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Bushmeat Trade and Hunting Pressures around the High Niger National Park, Republic of Guinea

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Abstract

The High Niger National Park (HNNP) is a protected area hosting a very diverse assemblage of wildlife species in Guinea but unfortunately under several threats. This study aimed to address concerns related to the seasonal use of wildlife in the Faranah and Kouroussa areas inside the HNNP. Data were collected from August 2017 to February 2018 in 12 villages of Faranah and Kouroussa (6 villages in each area: three (3) villages with markets and three (3) villages without markets) and Faranah and Kouroussa centers. A total of 9271 carcasses were recorded among which 9159 corresponding to 156731.85 kg were identified. The large (>50 kg) and medium (10-50kg) sized species were mostly recorded in Faranah's markets, while the small sized (<10 kg) species were mainly traded in Kouroussa. The monthly mean of carcasses recorded by non pest and pest species (72.142 ± 14.42 and 88.85 ± 10.22) were significantly greater in the urban center of Faranah than in that of Kouroussa (35.16± 3.83 and 15.66 ± 2.84). In the villages of the Faranah, the lowest frequency of the carcasses was recorded in November (8.87%), and the highest in February (21.04%). In the Kouroussa area, the frequency of carcasses decreased gradually from August (29.32%) to February (7.89%). In both areas, hunting focused mainly on the protection of crops in the rainy season; while in the dry season, hunting is a main activity in the Faranah area while in Kouroussa, the population is much more concerned about the exploitation of gold.

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Keywords

protected area, protection of crops, Hunting, Bushmeat market, Carcasses.

Introduction

Hunting for bushmeat has become the most significant threat to wildlife in many African countries especially in West Africa due to the increasing human populations, access to the forest and the increasing bushmeat commercialization (Robinson *et al.,* 1999; Robinson and Bennett, 2000; Milner-Gulland and Bennett, 2003; Wicander and Coad, 2018). It has been reported that the urban population in sub-Saharan Africa will double to C.1.1 billion by 2050 due to the rural to urban immigration; about 80% of this increase will be recorded in West Africa (World Bank, 2016). This population's growth in the urban centers causes an increase in the demand for natural resources, including bushmeat. Indeed, bushmeat is an essential source of protein for rural people (Fa *et al.,* 2002a & b, 2006; Brashares *et al.,* 2011; Hansilo and Tiki, 2017) and for a significant part of the urban population; even though some researchers believe that bushmeat is less important for the food

security of big cities (Hema *et al.,* 2017; Luiselli *et al.,* 2019; Luiselli *et al.,* 2018). Illegal hunting and the bushmeat trade are the key threats to wildlife conservation even though they provide a source of income for rural populations across almost all African countries (Naughton Treves *et al.,* 2003; Brashares *et al.,* 2004; Cowlishaw *et al.,* 2005). Studies conducted in West Africa and in the Congo Basin suggested that the impact of bushmeat trade exceeds that of habitat modification on the wildlife populations (Fa *et al.,* 2003). Unsustainable hunting practices affect not only the survival of wildlife species and their ecosystems, but also threaten the livelihoods and food security of rural people (80% poor), for whose bushmeat is a major protein resource (Coad, 2008). According to the prevailing scientific opinion, the current decline of biodiversity resources and animal species extinction are currently higher than in any period in human history and the major causes could be the human activities mainly hunting for bushmeat.

There is limited knowledge about the percentage of Guinea's national territory designated as protected areas, as some of these areas, not under official control, are currently being exploited by the local population. However, the National Park of Upper Niger is one of the main protected area and home to a very diverse assemblage of wildlife species (Humle and Konate, 2015). Unfortunately, this fully protected area is not well managed as such by the park conservation authority or by NGO's (Humle and Konate, 2015). In this pack, wildlife populations are exposed to various threats affecting their long-term survival due to the increasing human population in and around the park (Diallo, 2011). In the light of the above reality, studies need to be carried out to get more relevant information to guide the sustainable management and biodiversity conservation in the park. Indeed, several factors could be responsible for the rapidly declining wildlife in the HNNP, but hunting and bushmeat trade were the factors on which we focused our research with the population increase in the park, associated to the limited agricultural land and agriculture output, more pressure is noted on the natural resources in these times than ever before Humle and Konate (2015). A study by Humle and Konate suggested that there is a need to protect wildlife population including local chimpanzee in the HNNP. There is an increasing conflict between fauna and human because the people living in the park are largely dependent on the natural resources including wildlife. The provision of alternative livelihoods has been considered by previous study as a most strategy for reducing hunting pressure at a local level (Wicander and Coad, 2018). The hunter behaviors and the reasons that drive them remain woefully underappreciated (Cowling, 2014; Travers *et al.,* 2019). Unlike in rural zone, urban centers have access to different alternative forms of protein like that from beef and poultry or from frozen imports. However, bushmeat is relatively expensive in the urban centers compared to the rural area. Previous studies have shown a preference for bushmeat in the cities, making sometime bushmeat of some species as a luxury good (Coad, 2008). The high demand for bushmeat in the urban centers caused an increase in the numbers of commercial hunters in the villages, making hunting not a livelihood for rural population, but a lucrative activity (Cronin *et al.,* 2017). The information about how the rural communities use their incomes produced through the hunting and sales of bushmeat is very limited. That is one of the main questions at the heart of the conservation debate. The answers to these issues are required to know how the incomes from hunting and bushmeat sale are used within the rural communities. Information about the bushmeat trade in the Republic of Guinea is highly lacking even though there is an increase in the number of studies carried out in the HNNP in the area. In this work, we studied drivers of illegal hunting of wildlife and patterns of illegal bushmeat trade in and around the HNNP. We considered bushmeat as a meat from wildlife sources or undomesticated animals. The present paper also assays to create awareness on need for sustainable conservation of wildlife in the HNNP. The major hunting villages were selected and the principal points for bushmeat trade were visited daily to see what was traded in the rural and urban zones. To achieve our research objectives what was to address concerns related to the seasonal use of wildlife in the Faranah and Kouroussa areas inside the HNNP, six months market surveys were carried out in 12 villages in the park and the two urban centers (Faranah and Kouroussa) around it.

