MANAGING HUNTING AND TRANSPORTATION OF WILDLIFE IN AND AROUND THE OKAPI FAUNAL RESERVE, DEMOCRATIC REPUBLIC OF CONGO

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CONTEXT: HUNTING AND ROAD NETWORKS IN THE OKAPI FAUNAL RESERVE

Gazetted in 1992, the Okapi Faunal Reserve (OFR) is a human-inhabited protected area where local communities are permitted to practice subsistence activities such as farming, fishing, hunting and gathering. Its dual mission to conserve biodiversity and manage natural resource use by the resident human population makes it unique among protected areas in DRC. According to a 2003 census, the OFR is inhabited by 17,000 people within the Reserve limits and an additional 37,000 people within a 15km radius around its periphery. The Reserve is home to ethnically diverse human communities comprising farmers, hunter gatherers, NGO staff, park guards, merchants, and migrants. The OFR is located on a settlement frontier in Eastern Democratic Republic of Congo where it is bisected by one of the principle national roads (RN4), currently being rehabilitated, which will link the eastern provinces (North & South Kivu) and Kisangani - major population centers that have been cut off from each other's markets for more than a decade.

In 2000 a land use zoning system was launched to manage zones for hunting, agriculture/settlement and conservation. The zoning system formalizes limits to agricultural expansion and subsistence hunting - limits based on the number of resource users. Immigration towards the Reserve by people in search of arable farm land, bushmeat and other forest products as well as travelers along the road who want to buy forest products, chief among them bushmeat, threaten the integrity of the zoning system.

The improved road will facilitate greatly increased immigration to the area and enhance market access, which could overwhelm efforts to establish a functional zoning system. The zoning system is meant to respect the needs and rights of the different indigenous communities. However experience has shown that it is more often immigrant groups with more intensive farming techniques and economic savvy who profit most from increased market access. One of the management goals is to control immigration to the Reserve and to increase the capacity of indigenous groups to manage their land and wildlife in a sustainable manner. Unless control of these roads is established rapidly, management tools such as zoning are unlikely to succeed.

HUNTING IN THE OKAPI FAUNAL RESERVE

Bushmeat is an important source of protein and revenue for people living in the OFR. It is a commodity to be traded and it has significant cultural importance for indigenous Bantu and Pygmy ethnic groups. In general bushmeat is hunted by Pygmy net hunters or archers and by Bantu snare hunters. The majority of snares used by local Bantu groups are nylon or plastic. There are two categories of snare hunters in the Reserve: one is hunters who hunt for their own subsistence and basic needs and who have ancestral (clan) claims to hunting territories. The other is immigrants whose objective is to capture as many animals as possible to sell to external markets and they may violate hunting territories by entering and placing snares without gaining permission from those with ancestral claims to the forest.

Bushmeat is used for household consumption, sale, and trade. In many cases meat is sold to make money for basic needs such as salt, palm oil, soap, cloth, medicine, and school fees. Meat may also be sold to roadside restaurant owners who sell the meat to their clients at a slightly higher price. In the above examples, bushmeat is consumed *within* the Reserve and

often within the same village territory from where it was hunted. However, there are also cases of larger scale bushmeat sales that are destined for large towns on the Reserve's periphery and beyond where bushmeat is scarce and expensive.

With very few options for employment, most people rely on their farms and the forest for all of their needs. In general agricultural output is low, at or below subsistence level, and there is no significant market at which to sell agricultural products. To make matters worse, crop damage by wild animals further reduces output, especially for farmers along the RN4. Gold mining is illegal in protected areas in DRC. In this context, bushmeat is one of the few lucrative and legal sources of income.

The size (13,000km^2) and ethnic diversity of the OFR means that different villages within the Reserve have different bushmeat consumption profiles. This report will focus on detailed hunting profiles for four different villages in the Reserve: Bandisende, Epulu, Salate and Nduye (see map in appendix 1). Each village represents a different set of management challenges. This report draws on multiple sources of data in order to present a picture of who relies on bushmeat for their livelihoods and how they think that road rehabilitation may change that, what methods are used to hunt bushmeat in the Reserve, and how hunting territories may be managed through zoning. Bandisende, Epulu and Salate are located on National Road #4 (RN4) that bisects the Reserve and is currently being rehabilitated by a World Bank-funded Chinese company. Nduye is located on the eastern border of the Reserve on the road running north from Mambasa. This road was repaired by a French NGO Première Urgence in 2005 but is already rapidly falling into a state of disrepair (see photo 3). In addition to these four villages, market data is available for towns around the periphery of the Reserve.

Photo 1: Road between Mambasa and Nduye (A. Selemani)

Table 1: General description of villages monitored for this report

Village	Livelihoods	Hunting Methods	Hunting Territory	Road Access
Bandisende	Majority of population farmers (immigrant farmers) and hunters	Bantu snare hunters & Mbuti net hunters	4 clan hunting territories (total size ~ 443km^2) with use by both Bantu & Mbuti	Located east of Epulu, RN4 already repaired
Epulu	Ethnically diverse, majority immigrants, less	Net hunting by Mbuti clans (~10 clans) & some snare hunting by	~10 Mbuti hunting clans with clear	RN4 repaired and road building company has set up

	people farming but more people with $ to purchase agriculture & forest products	Bantu snare hunters (difficult to obtain details & they do not have territories like the Mbuti)	limits running perpendicular to RN4 – estimated size of ~660km^2	headquarters here – including the importation of workers from outside the OFR
Salate	Majority of population lives from farming and hunting	Bantu snare hunters & Mbuti net hunters	Hunting territory ~540km^2 No clear limits between neighboring village of Molokay and clans within territory do not have fixed limits	RN4 has not yet been repaired – in the process, already roadside restaurants are benefiting from road workers
Nduye	Majority of population – indigenous Bantu groups (immigrants in minority), very low agricultural output	Bantu snare hunters and Efe archers	Large hunting territory ~ do not yet have an estimate based on mapping	Not on the RN4, but this north-south road connects Mambasa to Isiro and large vehicle traffic is much higher that in Epulu. Number of restaurants has doubled this year.

