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Abundance and distribution of pangolins (*Manis* spp.) in the kimbi-fungom national park, North West Region, Cameroon

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Abstract

This research was carried out in 2017 and the general objective was to contribute to the conservation of Pangolins in their remaining stronghold habitats in the Kimbi-Fungom National Park (K-FNP). The methodology employed for data collection of bio-indicators signs was "reccé" walk. A total effort of 22.5 km was walked. Results identified three species of pangolins; *Phataginus tetradactyla*, *Smutsia gigantea* and *Phataginus tricuspis*. The encounter rate (ER) of pangolins gave 0.97 sign per km with the highest number of signs observed in the Northern regions of the Park. The mean ER of anthropogenic activities gave 1.1 sign per km with hunting as the most preponderant with an E.R of 1.87 sign per km. Encounter Rate of anthropogenic activities plotted against those of pangolin gave a coefficient of determination (R^2) = 0.096 indicating that 9.6% of pangolin distribution was accounted for by human activities. Therefore an urgent action plan to curb the illegal hunting of pangolins was needed to opens ways for conservation priority of this species in the K-FNP.

Keywords: Anthropogenic activities, bio-indicator, conservation, pangolin, status

Introduction

The conservation of pangolins is becoming a focal point of interest to conservationists due to their alarming decline and disappearance or extinction in some of their suitable habitats [1]. Despite this, one of the major impediments to studying the conservation status of wild pangolins has been the difficulty in locating them [2]. In many areas where biodiversity surveys have been conducted, no pangolins were recorded, despite extensive nocturnal searches [3]. This makes it difficult for the provision of data on their abundance and distribution [1]. Nevertheless, the Kimbi-Fungom National Park (K-FNP) is home to three species out of the four species of the African Congo Basin pangolins: white-bellied tree pangolin (*Phataginus tricuspis*); Black bellied tree pangolin (*Phataginus tetradactyla*); giant ground pangolin (*Smutsia gigantea*) and Temminck's ground pangolin (*Smutsia temminckii*) [4]. Previously, these species of pangolins were listed as "least concerned" or "near threatened" but due to their alarming continuous decline resulting from over hunting, are now all classified as threatened with extinction on the IUCN Red List of Threatened Species [5] and now all listed in Appendix I of the Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, with a zero annual export quota for wild caught individuals or those traded for commercial purposes [6]. Furthermore, the Ministry of Forestry and Wildlife (MINFOF) classified *Smutsia gigantea* in Class A amongst totally protected species and the other three sub-species in Class B as partially protected accordingly to the categories of mammals in Cameroon with both declared rare or threatened with extinction in some of their suitable habitats [7]. Despite this protection, the K-FNP pangolins are illegally hunted and traded widely, being highly valued for their meat, which is considered a delicacy around neighboring villages, their scales, which are used for traditional medicine by a number of traditional doctors [4]. Additional anthropogenic pressure results from the large-scale, rapid loss of their forest habitat [8].

Ahead of World Pangolin Day in February 2017, the government of Cameroon conducted Africa's first-ever public burn of confiscated pangolin scales, showing their commitment to conserving the world's most heavily-trafficked wild mammal [9]. This gesture of the state created awareness on the importance of these species of wildlife.

Unfortunately, the rate of encroachment into the K-FNP by the local communities have been reported very rampant and increasing [10]. This is because wildlife species especially pangolins are illegally hunted for food and for uses in traditional medicine as well as sold to improve livelihoods [11]. The evident of frequent catch and seizure of pangolins and pangolin scales are depicting high poaching rate in the park [4]. Equally, the presence of farmer's huts, hunter's huts and grazer's huts are indications of habitat fragmentation and degradation that exposes pangolins to be easily hunted [12]. The encroachment of Nigerian hunters and traders in search of pangolins and their exportation to international markets illustrated clearly the level of hunting pressure on pangolins depicting their rapid decline in the K-FNP which is one of the hotspots of wildlife in the Northwest region [4]. Despite all these threat factors, the relative abundance of these species has not been known in the K-KNP thereby creating a knowledge gap [4]. This has greatly hindered pangolin conservation in this park. Equally, there is no map showing the distribution of these three species of pangolins in K-FNP thereby limiting conservation efforts since their habitats characteristics, preferences and threats associated with them are of prime importance to their protection [4]. Whereas the IUCN pangolin specialist group's recommendation for Africa was to establish baseline ecological data to better assess the impact of harvest on wild population of pangolins. Base on this, a primary research question was posed to find out what was the status of pangolins in the K-FNP. This was aimed to attain the general objective of the study which was to contribute to the conservation of Pangolins (*Phataginus* sp.) by establishing a baseline data in the K-FNP which will serve as a guide for management decisions. More specifically to

investigate the relative abundance of pangolins, determine their distribution and evaluate the effects of anthropogenic activities on the distribution. This was to prove the main hypothesis that pangolins are decreasing in their population due to illegal hunting in the K-KNP.