Materials and Methods

Study area

Fieldwork was conducted in two zones of the HNNP, namely Faranah and Kouroussa. These zones are located in the natural region of Upper Guinea in the Republic of Guinea. The HNNP covers about 12 000 km^2 and includes the zone of Mafou and Kouya each containing a core protected area surrounded by a buffer zone. The forest of Mafou and the Kouya cover 554 km^2 and 674 km^2, respectively (Diallo, 2011). The buffer zones are limited by the main roads. The central areas are managed

as strict nature reserves without any permitted human activity except for conservation activities, tourism and scientific works. The human population of both regions (Mafou and Kouya) is estimated at 44 407 and 29 540 inhabitants respectively. Natural resources in the park are exploited according to regulations conjointly designed by local people and park authority (Diallo, 2011).

According to Béavogui (2004), the Park has a dry tropical climate called the Sub-Sudanese or Sudano-Guinean climate with two seasons (dry and rainy season). During these seasons, daily temperature changes are high, with thermal amplitudes ranging from 11 °c in the morning to 35 °c in the daytime. The period from March to June is the warmest; it ranges from 35 to 40 °c (Brugiere and Kormos, 2009).

Hunting is practiced by local people. It is practiced sometimes by a single hunter or by a group of 2 or 4 people. The activity is practiced during the night using flashlights with locally made cannons or modern cannons. In the Park, hunting is practiced for two reasons: subsistence (protein source) and commercial (income).

The ecosystems of the Park are shared in the triangle drawn by the prefectures of Faranah-Dabola-Kouroussa (Diallo, 2011) (Figure 1).

Data collection methods and analysis

The study was conducted in the Park from August 2017 to February 2018. Data were collected across 12 villages of Faranah and Kouroussa areas (6 villages in each area, 3 with market and 3 with none) inside the Park and the two urban centers, i.e. Faranah and Kouroussa (Figure1).

Villages were selected according to the following factors : villages should be located at variable distances to the main road that crosses the Park, and we also ensured an equal sample of villages between both areas with both a small market place or none.

Both Faranah and Kouroussa are the closest largest urban centers to the HNNP, hence why the focus of this study on a sample of villages connected to these two urban areas.

In each selected village, a guide was recruited to perform the wildmeat carcass surveys and data were collected on a weekly-basis by the main researcher. Carcasses were inventoried every day in the week during seven (7) months, i.e. August-October (rainy season), November (intermediary month) and December-February (dry season) in Faranah and Kouroussa. These investigations were taken at wildmeat markets places among saleswomen, with wholesalers, bar shop, local restaurants or other sources respectively in the urban centers of Faranah and Kouroussa. In the villages with markets i.e. Sidakoro, Mansiramoribaya, Koumady Koura, in the Faranah area, and Banfèlè, Woroko, Nafadji, in the Kouroussa area, data were collected during the weekly markets days i.e. Sunday (Koumady Koura), Thursday (Sidakoro) and Friday (Mansiramorybaya) in Faranah area, also Wednesday (Woroko), Thursday (Banfèlè) and Friday (Nafadji) in Kouroussa area in all stalls of wildmeat; while in villages without markets i.e. Foya, Nyanleymorya and Koumady Koro (Faranah area) and Banakoro, Douma, and Bérékina (Kouroussa area), carcasses were recorded every day in the villages from households including hunters, wholesalers, or other members of family.

The aim of this investigation was to get information on hunted species diversity, carcass numbers, hunted species categories (small (< 10kg), medium (10 to 50Kg) and large size (> 50Kg), IUCN status, hunted species type (pest, non-pest, Carnivore) and price of species.

We used the average body weight for each species reported in the Kingdon Field Guide to African Mammals to estimate biomass

Data analysis

Descriptive statistics (means ± SD) were computed per. A one-way Analysis of variance (ANOVA) followed by a Least significance difference (LSD) post hoc test was used to assess differences in mean monthly number of carcasses of non pest, pest species and carnivore recorded in urban centers, market and no market villages of both study areas (Faranah and Kouroussa).

A $\chi 2$ test was used to analyze the differences between frequencies of carcasses by weight categories (< 10 kg, 10-50 kg, and > 50 kg) across study sites. The significant differences between the monthly mean number of carcasses recorded across villages with markets, no markets and urban centers between the two main areas of Faranah and Kouroussa were perfumed using the Kruskall-Wallis's test. Data were analyzed using the Statistical Packages for the Social Sciences (SPSS) Version 20.0.

Results and Discussion

During six months of survey in 12 villages and two urban centers (Faranah and Kouroussa), a total of 9271 carcasses were recorded of which 9159 corresponding to 156731.85 kg were identified (Table 1). In the urban center of Faranah, 1130 carcasses belonging to 20 identified species. In the surveyed villages of Faranah, 3106 carcasses were recorded, of which 3088 belonged to 34 identified species, against 18 carcasses of 6 unidentified species (Table 1).

In the urban center of Kouroussa, 468 carcasses were recorded of which 448 belonged to 23 species against 20 carcasses from 2 unidentified species. A total of 4567 carcasses were counted in the 6 villages of the Kouroussa area among which 4493 belonged to 34 identified species against 74 carcasses of 6 unidentified species (Table 1).