PILOT MONITORING AND MANAGEMENT ACTIVITIES

Baseline data was collected on hunting practices in and around the Reserve, to serve as the basis for further research and management. Specific activities included: surveys on hunting methods, sales of bushmeat in and around the Reserve, surveys and monitoring of roadside restaurants, participatory mapping of hunting territories, and monitoring of snare hunters.

HUNTING METHODS USED IN THE RESERVE

Hunting methods differ from one area to another and from one ethnic group to another. Permitted hunting methods in the Reserve include nets and bows and arrows, whereas snares and guns are not permitted. Hunting with guns is quite rare in the Reserve, and the main cases of gun use are military who target elephants and primates. Snares are illegal in the Reserve, however unlike guns – snare hunting is widely practiced. In some areas of the Reserve, especially the northern sector, snare hunting is the most common hunting method. The size of the Reserve, the

low capacity of ICCN to control this activity, and the fact that people do not have alternative hunting methods contribute to the ineffectiveness of this ban. Mbuti net hunting is a group activity conducted by clans, whereas snare hunting, though perhaps organized by clan, is an activity carried out by an individual hunter. Both nets and snares target forest antelopes (duikers) which are the most commonly consumed bushmeat species in the Reserve.

Along the east-west road (RN4) from Zunguluka to Adusa the dominant hunting method is hunting nets followed by snares (mainly nylon). However as one advances in either direction (east and west) from Epulu it becomes evident that snare hunting, at least on a small scale, is part of the use regime of hunting territories. Bantu and Mbuti hunters divide their hunting territories according to hunting method. For example in Salate, snare hunters go further from the road (where the forest is calmer) and net hunters working closer to the road.

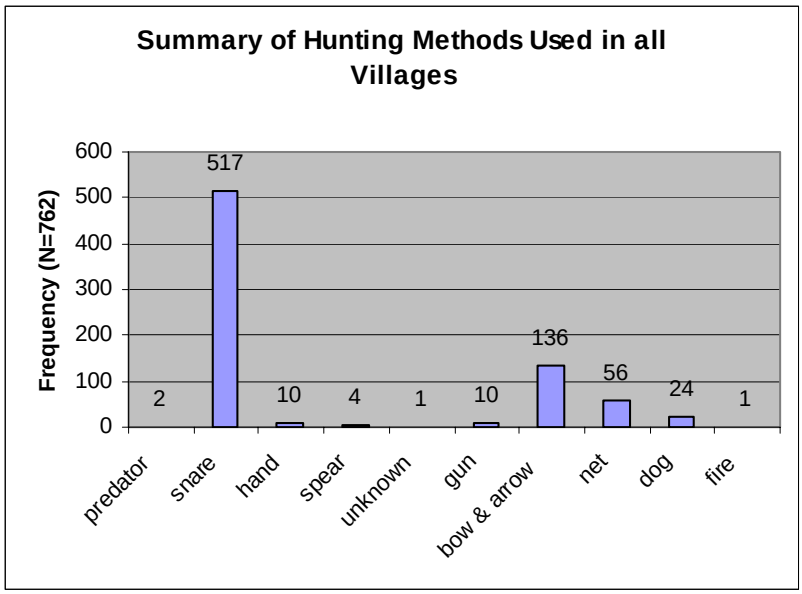
As one travels north of Mambasa net hunting is replaced by snare hunting and the Pygmy (Efe) hunters in this area use bow and arrows instead of nets. Some reasons for this are cultural but there may be ecological explanations as well. Net hunters in Akokora have noticed that the *nkusa* vine which is a liana they use to make hunting nets has become rarer in the forest around Akokora. Some hunters are said to be experimenting with nylon cord to make their hunting nets. This information remains to be verified and to see the effect this would have in the area if they must change hunting methods as the *nkusa* becomes increasingly more difficult to find. According to snare hunters, they claim that it is net hunters who capture a greater quantity of game than they do. Snaring is a blind method that kills or injures whatever animal that may pass through, but nets are supposedly selective because hunters see the animal before it is killed. This does not necessarily mean that net hunters are being selective; as past studies showed that 20% of blue duikers caught by Mbuti net hunters were pregnant females. They also kill water chevrotain which is a protected species. However, it is true that snares can injure larger animals such as okapi and leopard which are generally not threatened by net hunters.