Materials and Methods

Description of the study area

Kimbi-Fungom National Park was created by a Prime Ministerial decree number 2015/0024/PM of 3 February, 2015 with a total surface area of 953.8 km² (figure 1). The Kimbi-Fungom National Park occurs at latitude 6.5-6.9 °N and longitude 9.8-10.5° E in the North West Region of Cameroon. The K-FNP cuts through 3 divisions: Boyo, Menchum, and Donga-Mantung, covering 4 Sub-divisions: Fonfuka, Fungom, Furu-Awa, and Misaje. In the north, it is bordered by Tumbo and Tosso in Nigeria, Baji, Nser, Kpep, Furubana, Supong, Akum, Edjong and river Katsina Ala in Furu Awa sub-division. In the east by Labo, Batari, and the Dumbo cattle ranch in the Misaje sub-division. In the South by river Kimbi, Kimbi village and Su Bum in the Fonfuka sub division. In the center by Zhoa-Nkang, Esu, Kundzong and Iwo in the Fungom sub-division, and in the West by Munkep and Gayama also in the Fungom sub-division [4]. These two compartments are linked by a corridor that stretches between Nkang and Nkannye on the Fungom end to the north west of Kimbi and South West of Dumbo cattle ranch with river Kimbi being a natural boundary between the ranch and the National Park. The park has four main entry points: Kimbi to the south, Zhoa-Nkang in the center, Esu - Gayama to the west, and Furuawa to the North [4].

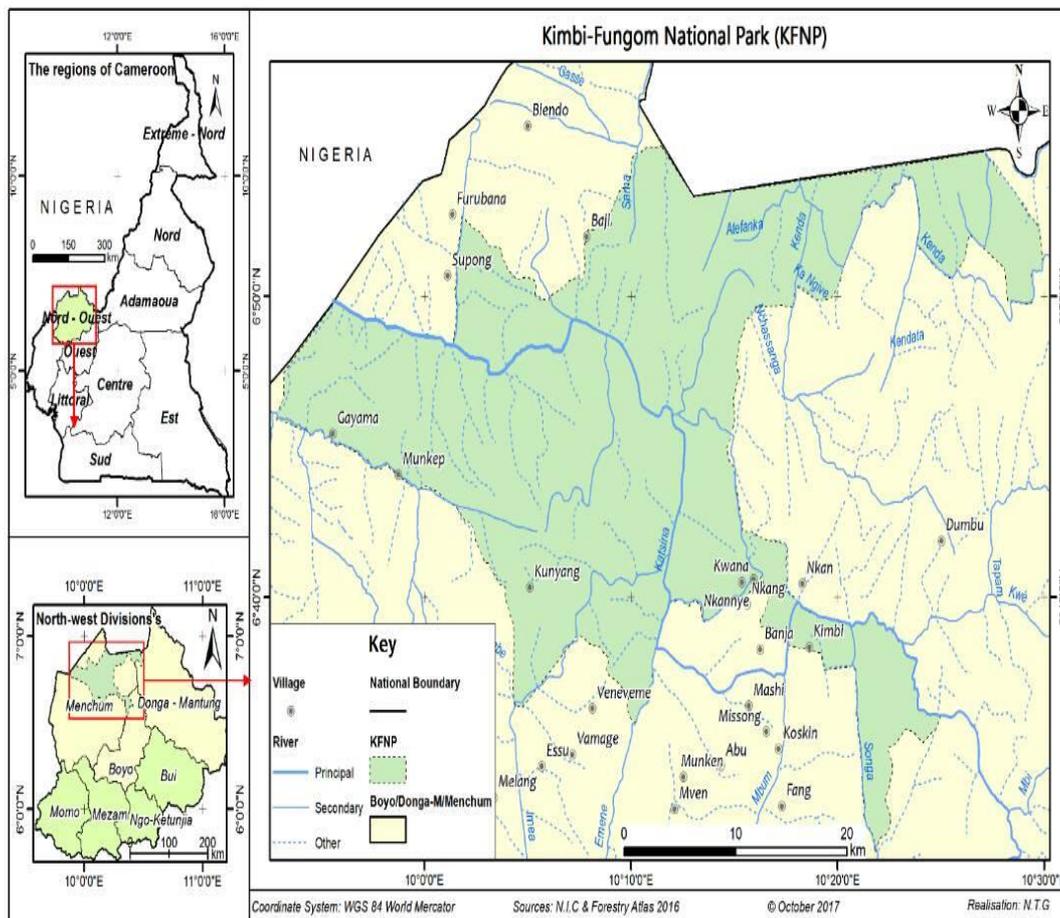


Fig 1: Map of Cameroon showing the location of the Kimbi-Fungom National Park in the North West region of Cameroon

Methods of data collection

The method used for data collection was the “recce walk” method. The zone was subdivided into quadrants of 1.5 x 1.5 km giving a total of 15 quadrants. In each quadrant, data was collected on recces of 1.5 km long oriented randomly in the West - East or North - South directions. A total of 15 recces of 1.5 km each were covered giving a total distance of 22.5

km. Recces were oriented to cut across major vegetation types (primary forest, secondary forest, gallery forest and Savannah) and drainage features (rivers and streams) in order to have a representative sample of the park. The start and end point of each recce was determined using a global positioning system GPS *Garmin etrex 10*. Figure 2 shows the sampling plan with distribution of recces in K-FNP