A total biomass estimated at 156731.85 kg were recorded during the 6 months of survey in all the study sites. A total of 94870.95 kg of carcasses were recorded in the Faranah zone against 61860, 9 kg in the Kouroussa area (Table 1).

There were significant differences in the weight categories of the recorded species across the study months between Faranah and Kouroussa zones (Chi-squared test: $X^2(2) = 554,62$; $p<0.001$); Urban centers of Faranah and Kouroussa (Chi-squared test: $X^2(2) = 16.39$; $p<0.001$); Market villages of Faranah and Kouroussa (Chi-squared test: $X^2(2) = 282.91$; $p<0.001$); no market villages of Faranah and Kouroussa (Chi-squared test: $X^2(2) = 281.69$; $p<0.001$) (Figure3 a, b, c and d).

In detail, the large (>50 kg) species and medium sized species (10-50kg) were recorded significantly more in the Faranah area, while the small sized (<10 kg) species were significantly traded less than expected (Figure 3a). These observations were similar to those found in the market and no market villages of the Faranah area (Figure 3 c and d).

The opposite case was observed in the Kouroussa area as well as in its market and no market villages (Figure 3 a, c, and d). The small sized (<10 kg) species were traded significantly more than expected, when large (>50 kg) species and medium sized species (10-50kg) were recorded less (Figure 3 a, c, and d).

In the urban center of Kouroussa, large (>50 kg) species were traded as expected, while small (<10 kg) and medium sized species (10-50 kg) were traded less and more, respectively (Figure 3b). On the other hand, all weight categories (<10 kg, 10-50 kg, and >50 kg) species were recorded as expected in the urban center of Faranah (Figure 3b).

The LSD test (One way-ANOVA; $P<0.05$) shown that the monthly mean of carcasses recorded by non pest and pest species (72.142 ± 14.42 and 88.85 ± 10.22) were significantly greater in the urban center of Faranah than in that of Kouroussa (35.16± 3.83 and 15.66 ± 2.84) (Figure 2a and b).

The LSD test also revealed that the mean monthly number of carcasses of non pest and pest species recorded in the market villages of Kouroussa (225, 42 ±38, 86 and 125, 16 ± 9, 88) were significantly greater than in those of Faranah (145±11, 30 and 70, 66 ± 4, 86) (Figure 3a and b). No significant difference was observed between the no market villages of Faranah and Kouroussa about the mean monthly number of carcasses of non pest and pest species (Figure 3a and b). The level of hunting and bushmeat trade of the carnivore species remained practically identical in all the study sites. No significant difference was observed between the mean monthly number of carcasses of carnivore species in urban centers, market villages, and no market villages of both study areas (Figure 3c).

There was a significant difference between the monthly mean number of carcasses recorded across villages with markets, no markets and urban centers in the two main areas of the park (Kruskall Wallis test: W (5) =22.456; $p<0.0001$). The post hoc pairwise comparisons confirmed that the urban center of Faranah showed significantly greater monthly number of carcasses compared to the urban center of Kouroussa (adjusted $p=0.009$) and villages without market place in both the Kouroussa (adjusted $p=0.030$) and Faranah area (adjusted $p=0.001$).

The hunters' habits vary by zone. The frequency of hunting and bushmeat trade was very higher in the villages of Faranah area during the dry season (December, January, and February), unlike the Kouroussa area where the frequency of carcasses recorded has significantly decreased in the market and no market villages in the dry season (Figure 5a, b, c, and d). The hunting level has largely decreased between October and November in the Faranah area, except Nyanlemorya village where no significant variation was observed in the frequency of carcasses recorded across rainy season

(August to November) (Figure 5a and b). The lowest frequency of the recorded carcasses was observed in November (8.87%), while the highest frequency was recorded in February (21.04%) in the market and non-market villages of the Faranah district (Figure 3a and b). In the Kouroussa district (Figure 5c and d), the frequency of carcasses recorded decreased gradually from August (29.32%) to February (7.89%) in market and non-market villages except for Banfèlè (market village) and Bérékina (no market village), where a high frequency of bushmeat was noted in November (23.47% and 18.7%, respectively). Overall, the carcass frequency is much lower in the villages having markets than those without market in the dry season (December to February) in the Kouroussa area (Figure 5c and d).

Endangered species and primates hunted in the PNHN

The figure 6 showed the hunting frequency of endangered species (Yellow-backed duiker (NT) Giant pangolin (VU), African rock python (VU), African caiman/dwarf crocodile (VU) and Leopard (VU)) (IUCN) compared to all identified species across the study period in the both zones (Faranah and Kouroussa). A total of 5 endangered species (IUCN) were recorded among the species hunted in both study areas. The Yellow-backed duiker was the most-hunted endangered species with a recorded carcass frequency of 0.95% and 1.2%, respectively in the Faranah and Kouroussa area.

On the other hand, the lowest frequency (0.02%) of the carcasses was observed with the Leopard species, whose hunting was noted only in the Kouroussa area. In terms of primates, Faranah recorded the high percentage of green monkeys (6.73%) compared to Kouroussa area (2.83%), while Patas monkey (3.89%) were more present in the Kouroussa area compared to Faranah (2.04%). Cercopithecus sp. (0.78%) was also recorded more often in the Kouroussa area than Faranah, and for baboon and King Colobus, they were almost equally recorded in the two areas (Figure 6b).