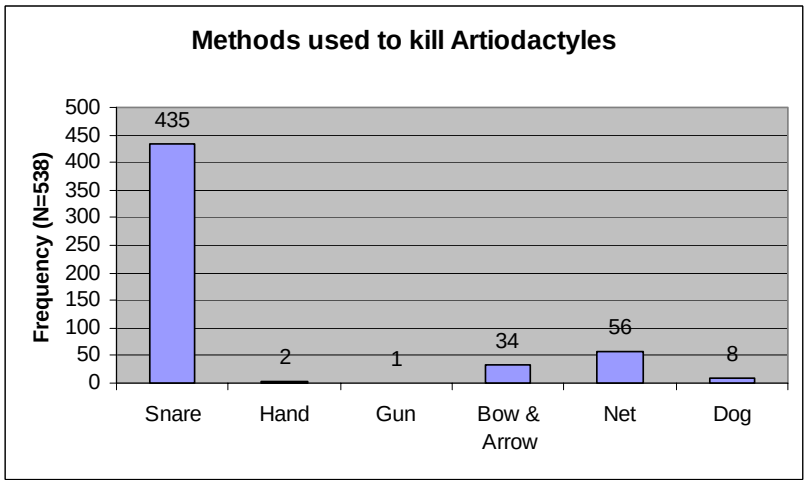
HUNTING METHODS AND BUSHMEAT SALES

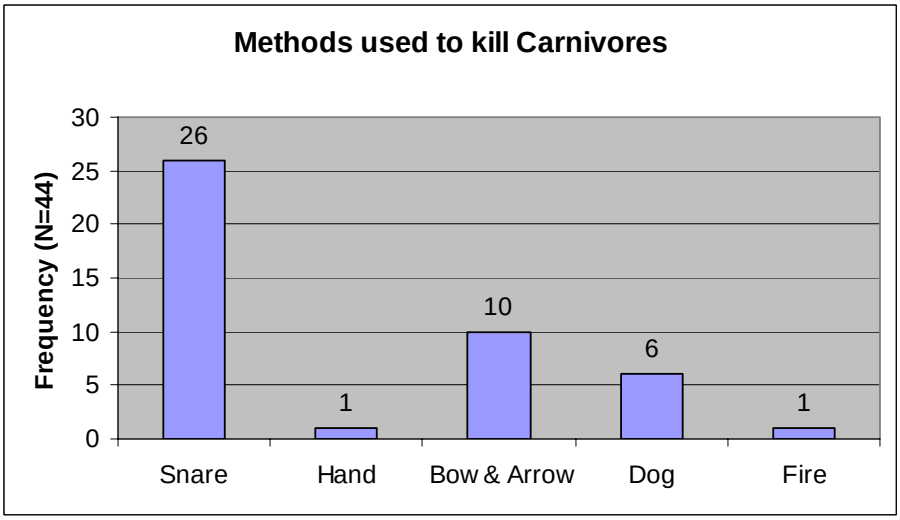
In order to document hunting methods along the Mambasa-Mungbere road a survey was conducted over a period of four months (December 2006 to April 2007) which included 29 villages grouped into eight sites. In each of the eight sites a data collector was trained to record information on species hunted and the method used, at the end of each month data was collected by a WCS-ICCN researcher.

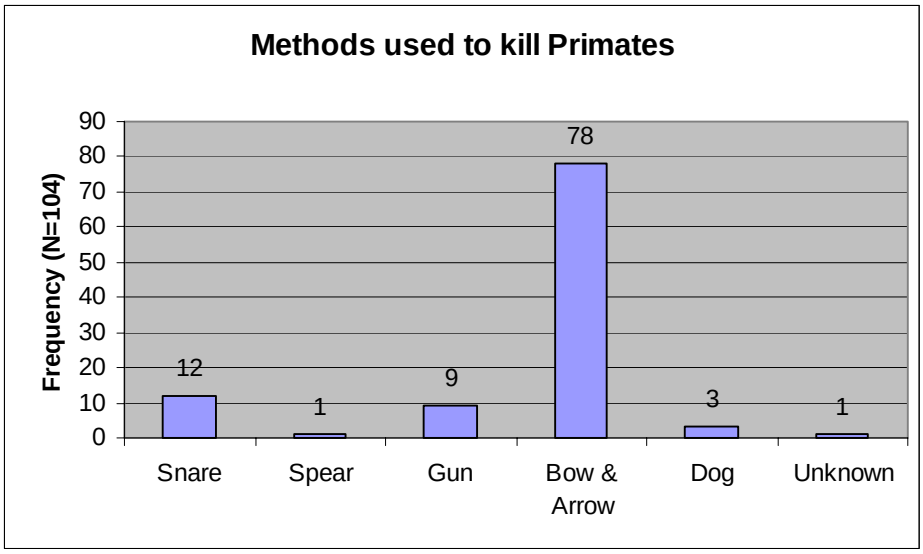
Results

Nine hunting methods were recorded along the eastern border of the Reserve between Mambasa and Nduye, including snares, bow & arrows, spear, net, dog, fire, manual catch, gun and sling shot. A few animals were killed by a predator such as a leopard and for a few others the method was not recorded. A total of 1,329 animals were recorded for the eight sites distributed in the following manner : snares 65%, bow & arrow 19%, net 9%, dog 3%, by hand 2%, spear 1%, gun 1%. In a few cases fire, sling shot, predator, and unknown were cited as the hunting method. Snares most commonly captured antelopes, small carnivores, rodents, and some terrestrial primates; while bow & arrows show a higher frequency of primates hunted.


Summary of Hunting Methods Used in all Villages
Frequency (N=762)
600
500
400
300
200
100
0
2
517
10
4
1
10
136
56
24
1
predator
snare
hand
spear
unknown
gun
bow & arrow
net
dog
fire


Methods used to kill Artiodactyles
Frequency (N=538)
500
450
400
350
300
250
200
150
100
50
0
435
2
1
34
56
8
Snare
Hand
Gun
Bow & Arrow
Net
Dog


Methods used to kill Carnivores
Frequency (N=44)
30
25
20
15
10
5
0
26
1
10
6
1
Snare
Hand
Bow & Arrow
Dog
Fire



During the same time period, bushmeat sales were recorded at formal or informal markets in 6 sites around the periphery of the Reserve and two population centers in the Reserve along the RN4 including Mambasa, Nduye, Apodo, Mungbere, Wamba, NiaNia, Badengaido and Epulu. Data collectors were trained and given notebooks to collect data opportunistically when they learned that meat was available for sale. The results of this study show that antelopes are the most commonly sold species followed by primates and wild pigs. The category "antelopes" includes six species (*Cephalophus dorsalis, C. sylvicultor, C. monticola, C. callipygus wenysi, Neotragus batesi* and *Hyemoscus aquaticus,*) and all unspecified species of antelopes. The category "primates" includes *Papio anubis* and all unspecified species of primates (but not chimpanzees).