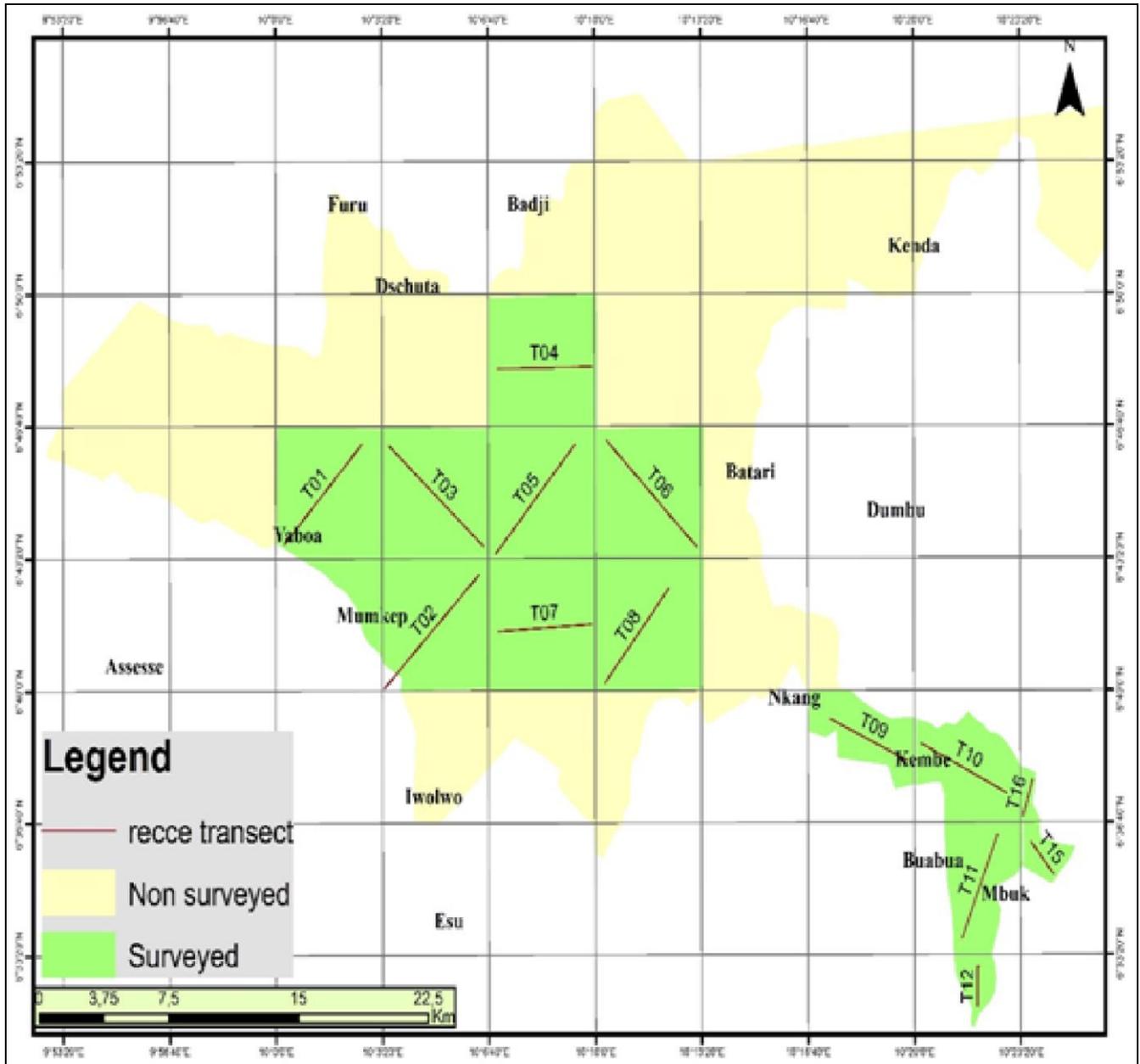


Fig 2: Map showing representation of recce-transects for animal inventory in the kimbi-fungom national park

The research team constituted a Leader who coordinated all the activities of the entire team and was also responsible for taking down coordinates and necessary information in the field note book; a Field Assistant who was in charge of reading coordinates and indicating direction; a hunter who best mastered the study site more than anyone else and was responsible for identifying and indicating most of the indirect signs of pangolins and of other animals (footprints, scales, tracks); an observer who was responsible for searching signs of abundances of different species of wild life and presenting to the team for identification and record of coordinates; an Eco-guard who ensured general security of the team; two bike riders whose job was mainly to transport the research team

from one part of the Park to another. These data were recorded on a standard field data collection sheet [13].