Unsustainable hunting activities for bushmeat consumption or trade in the rural area and urban center are a threat to sustainability of biodiversity conservation in the HNNP. The high economic value of bushmeat is related to its subsistence and commercial use in rural and urban areas of Faranah and Kouroussa. Our results showed more carcasses recorded in the urban center of Faranah than that of Kouroussa (Table 1). This difference is justified by the following reasons:

To sell bushmeat in the big market of the urban center of Kouroussa, there is a tax (500000 GNF to 600000 GNF) to pay to the State per person per year. Bushmeat is sold by Kg (1Kg = 25000 FG ie US) in the urban center of Kouroussa, and the nature conservators are often present on the market to control the categories of bushmeat sold. That is why very few people are interested in the sale of bushmeat in the urban center of Kouroussa. Only two women are recognized in the urban market of Kouroussa as bushmeat sellers. However, some elements illegally sell it in neighborhoods. In the urban center of Faranah, the place occupied by the bushmeat sellers on the big market is called "Kèmoniloro". More than 15 women share this part of the market for the bushmeat sale. The bushmeat is cut into pieces, exposed on tables, and sold without any precision of weight.

Compared to Kouroussa urban center, bushmeat sellers in the market of Farahan's urban center do not pay tax to the State. What they considered as an expense to the State was the store charge where they kept their baggage after the market before to go home in the evening. This women group used the only store and paid 40000 GNF per month (480000 GNF per year). This means that each of them pays about 2500 FG per month (about 30000 GNF for the whole year). This is more less than the tax (50000 GNF) paid by a bushmeat saleswoman per month in the Kouroussa urban center. It should be noted that in Kouroussa, the women sellers of bushmeat also paid the store fees where they kept their baggage and this charge was totally different from the tax to be paid. This is for all these reasons:

- Bushmeat is more expensive in the urban center of Kouroussa than in that of Faranah;
- There are more bushmeat sellers in the urban center of faranah than Kouroussa;
- Bushmeat is much more exposed in the urban center of faranah than Kouroussa.

A significant difference was noted between the both urban centers but also between their market villages based on LSD test (ANOVA) analysis of species types (Figure 3). The monthly mean of non-pest and pest carcasses were significantly high in the urban center of Faranah than that of Kouroussa, compared to the market villages where the monthly mean of carcasses of non-pest and pest were recorded significantly in the Kouroussa area. This is dependent on the strong correlation between the urban center and villages of Faranah area, compared to the Kouroussa area where hunting and the bushmeat trade appear to be much more

influenced by mining (Gold). The population size carnivore species mainly the large carnivores decreased gradually across the years in the NHHN, and this requires special concern. The lack of understanding by many hunters that natural resources can become scarce is a threat to the conservation concern more than the hunting action (Croll and Parkin, 1992). Some species are hunted to get respect from other hunters according to a hunter in Bérékina, because the hunter who kills some species such as large carnivores increase in rank. No significant differences were observed between the carnivore monthly mean in all study sites (villages and urban centers).

Coad (2008) noted that hunting for bushmeat is rarely linked removal of crop pests and other problem animal. We observe the opposite in this present study. Agriculture is one of the main activities in both study areas (Faranah and Kouroussa) and the protection of crops against pest's animal species is a concern for the local population during the dry season in the park. However, the relationship between hunting and farming is not the same in both areas. In market and no market villages of Faranah area, the percentage of carcasses decreased progressively from August to November. During the rainy season period, hunting was done around crop fields against the pest animal species. In November, the crops are harvested and transported to villages before the release of domestic animals and the start of bush fires in December. The hunting level decreased and the percentage of carcasses varied from 9 to 13% in the market and no market villages (Figure 4). During the dry season, there are no works in the farm. This rest period corresponds to New Year's Day and other religious holidays. The fathers' expenses increase to manage the needs of their families. The only possibility for most to solve these problems without selling all their agricultural products is hunting. From December to February (The end of our investigations), the main occupation of men in the selected villages of Faranah area was hunting activity. According to Juste *et al.,* (1995), bushmeat is an important source of income for numerous rural populations in Central Africa (Juste *et al.,* 1995).

Bennett and Robinson, (2000) suggested that 54 % of hunting off takes across the region are sold. About 15 to 72 % of household incomes come from hunting activities of the Poore and most remote communities in the rural Gabon (Starkey, 2004). The commercial trade of bushmeat makes an important source of livelihood of rural communities in the HNNP and the urban populations in Faranah. Some previous studies considered bushmeat as important resources for rural population in Africa, Asia, and South America where many people are poor (Nasi *et al.,* 2008). It has been reported that, 75% of meat derives from wildlife in Liberia, and about 67% of the kelabit people meals in Malaysian state contain bushmeat (Bennett *et al.,* 2000; Anstey, 1991). In the Amazon Basin, the value of bushmeat harvested was estimated to exceed USS 175 million per year according to Lamarque (1995). According to some hunters, during the dry season period the landscape is opened by bush fires, the animals are concentrated around the rivers, the hunters move without difficulty others with motorcycles to reach their hunting place; there is an abundance of bushmeat in no market villages (14.75 - 21.04%) and in the market villages (14.19 - 19%) (Figure 5a). The variation in the hunter habits in the villages of Faranah area due to the agriculture activities influenced the abundance of carcasses in the urban center of Faranah (Figure 3a). A correlation was observed between the market villages and the urban center of Faranah. The carcass abundance days on the urban center market of Faranah corresponded to the moment after the market days of some market's villages in the park (Mansiramoribaya, Sidakoro, Koumadi koura). Intermediaries in the bushmeat industry, after the market day in the village, returned to Faranah in the evening or at night. The bushmeat was exposed in the Kemoniloro market the next morning (Figure 4b). During the dry season, small mammals (<10 kg) are not the hunters' priority in the Faranah area (Figure 2). They go very far from the villages to get large mammals (>50 Kg), only one of which could give them a lot of money. That is why medium and large species (70-80%) on the abundant species listing in this study were much more recorded in the Faranah area than Kouroussa. The medium and large sized species were traded significantly more than expected in the Faranah villages and urban center, while the small «10 species were traded significantly less in the kouroussa area. Obtaining animal trophies as personal adornment or for cultural artifacts is recently known as one of the main reasons for hunting. This reality is not much currently considered in the HNNP. Some species are consumed because of their taste, they are affordable, or because of their cultural value (Wilkie *et al.,* 2005). According to some sellers in Kemoniloro (Faranah), the Greater cane rat is a species solicited by everyone because of its much-appreciated meat; while Yellow-backed duiker called Foulanissy in the local language (Malinké) is consumed for cultural reasons (Figure 3). This species is known as a source of chance and happiness.