Village/Town	**Species Sold**
Mambasa	antelopes, primates, chimpanzee and wild pig
Badengaido	primates and antelopes
Epulu/Bapukeli	primates, antelopes, pangolin, mongoose, crocodile, turtle and squirrels
Mungbere	antelopes, primates, buffalo, kob, porcupine and elephant
Nduye	antelopes, porcupine, wild pig, chimpanzee, sitatunga and squirrel
NiaNia	sitatunga, leopard, buffalo, chimpanzee, primates, wild pig, elephant, and porcupine
Wamba	antelopes, primates, wild pig, pangolins, porcupines, buffalo, sitatunga, elephant, chimpanzee and okapi
Apodo	antelopes, chimpanzee, hippo, wild pig, buffalo and porcupine

The towns with the highest levels of recorded bushmeat sales (dollars per number of days data was recorded) were Wamba and NiaNia followed by Apodo and Mambasa. The presence of gold mines along the NiaNia-Wamba road most likely contributes to the demand. The sale of meat from protected species including elephant, chimpanzee, leopard, and okapi, was noted in Wamba, Mambasa, Mungbere, Nduye and Apodo.

Village/Town	# Days	($) Total	$/Day
Mambasa	20	$746.89	$37.34
Nduye	22	$158.52	$7.21
Apodo	24	$1,181.29	$49.22
Mungbere	15	$216.92	$14.46
Wamba	32	$3,006.68	$93.96
NiaNia	50	$3,208.51	$64.17
Badengaido	17	$149.33	$8.78
Bapukeli	35	$985.33	$28.15
Epulu	34	$217.35	$6.39

MONITORING SNARE HUNTERS

The data collected on hunting methods between Mambasa and Nduye did not encourage direct dialogue between snare hunters and Reserve staff because it was believed that hunters may be hesitant to reveal the source of their bushmeat (that it was trapped in snares). Because hunting zones will require a system of co-management between community and Reserve, it was determined that despite the challenge we would try to work directly with snare hunters. Thus in January 2007 members of the WCS Community Conservation Program (PCC) staff began trying to make contact with snare hunters in the Reserve and to explain why WCS-PCC is interested in understanding more about their hunting activities. Initially there was resistance from hunters who believed that this was a ploy to arrest them for illegal snare hunting, but after several explanations some hunters accepted to participate in the monitoring study. This acceptance was no doubt facilitated by the fact that PCC staff members are based in villages.

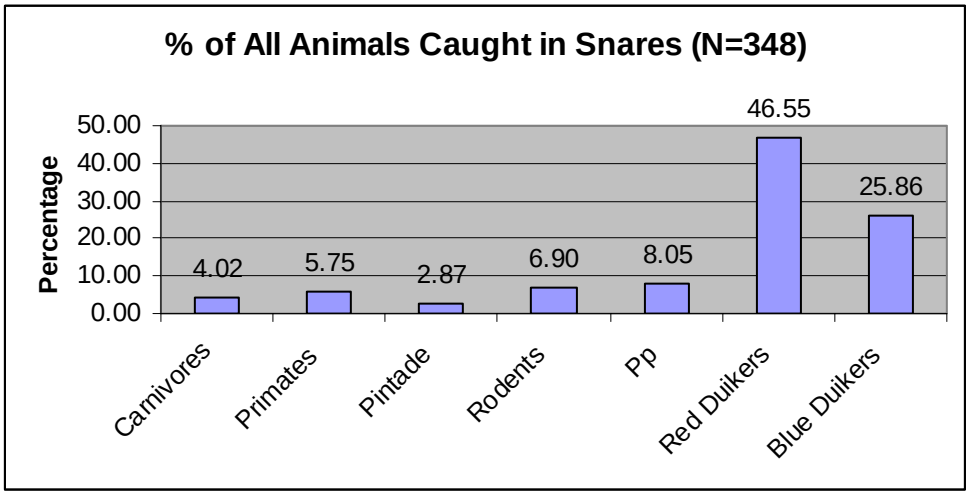
Along the RN4 (east-west axis) the presence of OFR guards and conservation projects is most noticeable it was more difficult to gain the confidence of snare hunters. In Epulu especially, it is difficult to find people who openly declare themselves as snare hunters since the ICCN headquarters is located here, therefore the data presented here is from snare hunters in Nduye, Salate, and Bandisende.

For management purposes a distinction should be made between two different categories of snare hunters; those who are indigenous Bantu groups such as the Lese and Ndaka who hunt for subsistence purposes and those who hunt for commercial purposes. Snare hunters monitored by this project are of the former category; those who have clan claims to hunting territories, often in overlap and collaboration with Pygmy hunters. WCS-PCC staff never accompanied hunters into the forest while they placed snares because this could be construed as complicity by the Reserve in illegal hunting activities and could cause conflicts with ICCN. Instead, snare hunters were visited on a regular basis by WCS-PCC staff who filled out data sheets with the following details: date, location, number and type of snares set, species, quality of meat, destination/usage of meat and value ($) of meat sold.

Data was collected on a regular basis from 4 hunters in Salate, 6 hunters in Nduye, and 5 hunters in Bandisende. The snare hunters who were targeted for this study are defined as

someone who is capable of purchasing snare hunting materials, who has a camp in the forest, who can use his hunting profits and hunt all year on a regular basis, however it is widely noted that most adult males (Bantu) do periodically place snares.
This method necessarily has its errors, such as the fact that not all hunters provided data for all months. Therefore the results represent an average of all hunter data per site in Nduye, Bandisende and Salate. Snare hunters provided data on their activities when possible. Different numbers of hunters provided data in different villages, and some months the hunters did not place snare in the forest because of dry season weather (lack of game) or they were busy with other activities such as field work, control or confiscated snares by Reserve guards and because of Pygmies who destroy their snares. Due to this and the fact that data collectors did not accompany snare hunters into the forest while they placed snares, the data available are a best estimate given the situation.

Following are results from snare hunters monitored between February and July 2007 in Nduye, Bandisende and Salate.