Data analyses

Data collected from the field was summarized and presented using inferential and descriptive statistics (abundance indices, charts, maps and frequency tables). The Encounter Rate (ER) or Kilometric Index of Abundance (IKA) which represents the total number of observations per kilometer ($IKA = N/L$ where N is the total number of observations per transect and L, the transect’s length in kilometers) was estimated for pangolins signs and human activities. The GPS points of pangolins 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 quadrats 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 the defining of important zones for pangolins in order to determine management strategies for their conservation. Regression analyses were carried out to test the relationship between the encounter rate of pangolins and anthropogenic activities. Encounter rates of these two variables were exported to Excel and Statistical Package for Social Scientists (SPSS) (Version 14) to produce fitted regression line. The mathematical formula used to determine the correlation coefficient (r) was that developed by Pearson given by:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Table 1: Pangolins species recorded in the Kimbi-Fungom National Park

Family	Common Name	Scientific Name	Minf of classification
Manidae	Pangolin species	<i>Manis (Phataginus) tetradactyla</i>	B
		<i>M. (Smutsia) gigantea</i>	A
		<i>M. (Phataginus) tricuspis</i>	B

Among these species of pangolins the giant ground pangolin (*Smutsia gigantea*) is currently classified under the A category and are totally protected under Cameroon Forestry law.

Indices of pangolins identification in the Kimbi-Fungom National Park

It is evident that the studying of pangolins through signs

Table 2: Indices of pangolins identified in the Kimbi-Fungom National Park

Indices	Indirect indices					Sighting
	FS	FP	D	C	HT	
Signs	4	5	6	1	5	DO
Number	4	5	6	1	5	1
TDC(km)	2hjjd 22.5	Fdd222.5	22.5	22.5	Yddd 22.5	22.5
ER	0.18	0.22	0.27	0.04	0.22	0.04
Total	0.97					

Legend: ER=Encounter rate, D=Dung, TDC=Total distance covered, DO=Direct observation, FP=foot print, C=carcass observation, FS= Feeding sign. ER, 0.1- 0.5 = Weak, > 0.5 = High (14)

Table 2 shows that a total of 22signs of pangolins of which 21 were recorded as indirect signs and one direct sighting with a total effort of 22.5km gave an encounter rate (ER) of 0.97 signs per km during the survey. Only one pangolin was observed directly which immediately escaped into its burrow and gave an encounter rate of 0.04 signs per km. These findings contradict those of Chuo *et al.*, (2017e) who reported only one sign (Pangolin carcass) of pangolin in the Kom-Wum Forest Reserve North-West Region of Cameroon.

The coefficient of determination, R² was calculated from r using

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

Where

- X: is Anthropogenic activities.
- R²: 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.

Results and Discussion

Relative abundance of pangolin encountered in the Kimbi-Fungom National Park

During the survey, and with the assistance of hunters, a total of three species of the Congo basin pangolins; the Tree or White-bellied pangolin (*Phataginus tricuspis*), the Long-tailed or Black-bellied pangolin (*Phataginus tetradactyla*) and the Giant Ground pangolin (*Smutsia gigantea*), were recorded within the K-FNP as shown in table 1 of the current classification with MINFOF.

observation seems difficult even though not impossible. With the help of hunters, pangolins signs were carefully observed within the park. Table 2 summarize the direct and indirect indices of pangolin recorded during the survey.

Geo-spatial distribution of pangolins in the Kimbi-Fungom National Park

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 [14]. The distribution of animals in K-FNP is highly affected by vegetation type; primary forest, secondary forest, gallery forest and open savannah [12]. For instance pangolins preferred primary forests. Figure 3 shows the distribution of pangolins in the K-FNP.