Table.1 Overall data statistic

Areas Sites		Species		Carcass		Biomass for identify species (Kg)
		Identified	Unidentified	Identified species	unidentified	
Faranah	**Urban center**	20	0	1130	0	37190
	Villages	39	6	3088	18	57680.95
Kouroussa	**Urban center**	23	2	448	20	18530.4
	Villages	34	6	4493	74	43330.5
Total				**9159**	**112**	**156731.85**

Figure.1 The Mafou area of High Niger National Park indicating the location of the main urban centre of Faranah and Kouroussa villages located within the Park, including the study villages Mansiramoribaya, Sidakoro, Koumandi Koura, Foya, Nyanleymorya and Koumady Koro (Faranah's villages) also Banakoro, Douma, and Bérékina, Woroko, Banfèlè and Nafadji (Kouroussa's villages) (adapted from Brugière & Magassouba, 2009).

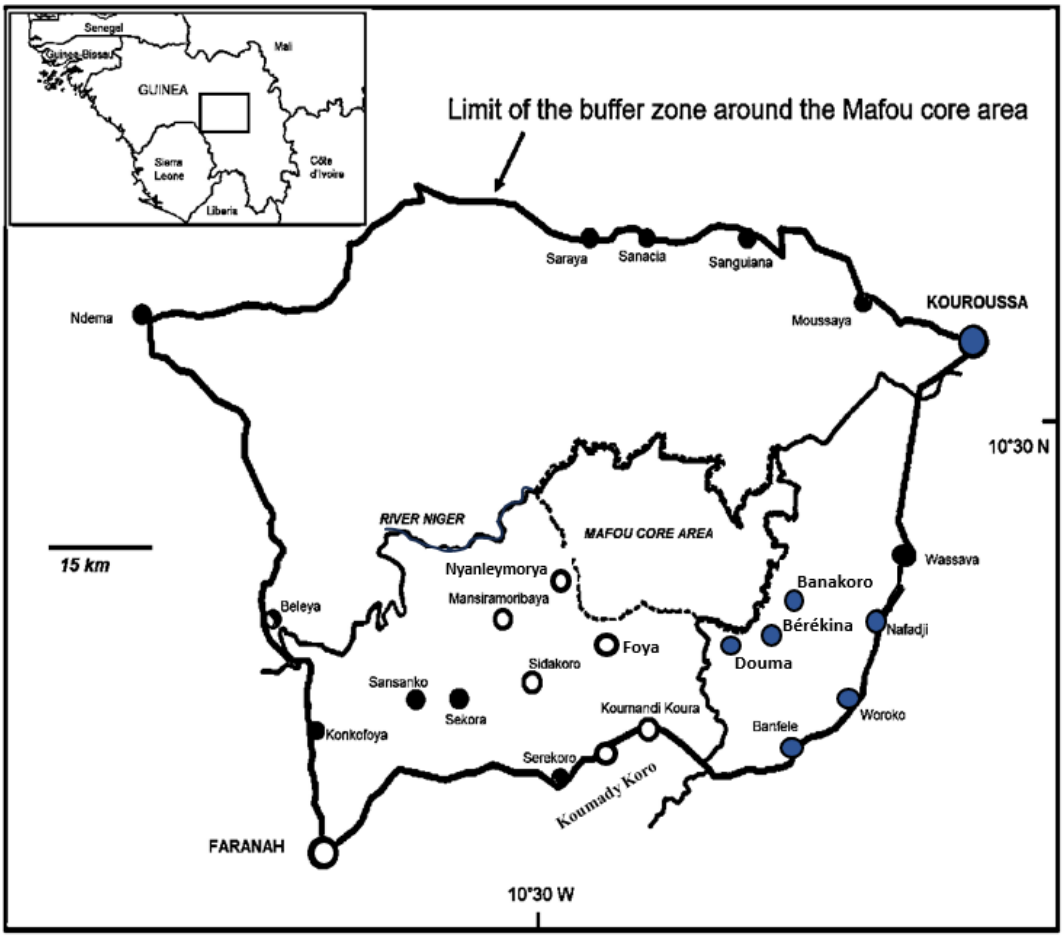


Figure.2 Number of carcasses per weight category of species hunted by locality (Category of species hunted by locality: a=global study area, b= urban center, C= Market villages, and D= No market villages)