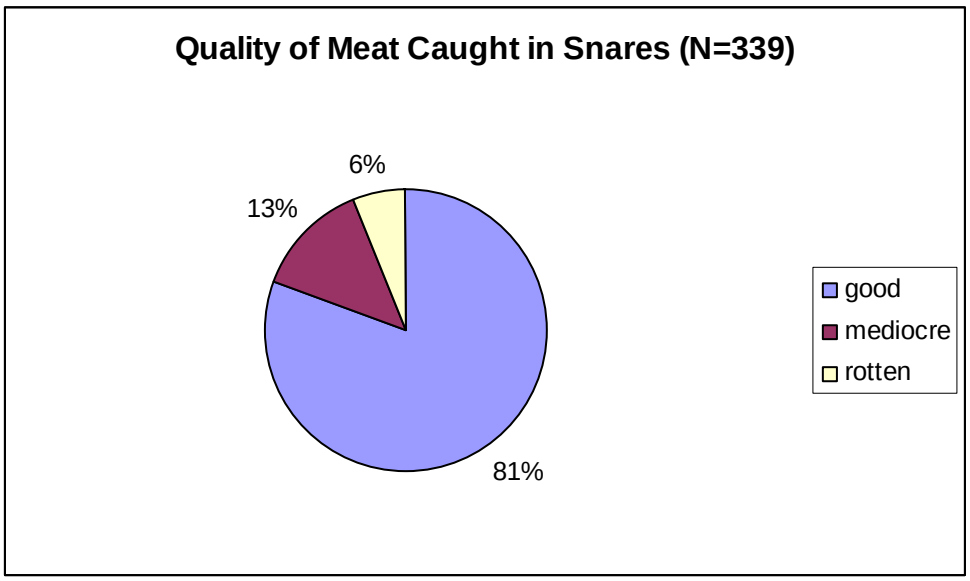
Carnivores includes tree hyrax, mongoose, and civet. Primates includes all unspecified species, *Papio anubis, Cercopithecus hoesti, C. agilis, C. spp., and Colobus spp.* Rodents includes porcupine and cane rats. Pp = wild pig. Red duikers includes *Cephalophus callipygus, C. dorsalis, C. leucogaster, C. nigrifrons, C. sylvicultor, Hyemoschus aquaticus,* and *Neotragus batesi.* Blue duikers = *Cephalophus monticola.*

For many cases where the hunter said that part or all of meat trapped was sold, price data was not provided. For the 89 cases where price data was provided, snare hunters claimed earnings of $388.70 – which is certainly an underestimate of the real value of bushmeat sold and traded. There is virtually no price data recorded for primates.

The average prices for the most commonly hunted species are:
Average price/red duiker (dorsal portion) $4.95
Average price/for blue duiker (entire animal) $2.51
Average price/wild pig (portion e.g. leg) $4.71

Blue duiker is less expensive in Nduye than along the RN4 where there is more demand. The price of blue duiker in Epulu increased during the monitoring period from $3 to $5.

Hunters return regularly to check on their snares, as is evident from the state of the meat trapped in snares. In cases where meat has already started to turn rotten, it was consumed by the hunter's family. In a couple of cases antelopes were found after being partially destroyed by a predator (probably a leopard) and by driver ants.

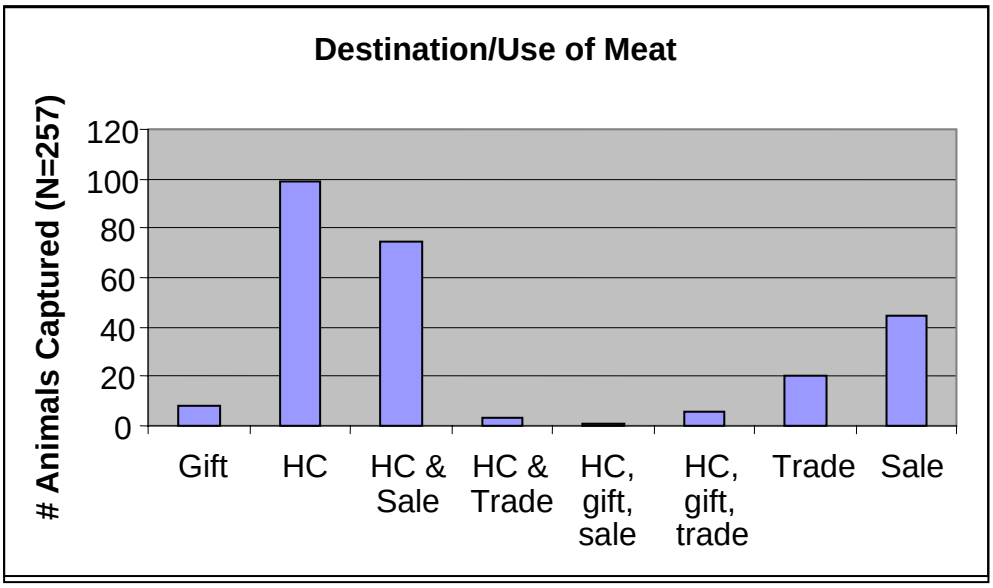


Destination/usage of meat procured by snare hunters

In 38.52% of the cases (N=257) meat was used for household consumption and in 17.51% meat was sold. In 7.78% of the cases the meat was traded. In 33.07% of the cases snare hunters cited multiple uses of meat including different portions for consumption by his family, trade (often in exchange for field labor or seeds), sale and gifts (usually to in-laws).

Household consumption was cited as the sole use or as one of the uses of meat in 71.6% of cases recorded; this includes meat consumed by family members during special occasions such as holidays and special events such as the birth of twins.

All (17.51%) or a portion (29.57%) of meat was sold in 47% of the cases. When meat is sold the primary uses for money earned include: purchase of salt, cloth, soap, palm oil, alcohol, nylon to replace snares, pay debts/fines to police, hospital fees, and school fees. The table below shows the combination of different uses of meat from animals captured by snare hunters.



HC = Household Consumption

MONITORING ROADSIDE RESTAURANTS

Photo 2 Meat to be weighed by field technicians at a restaurant in Nduve (WCS)

Roadside restaurants are one destination of meat trapped by snare hunters. This study did not specifically follow this chain, but instead we approached restaurants owners directly and asked permission to interview them monitor their activities.