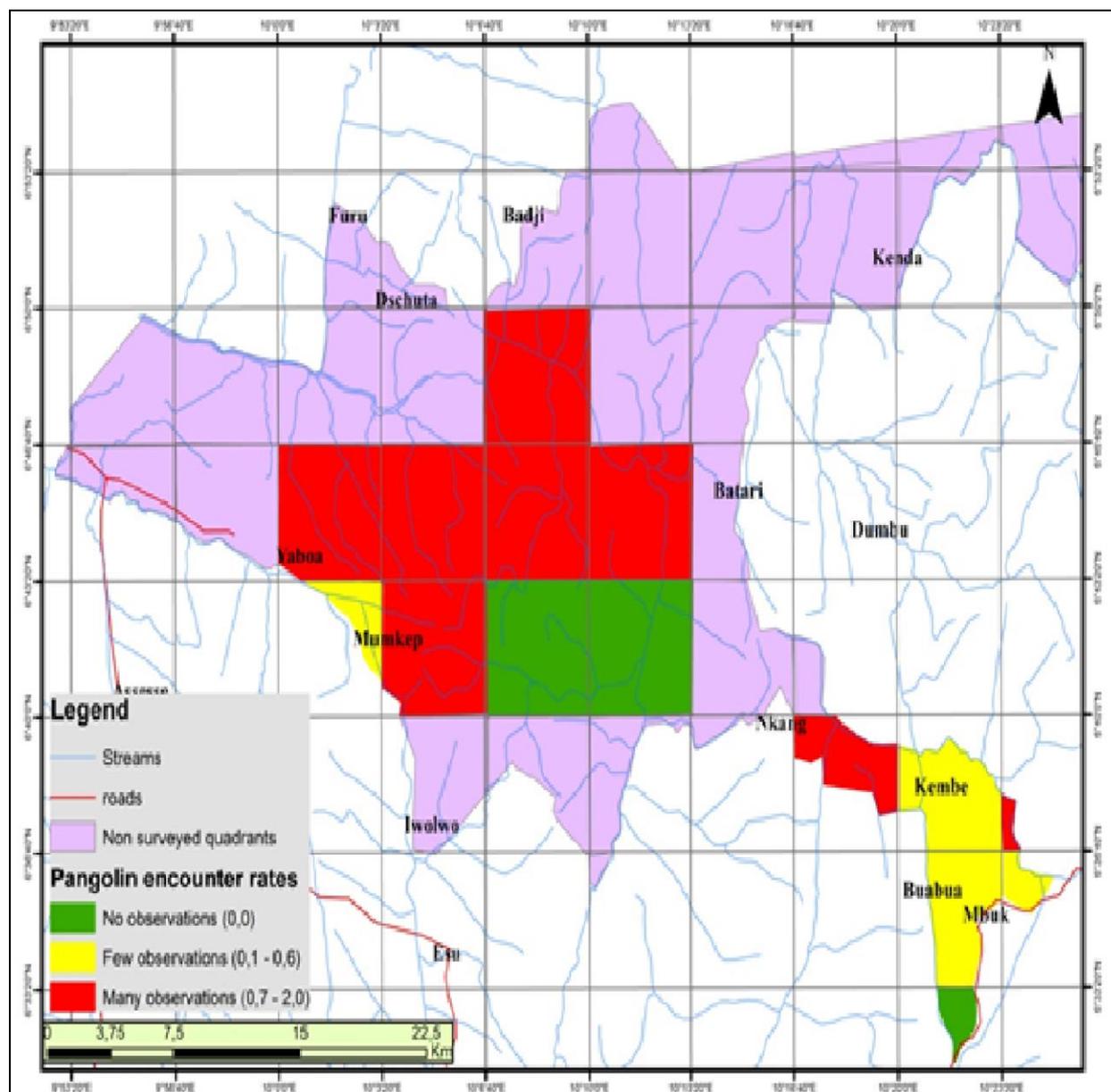


Fig 3: Map showing spatial distribution of pangolins in the Kimbi-Fungom National Park

From figure 3, the corridor linking the Kimbi and Fungom compartments was recorded as a hotspot for pangolins. In addition, the Central, Northern, Eastern and Western regions of the park were also found to contain high pangolin density. Few observations were recorded at the Southern and Western extreme of the park. The extreme south and central south of the park were not noted for any observations. The few observations recorded around the Kimbi village against a backdrop of the Park’s head office reveals the vulnerable nature of pangolins. They can be easily caught and hidden without someone noticing. Secondly, it is highly hunted for its scales and other parts which are highly medicinal. Human intrusion into the park has less influence in the distribution of pangolins because it spends most of its day in burrows and

only comes out in the night. Therefore very skilled hunters know when and where to find them.

Anthropogenic activities in the Kimbi-Fungom National Park

There has been a rapid population increase in and around the park in recent times resulting in a corresponding increase in the demand for forest wood, NTFP, bush meat, animal parts for medicine, agricultural farm land, house construction space just to name a few [15]. This has significantly increased the rate of forest degradation. Anthropogenic activities were grouped into three main types; hunting, agriculture and grazing. Table 3 shows the different encounter rates of anthropogenic activities recorded in the study zones of the K-FNP.

Table 3: Encounter rates of anthropogenic activities per zone

Anthropogenic activity	Zone						
	South	West	Est	Center	Total	ER	Percentage (%)
Hunting	5	14	11	12	42	1.87	58.33
Grazing	4	5	5	3	17	0.75	23.61
Agriculture	0	3	2	8	13	0.58	18.05
Mean 1.1							

Hunting was the most encountered activity representing 58.33% (n=42) of the total number of anthropogenic activities encountered (Figure 3). This was closely followed by grazing (23.61%, n=17) and then agriculture (18.05%, n=13). The high hunting percentage was due to the variation of hunting indices (traps, cartridge shells, hunting camps, hunters met

and gun shots) encountered in the different study zones (Table 4). These results are in line with those of [16], which stated that hunting activities were the main anthropogenic activities influencing the distribution of blue duikers (*Cephalophus monticola*) in the Lebialem-Mone-Banyang-Mbo landscape, South-West Cameroon.

Table 4: Hunting signs encountered in the Kimbi-Fungom National Park

Hunting indices	Zone					Totals	ER/km
	South	West	East	Center	Center		
Traps	3	3	4	2		12	0.53
Cartridge shells	2	3	2	4		11	0.49
Hunting camps	0	2	1	3		6	0.27
Hunters met	0	5	2	2		9	0.4
Gun shots heard	0	1	1	2		4	0.18
Total	5	14	11	12		42	1.87

Geo-spatial distribution of anthropogenic activities in the Kimbi-Fungom National Park

The persistence of anthropogenic activities in any biodiversity hotspot could probably provide vital information to

implement effective conservation policy within the zone of interest [17]. Figure 4 shows the spatial distribution of anthropogenic activities recorded in the K-FNP.