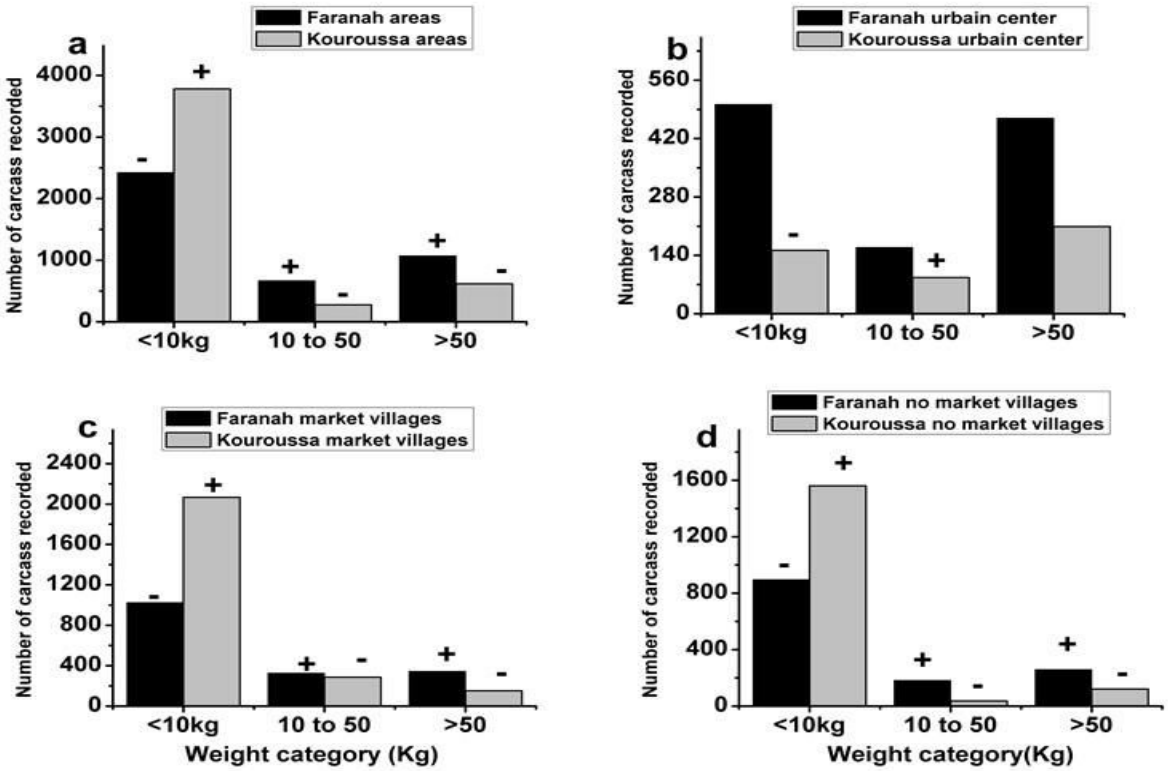


Figure.3 Monthly mean of carcasses recorded by type of species, (a= non pest, b= pest, and c= carnivore; SPSS: LSD-test, P<0, 05)

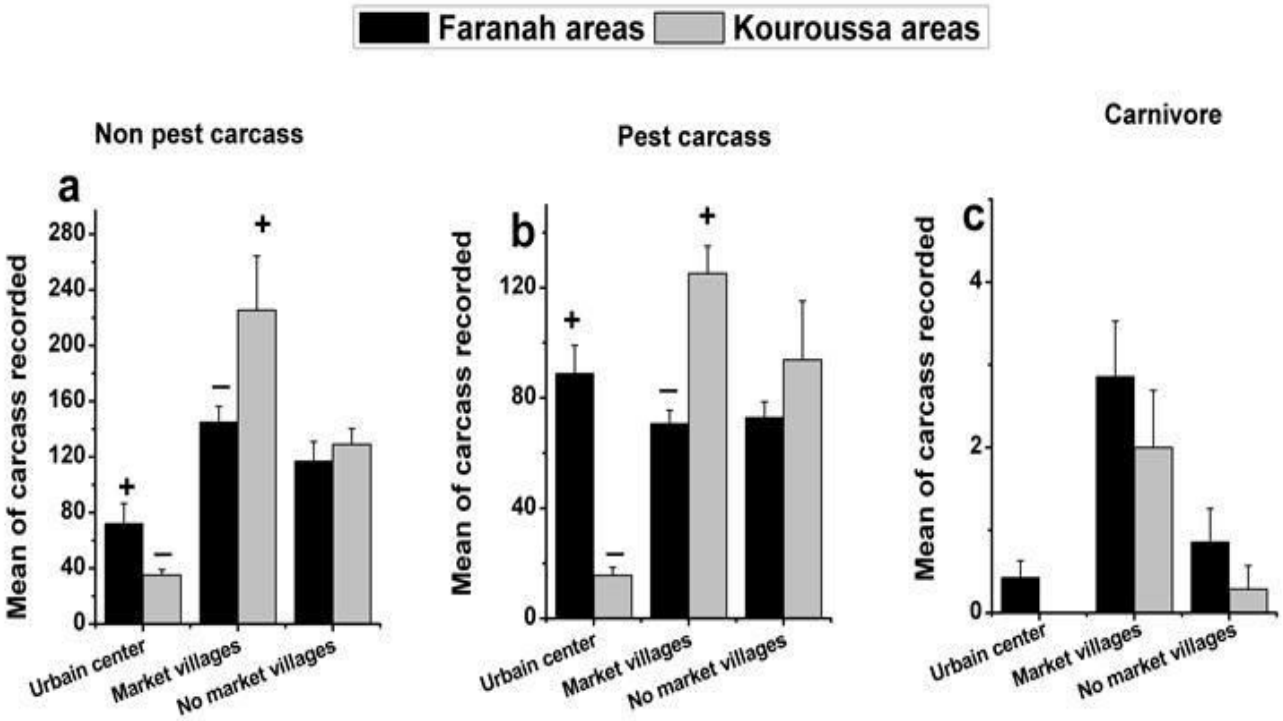


Figure.4 The monthly mean number of carcasses recorded across villages with markets, no markets and urban centers in the two main areas of the park