Interviews were conducted with 14 restaurant owners in six villages along the two principal roads in the Reserve: Nduye, Bandisende, Epulu, Eboyo, and Salate. 12 out of 14 restaurant owners are women ranging in age from 25-60 with an average age of 42.5 years. Some restaurants began around 1992-2001 as the number of bicyclists (Kumba Kumba) was increasing, while others opened their restaurants in the past two years. Restaurant mamas, as these women are called, purchase or trade meat either directly from Pygmy hunters, from Bantu intermediaries, or from Bantu snare hunters. In Nduye, restaurant mamas purchase or trade meat from Lese (Bantu) snare hunters and Pygmy hunters. Trade often involves alcohol and cloth.

When asked about the most common meat served in their restaurants, the response was antelope – especially blue duiker (*Cephalophus monticola*). One woman, who began her restaurant before the deterioration of the road, said she used to go to Mambasa to buy beef but that option has become too expensive now; she speculates that the opening up of the road could

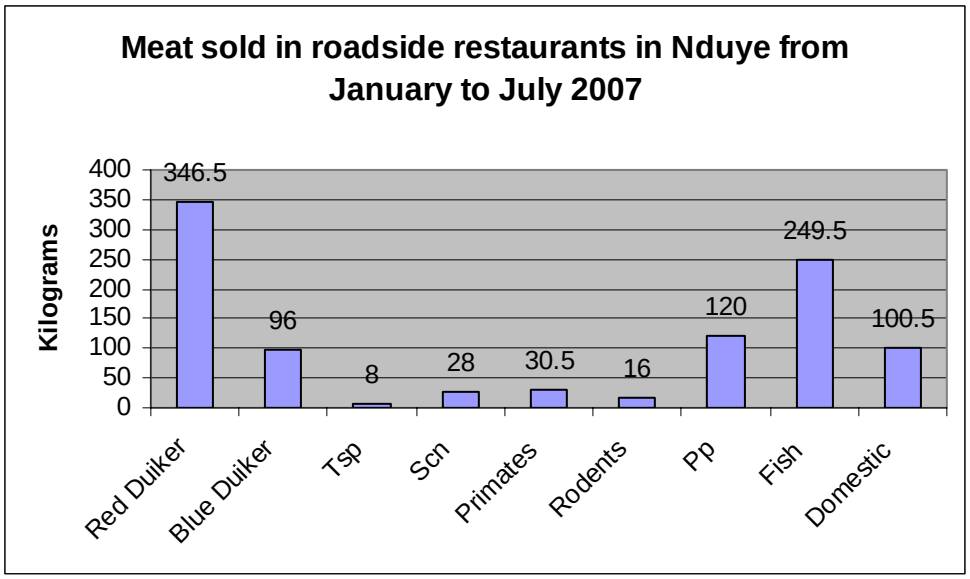
make this possible again. Before, it was possible to kill a cow in Epulu and sell the meat, something which is virtually unheard of now.

The road heading north from Mambasa has deteriorated in the past several months due to a lack of maintenance, heavy rains and the traffic of large market trucks that frequent the route on their way to Isiro. Vehicle traffic through Nduye is heavier than in Epulu despite the fact that Epulu is a larger town and the road leading to Epulu is in good shape. This is because Epulu is effectively "the end of the road" and the link to Kisangani has not yet opened up. The frequent passage of market trucks and bicycles through Nduye has encouraged more women to start their own restaurants – doubling the number of restaurants in Nduye from three to six since February 2007.

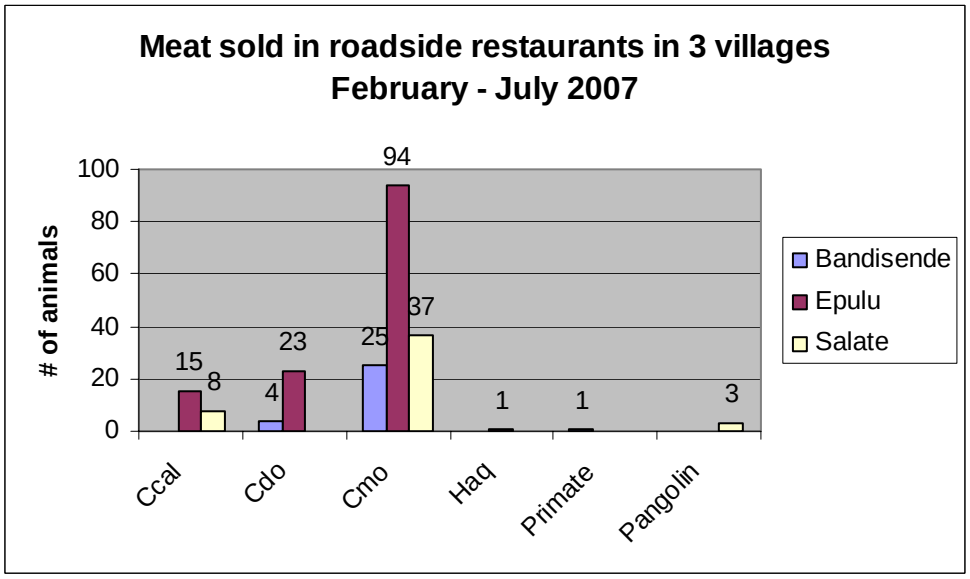
According to interviewees, the price of bushmeat has increased with the increased number of restaurants. In Nduye, some of the best hunters are now employed to do road repair so they are not supplying bushmeat. Ironically, they now have spending money and want to eat at the restaurants, which because of them, have less meat at higher prices. This has led some hunters to realize that restaurants are selling bushmeat at a high price compared to the selling price of the hunters, and that they should increase their selling price.

When asked about bushmeat price changes, restaurant mamas replied that in cases where people trade rather than purchase bushmeat with cash, the price/value is more stable. Others replied that there is a rarity or reduction in game because Mbuti sell their game to passers-by along the road. They say there has been a price increase from $2 before the war to $3 and now in some cases the price of a blue duiker has risen to $5. In general they speak of increased prices for meat which is less abundant. Along the RN4, they have noticed that as the road has improved, bicyclists can continue longer distances per day and therefore do not stop in their restaurants to rest and eat, as they did before road repair.

