.33	7.64	58.33	4.41	32	#N/A	-0.94	15	18.97
	Pko	206	5	41.2	3.7	13.7	1.66	42	#N/A	-0.61	9	4.6
	Dst	69	3	23	3.61	13	2.08	22	#N/A	1.15	7	8.96
Zone D	Sha	139	5	27.8	9.04	81.7	4.04	30	#N/A	-0.45	21	11.22
	Isje	184	4	46	15.47	239.33	7.74	50.5	#N/A	-1.43	35	24.62
	Lnga	204	5	40.8	12.28	150.7	5.49	35	#N/A	1.22	29	15.24

Com=Community; Ibt=Iboti; Mos= Mosse; Lnd=Logndeng; NdmN=Ndogmen Nord; Ndk=Ndokama; Mam=Mamba; Ngg=Ngonga; Dks=Dikous; Pko=Pokoo; Dst=Dissat; Sha=Saha; Isje=Issondje; Lnga=Lognanga.

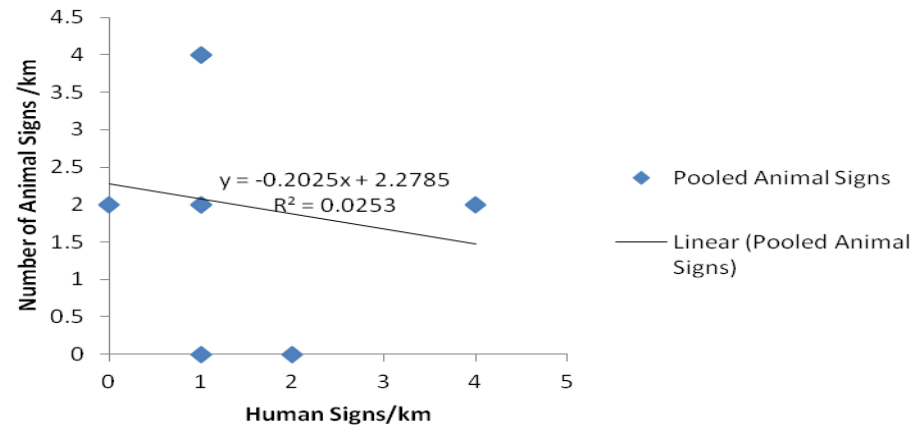
**Appendix Table 2.** t-test analysis of season bush meat harvest per species/group.

Species/ Group	Degree of freedom	t-stat	p-value
Primates	14	10.56	4.71E-08
Antelopes	14	10.90	3.19E-08
Carnivores	12	4.41	8.45E-04
Rodents	14	8.78	6.02E-07
Reptiles	14	3.31	5.12E-03
Swines	9	0.91	0.39
Scaly ant eater	11	1.52	0.16



B

**Appendix Figure 1. A.** Weekly variation of harvest of species/ in dry season. **B.** Weekly variation of harvest of species/ in rainy season.



Appendix Figure 2. Fitted regression line of encounter and human signs.