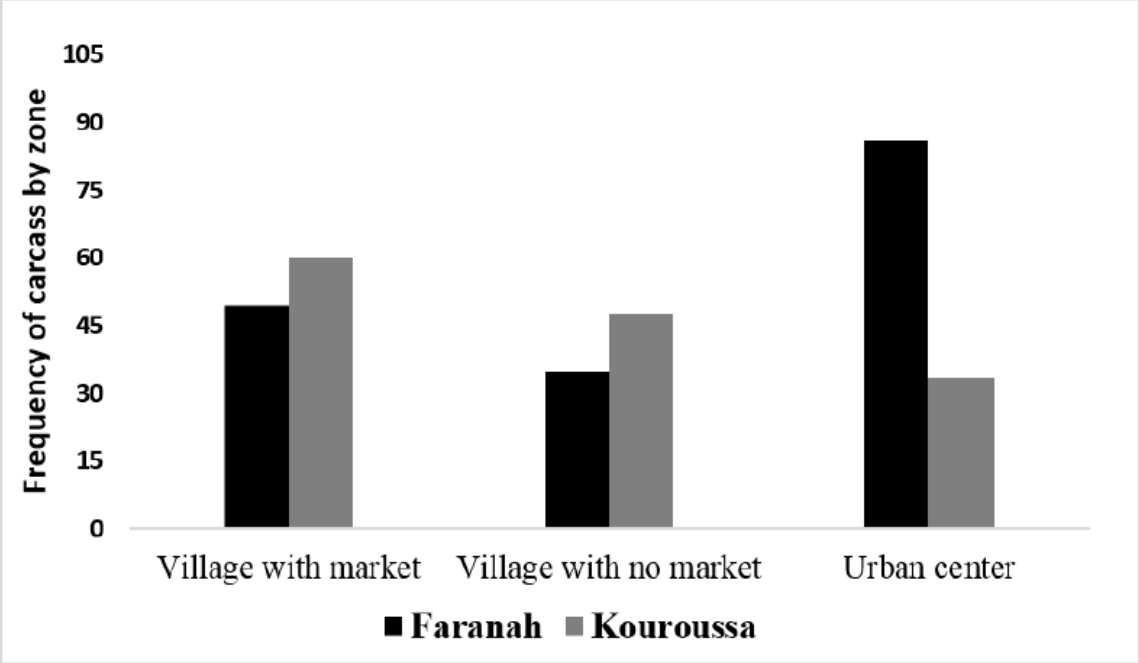


Figure.5 Monthly percentage of carcasses recorded per village and across zones. i.e. Faranah or Kouroussa (a and b = market and no market villages in Faranah area; c and d= Market and no market villages in Kouroussa zone).