After the interviews were conducted, WCS-PCC began monitoring daily restaurant activity in four villages: Nduye, Bandisende, Epulu and Salate. Results have been separated according to the principle road where the restaurants are located, with Nduye along the road north of Mambasa and the other restaurants all located along the RN4. Preliminary results show that antelopes are the most common bushmeat served in restaurants. The variety of bushmeat and other protein options (fish and domestic meat) is greater in Nduye than in all of the villages along RN4. In Nduye, fish is an important source of protein and places second after red duikers as the most abundant (kg) item sold during the study period. In Epulu's restaurants, in addition to bushmeat, 4kg fish and 15kg beef were recorded. Despite the presence of the Epulu River, fish does not appear to be a significant protein source consumed in restaurants, as is the case in Nduye.



Red duiker includes: *Cephalophus dorsalis, C. leucogaster C. sylvicultor, C. callipygus, & Neotragus batesi.* Blue duiker = *Cephalophus monticola*, Tsp = *Tragelaphus spekii*, Scn = *Syncerus caffer nanus*, Primates includes: *Cercocebus agilis, Cercopithecus hoesti, & Cercopithecus ascanis,* Rodents includes: porcupine *Atherurus africanus* and cane rat *Thryonomys swinderianus.* Pp = *Potamochoerus porcus.* Fish includes both fresh and smoked fish. Domestic meat includes chicken, beef, and goat.



Ccal: *Cephalophus callipygus*, Cdo: *Cephalophus dorsalis*, Cmo: *Cephalophus monticola*
Haq: *Hyemoschus aquaticus*. The species of primate was not documented.

TRANSPORTATION NETWORKS AND BUSHMEAT – ROADS AND THE RESERVE

Beginning in 1985 with the fall in world coffee prices and the aftermath of Mobutu's *Zaïrianisation*, the country's economic situation went into decline. As the markets collapsed and plantations were abandoned, the roads were left to the elements and a succession of wars in 1996 and 2003. Following years of civil conflict, where most of the main roads were reduced to foot paths, the region has been cut off from markets. A phenomenon began in response to the degradation of the road system, where an enterprising group of bicyclists called "Kumba Kumba" began hauling goods between market centers and villages that were slowly becoming more and more isolated from the rest of the region. Most cyclists took up this profession between 1990 and 1995, with the largest increase between 1995 and 2000. The Kumba Kumba cover distances of 300-400km mostly on foot, pushing their mammoth loads which had become the only way to evacuate some local products and to bring manufactured goods to villages cut off from markets (Tshombe).

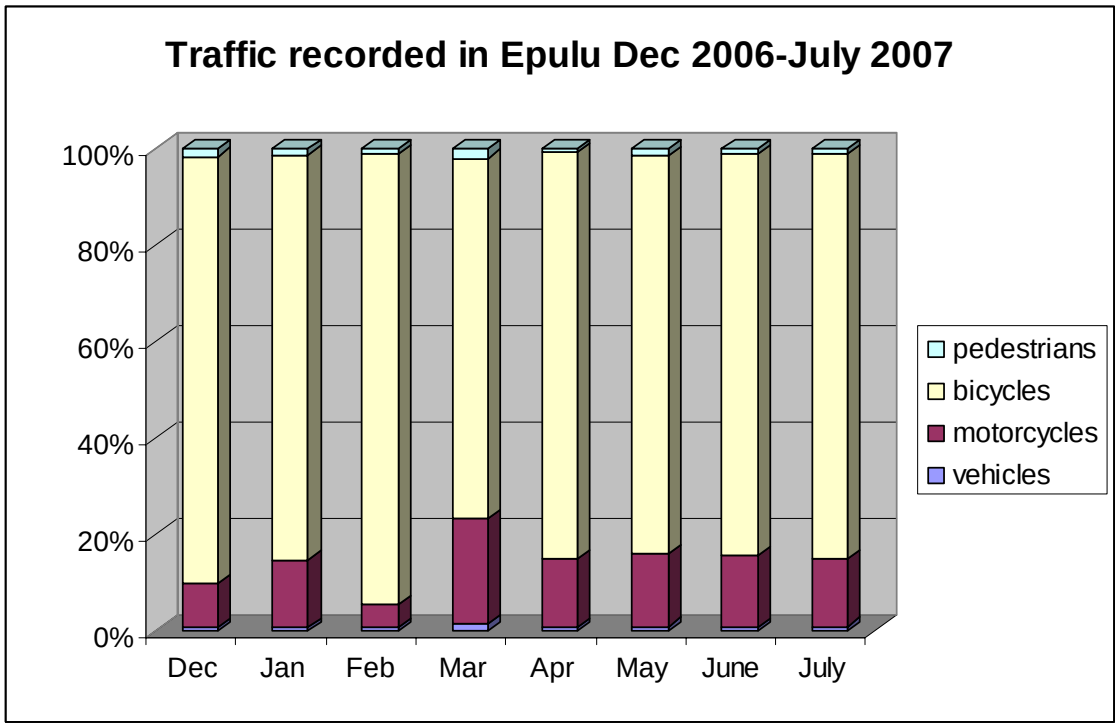
Photo 3: PCC technician traveling to Salate on the RN4. The road is not yet open, but within the next six months (by the beginning of 2008) that is due to change and vehicles will be able to travel from Kisangani to Beni passing through the heart of the Reserve. (WCS)

Road repair on the RN4, which is meant to connect Bunia and Beni to Kisangani, began in the Reserve in 2006. A Chinese road building company funded by the World Bank is working its way west as a Lebanese company is working its way from Kisangani in the direction of the Reserve. When these two efforts meet, the road will be open to vehicle traffic for the first times in more than a decade.