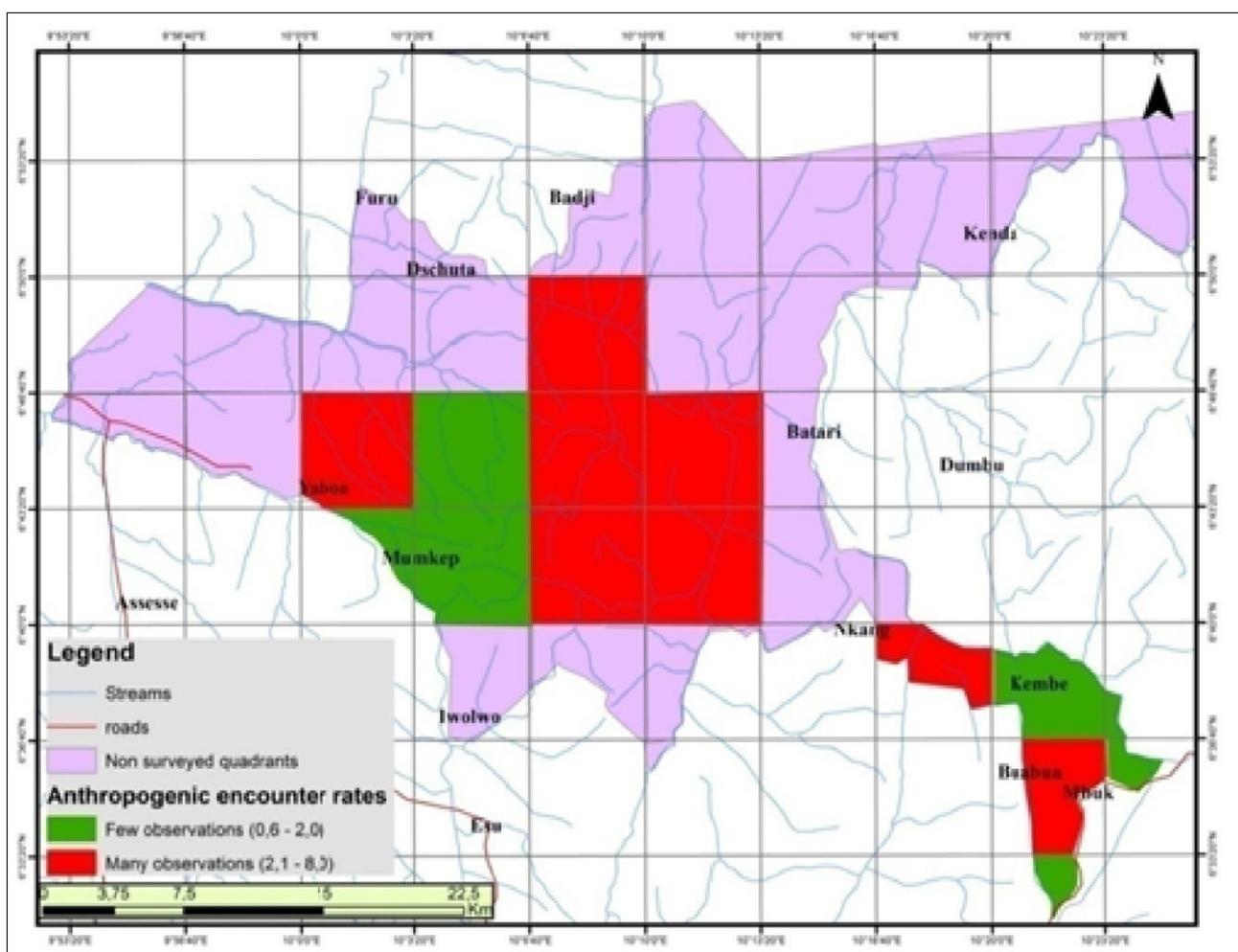


Fig 4: Map showing spatial distribution of anthropogenic activities

Figure 4 reveals that anthropogenic activities were more pronounced in the South East, Eastern, Central and Northern sections of the park. Grazing was very rampant in the South East around the Kimbi and Buabua villages, Eastern regions around Batari and in the central region around Esu area. The high grazing density in those areas is evident of the presence of the Buabua, Dumbu and Esu cattle markets. Hunting activities were rampant around Munkep, Esu and Kpep

compartments which might be attributed to the non-frequent patrol by the forest guards. From these areas right into the park interior could be seen hunting tracks leading to the most enclaved areas of the park where more hunting activities could be predicted to be even more pronounced. Signs of agriculture were mostly banana, plantains and extension of maize farms. So many groundnut farms could be encountered around the Munkep, Kpep and Nkang areas.

Effects of anthropogenic activities on the distribution of pangolins in the K-FNP

Using the encounter rate of pangolins and anthropogenic activities, the coefficient of determination R^2 was determined.

The scatter plot of the fitted regression line for the encounter rates of pangolins and anthropogenic activities is presented on figure 5.