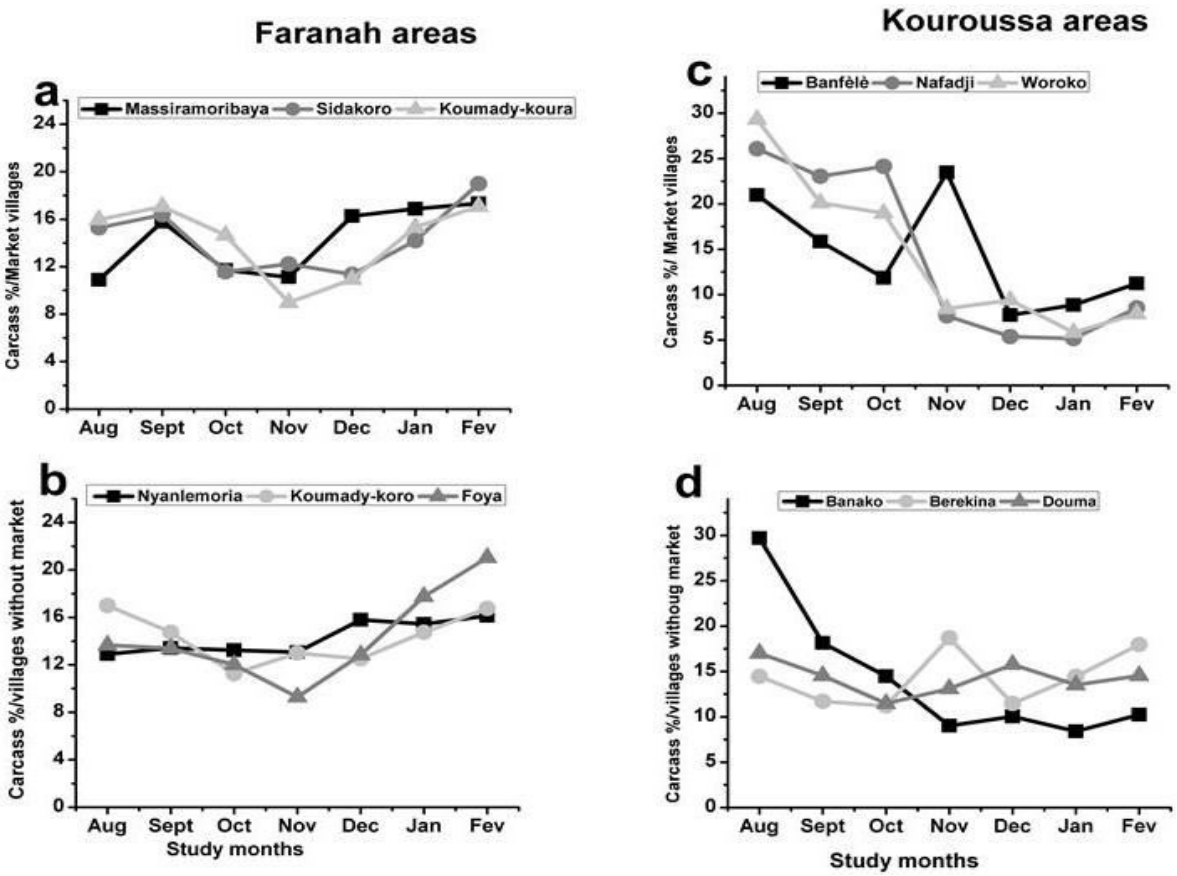
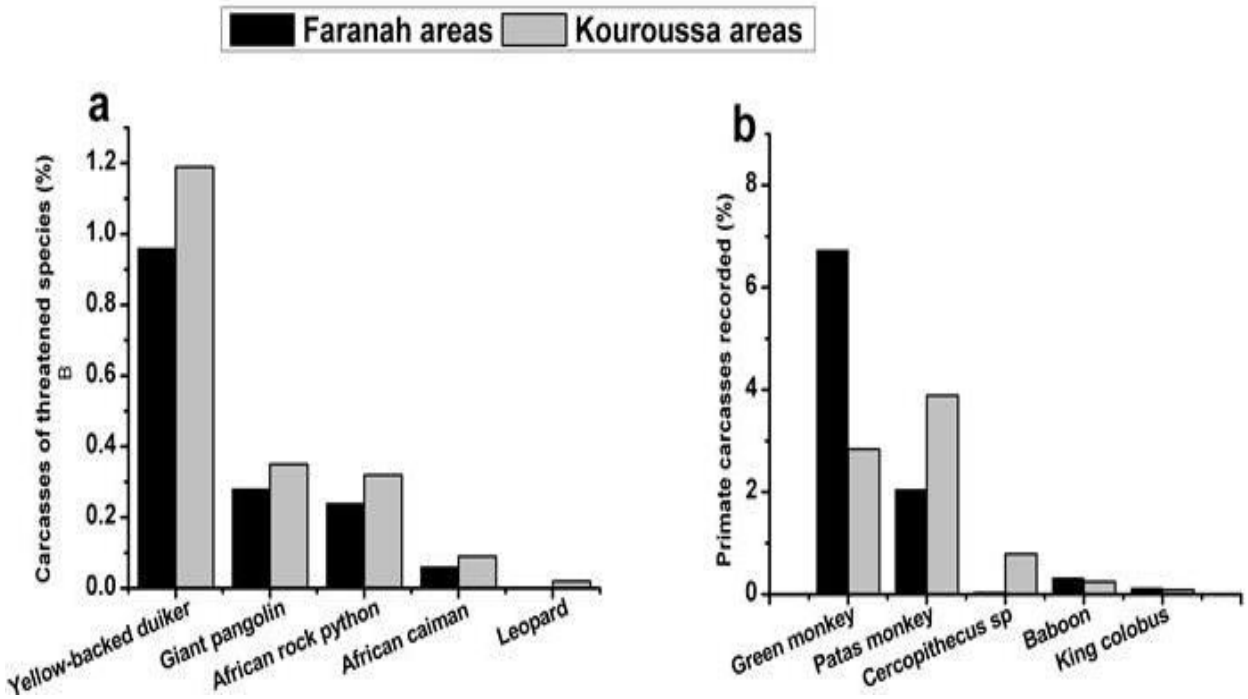


Figure.6 Percentage of carcasses of endangered and primate species hunted in the urban areas of Faranah and Kouroussa and a sample of villages in both areas in the Haut Niger National Park. VU=Vulnerable, NT= Near threatened



In the Kouroussa area, hunters have almost the same concerns as those in the Faranah zone during the rainy season, that of crops protection. The monkeys (green and patas) and Greater cane rat were recorded the most pest species in the Faranah area. In the Kouroussa's villages, the list of the main pest species was very long and included: Perdrx perdrix, Crested Guinea fowl, monkeys (green, patas, black), Greater cane rat, Warthog, and Gambian pouched rat.

All of these species have a very considerable population in the Kouroussa's selected villages. They were the most hunted and the most sold in the rainy season. This explains why the abundant species of weight groups less than 10 were much more hunted and sold in the Kouroussa area than Faranah. Naughton-Treves *et al.,* (1998) reported that in Kibale, up to 17 wildlife species damage crops around the park and primates account for as much as 71% of damage events. The wildlife authority of Uganda declared three species (baboons, vervet monkeys, and bush pigs) could be hunted outside of protected area by farmers due to their damages to crops (Naughton-Treves, 1997). Berekina is a landlocked village at the ZIP edge. Hunting is their main activity in the dry season (11.47 - 17.96% of carcasses) (Figure 5 d). In general, after crops harvesting in kouroussa villages, about 80% of hunters preferred to go in the gold mining sites in the dry season. There was a decrease in the frequency of carcasses (5.15 - 11.24%) between January and February in the markets of the Kouroussa' villages, compared to August (20.97 - 29.32%) (Figure 5 b).

There is consensus that hunting more specifically rural activity and bushmeat is an important protein source for the rural poor people in West Africa. The information about how the rural communities use their incomes produced through the hunting and sales of bushmeat is very limited. That is one of the main questions at the heart of the conservation debate.

The answers to these issues are required to know how the incomes from hunting and bushmeat sale are used within the rural communities and make a better decision for PNHN management. Study and research the alternative protein and income-generating sources for local population in the HNNP could be necessary to reduce bushmeat consumption and trade, while aiming to improve local livelihoods with an insignificant negative impact on the wildlife population.

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