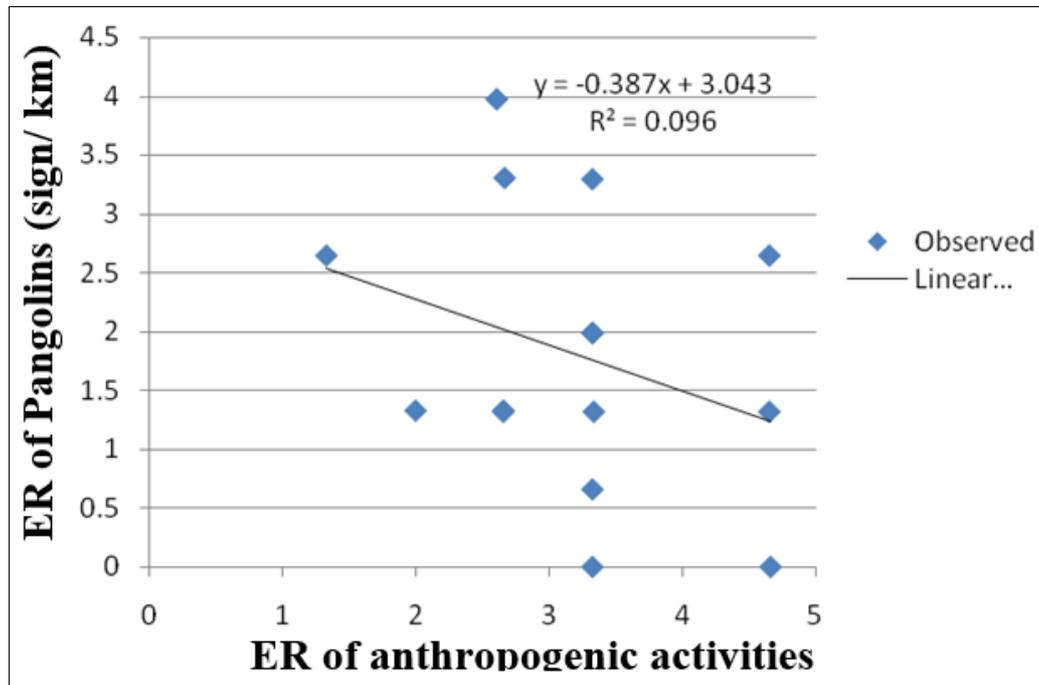


Fig 5: Fitted regression line for ER of pangolins and anthropogenic activities in the K-FNP

Figure 5 shows a very weak relationship between the medium to large size mammals and human activities in K-FNP. The least square equation for the data is given by:

$$\text{Regression equation: } Y = \beta_0 + \beta_1 X + \text{Error}$$

$$Y = 3.043 - 0.387X + 1.089, R^2 = 0.096, r = -0.311$$

Where Y = pangolin, X = anthropogenic activity, R^2 = coefficient of determination, r = correlation coefficient, β_0 and β_1 are constants.

Figure 5 shows that, the number of signs encountered per Kilometer decreased with increase in anthropogenic activities. The correlation coefficient of $R = -0.311$ is less than -0.05 implying a negative correlation between the anthropogenic activities and pangolin's distribution. The coefficient of determination ($R^2 = 0.096$) shows that 9.6% of changes in mammals' distribution in the K-FNP are under the influence of changes in hunting, agriculture and grazing. These results are different from those reported by ^[18] who states that only 2.33% of changes in mammals' distribution in the Bakossi landscape were directly due to changes in hunting, agriculture and grazing. The findings also contrast those forwarded by ^[18], in which his coefficient of determination was gotten as 0.375 from Mbi crater in the North West region. In comparative terms, hunting was the highest recorded anthropogenic activity affecting the distribution of medium to large sized mammals in the K-FNP with the mean E.R of 1.87 sign/km (58.33%), followed by grazing (E.R=0.75 sign/km, 23.61%) and lastly by agriculture (E.R=0.58 sign/km, 18.05%) as shown in table 3. Among the hunting activities, trapping had the highest influence (E.R=0.53 sign/km), closely followed by use of gun (E.R=0.49 sign/km). These are not different from those reported by ^[18] which stated an E.R of 2.65 sign/km 61% for hunting from the Bakossi Landscape. ^[19] also indicated hunting as having an E.R of 1.46 sign/km

from Nguti Council forest South West Region of Cameroon.

Conclusion

After a total survey effort of 22.5km, a total of 22 pangolins were recorded. The ER of pangolins stood at 0.97 pangolin sign per kilometer. Three species of Congo basin pangolins were found to occur in the park. These included the giant ground pangolin (*Smutsia gigantea*) followed by the White-bellied pangolin (*Phataginus tricuspis*) and then the black bellied pangolin (*P. tetradactyla*) according to the hunters' description. The spatial distribution map show that the pangolin signs were encountered more in the Central, Northern, Eastern and Western regions of the Park. Looking at the anthropogenic activities, hunting was the most rampant human activity in the Park (58.33%, n=42) with mean ER of 1.87 signs per kilometer and found to have the greatest impact on the distribution of pangolins. The fitted regression line of ERs of pangolins and ERs of anthropogenic activities clearly illustrates the effects human activities have on pangolin distribution. Categorically speaking, where anthropogenic activities were most rampant, few or no signs of pangolins presence were observed. Analyses of the regression plot of ER of anthropogenic activities and pangolins gave a coefficient of determination of $R^2 = 0.096$ implying that 9.6% of pangolins' distribution was affected by anthropogenic factors. Therefore, strategies such as introducing alternative sources of protein, sensitization campaigns and educational forum are urgently needed to combat illicit hunting and smuggling of pangolins to boost their conservation in the K-FNP.

Conflict of interest statement

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

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References

- Bafelli F. Cameroon: Enforcing laws protecting the pangolin. Published, 2016.
- Lim NTL, Ng PK. Home range, activity cycle and natal den usage of a female Sunda pangolin *Manis javanica* (Mammalia: Pholidota) in Singapore. *Endangered Species Research*. 2007; 3:1-8.
- Duckworth JW, Steinmitz R, Pattanavibool A, Than Zaw DT, Newton P. *Manis pentadactyla*. In: IUCN 2011. *American Journal of Zoological Research*. 1999; 1:16-21.
- Fominyam NCT. Kimbi-Fungom National Park Presentation. By the Pioneer conservator. CUPGR-UK, 2015.
- International Union for the Conservation of Nature Red List of Threatened Species (IUCN). Third update of the IUCN Red List of threatened species, 2017.
- Convention on International Trade in Endangered Species (CITES). The 17th meeting of the Conference of the Parties to CITES (CoP17), In Johannesburg, 2016-2017.
- Ministry of Forestry and Wildlife (MINFOF). Order No.0565/A/MINEF/DFAP/S DFn/SRC to set the list of animals of class A, B and C, distributing animal species per type of hunting permit and whose killing are authorized. Available at: www.lagaenforcement.org/.../législation%20faunique_Protection... .2013.
- Leng T, Gerald AM. *Governance of Biodiversity Conservation in China and Taiwan*, 2006.
- Zoological Society of London (ZSL). MENTOR-POP (Progress on Pangolins) Fellowship Program, 2016.
- Chuo MD. Biodiversity, Traditional Knowledge Systems and Conservation of *Pan troglodytes ellioti*, in the Kimbi-Fungom National Park and Kom-Wum Forest Reserve, NW Region, Cameroon Ph.D Thesis: University of Dschang, Scholar Press, 2018.
- Chuo MD, Tsi EA. Influence of Traditional Beliefs on the Conservation of *Pan troglodytes ellioti*: Case Study, Kimbi-Fungom National Park and Kom-Wum Forest Reserve, NW Region, Cameroon. *International Journal of Forest, Animal and Fisheries Research*. 2017b; 1(3):1-14.
- Chuo MD, Tsi EA, Chefor F, Fru BS. Estimation of Chimpanzee's (*Pan troglodytes ellioti*) Abundance in the Kimbi-Fungom National Park and Kom-Wum Forest Reserve, Nw, Cameroon. *J Biodivers Manage Forestry*. 2017; 6(3):1-7.
- Buckland ST, Anderson DR, Burnham KP Laake JL. *Distance Sampling: Estimating Abundance of Biological Populations*, Chapman and Hall London, reprinted by Research Unit for Wildlife Population, 1993-1999, 10
- Tsi EA. Status of wildlife and its utilization in Faro and Benoué National Park North Cameroon: Case study of the Derby Elands (*Taurotragus derbianus*) signs (Gray 1847) and African Wild Dog (*Lycaon pictus*) (Temminck 1820), Ph.D. thesis Brandenburg University of Technology, Cottbus Germany, 2006.
- Nda NF, Tsi EA, Fominyam C, Chuo MD, Fotang C, Agbortoko BA, Akwo CE. Status of Bushbuck (*Tragelaphus scriptus*) and Buffalo (*Syncerus caffer*) in the North and South Eastern Parts of the Kimbi-Fungom National Park, North West Region of Cameroon. *International Journal of Forest, Animal and Fisheries Research (IJFAF)*. 2018; 2(3):2456-8791
- Tchamba MN, Tsi EA, Titih DA, Awoh JA. Status of blue duiker (*Cephalophus monticola*) in the Lebialem-Mone- Banyang-Mbo landscape, South-West Cameroon. *International Journal of Biology and Chemistry Science*. 2015; 9(3):1367-1374.
- Tsi EA, Fotang C, Billa SF. Status of Medium-sized Mammals in Mbi Crater Game Reserve, North West Region, Cameroon. Case Study of: Blue Duiker (*Cephalophus monticola*) and Bushbuck (*Tragelaphus scriptus*). *Annual Research and Review in Biology*. 2016; 11(2):1-13.
- Fonkwo NS, Tsi E A, Mpoame M. Abundance and distribution of large mammals in the Bakossi Landscape area, Cameroon. *Journal of Soil Science and Environmental Management*. 2011; 2(2):43-48.
- Ekobo AEno KM. Large Mammal Survey of the Nguti Council Forest, South West Province Cameroon. WWF, For a Living Planet issued on the 14th October, 2008-2016.