Because land use zoning is based on the number of resource users, the sound management of agriculture and hunting zones is in jeopardy if there is an influx of immigrants. To address this threat, a pilot Immigration Control project was launched in 2005. One of the objectives is to record the passage of vehicles, bicycles and pedestrians through the Reserve along the RN4. Data from the past two years clearly support the fact that the road and its impact on bushmeat consumption and export is still in the *"Before"* stage (photo 2).

Photo 4: RN4 in the Reserve ~20km east of Epulu (E. Brown)

Traffic recorded at ICCN patrol post in Epulu (Dec. '06 - Jul. '07)				
month	**vehicles**	**motorcycles**	**bicycles**	**pedestrians**
Dec '06	20	216	2158	39
Jan '07	23	378	2296	35
Feb '07	15	106	2031	22
Mar '07	21	310	1064	28
Apr '07	20	351	2077	20
May '07	19	323	1755	30
June '07	18	339	1906	25
July '07	22	330	1971	28



How the above graph changes in the future will depend upon the upkeep of the road and bridges, but one can imagine a scenario where the Kumba Kumba become less numerous as they are replaced by large market vehicles. This could have alarming consequences for game populations in the Reserve if hunting is not properly managed and if ICCN check points and secondary paths are not sufficiently controlled.

The Immigration Control system also issues transit passes to people traveling through the Reserve. By monitoring transit passes issued at the Reserve's eastern entrance and those who pass through the Epulu ICCN check point, it is evident that some people exit the Reserve via secondary routes (forest footpaths). It is estimated that most people who "go missing" are headed for Bandisende and Babama where they enter forest hunting camps to procure bushmeat for export to markets southeast of the Reserve where it can be sold for much higher prices.

Another aspect of Immigration Control is the monitoring of people who are on "temporary visits" to the Reserve. Most notable during the past year is the influx of workers employed by

the road-building company. Not only does the road-building company import some of its work force, but it hires many local laborers from villages as the road progresses, including manual laborers and local cooks who prepare pots of antelope meat for lunch. In addition to meals during the work day which are catered by local woman (some of whom are restaurant owners); there is also an injection of cash into the local economy.

This increase in people with money to spend is most noticeable in Epulu where the road-building company has set up a base for some of its managers and workers, which has caused prices of bushmeat and agricultural goods to increase. In general food is scarcer in the local market because now there are more people who do not have their own fields but who have money to spend on food. The restaurants in Epulu have benefited from this influx of people with spending money and Mbuti net hunters around Epulu are hunting at high levels which, according to them, are fueled by demand from road workers.

Photo 5: blue duikers & water chevrotain captured by Mbuti net hunters (E. Brown)

Monitoring of Mbuti net hunters around Epulu between April and August 2007 has revealed high harvest levels, especially for red duikers. Seven Mbuti clans around Epulu (in an estimated area of 660km^2) claim that they have captured 1,132 blue duikers and 1,534 red duikers between April and August. This data is based on a pilot effort to collect hunting data directly from hunters rather than sending a technician to their hunting camps. This method certainly has its errors, but we are currently testing this approach and sending technicians to follow up on the quality of the data. That aside, if hunting continues at this pace for the whole year, harvest levels would greatly surpass the recommended harvest of 40% of annual production, even when density levels for the higher productivity mixed forest type are used.

	# harvested April-August	harvest levels (5 months) - #/km^2	projected annual harvest levels (#/km^2)	Max. Sustainable Harvest (#/km^2)
red duikers	1534	2.32	**5.58**	2.76
blue duikers	1132	1.72	**4.12**	3.11

Reserve managers have their concerns about road rehabilitation and increased traffic through the Reserve. As we have learned from research and monitoring activities, hunters, traders, and restaurants will respond to increased demand in order to gain where few alternatives for revenue exist. ICCN must be ready to mitigate this predicted chain of events.

ATTITUDES OF RESERVE RESIDENTS TOWARD REHABILITATION OF THE RN4

It is also important to understand how local residents along the RN4 perceive the road and the positive and negative impacts they think the road has already brought or will bring in the near future. Interviews were conducted in three villages along the RN4 with 70 individuals, who were asked to give their opinions on the positive and negative aspects of the re-opening of RN4. The three villages represent different phases of road repair. In Bandisende, the road has been repaired since late 2006, in Epulu the road-building company has set up a base, and Salate is on the verge of being connected to this improved road system at the time of writing in August 2007.

Epulu has a large population will a high number of non-farming households. In other words, as more people arrive who demand food (agricultural products and bushmeat), there are less agricultural products available for local consumption and what *is* available is more expensive. The same goes for bushmeat, which has increased in price in Epulu since the road workers have set up their base. The average villager finds it more difficult to have access to bushmeat – the level of hunting by Mbuti net hunters to supply restaurants for road crews is steady. Some people in Epulu think that the improved road will only increase the "famine" or further impoverish the town in terms of agricultural goods because farmers will prefer to sell their agricultural goods to passing vehicles at a higher price rather than sell to their neighbors at a lower price; this remains to be seen.

One respondent in Bandisende said: "The road has been well repaired; it permits us to achieve our activities in less time, for example getting bushmeat from Mbuti that is then quickly sold to a passer-by along the road at a good price. Before the road {was repaired} a blue duiker sold for $2.40 and now the price has risen to $3.00, that is to say, the price of forest products has risen."

Summary of Interview Results (N=70)

Responses concerning the rehabilitation of RN4	**Salate**	**Epulu**	**Bandisende**
Positive points already experienced or anticipated	Travel is easier, improved market access, reduction in harassment from military, **increased demand & price for bushmeat**, increased demand & price for other forest products, connected to the outside world, increased population	Decreased price of manufactured goods, travel is easier, improved access to information & communication, improved market access & circulation of money, improved possibility to earn money as a vendor or	Increased market access (more vehicles passing & better prices), sale of forest products (such as wood & mushrooms), money in circulation, **increased and "easy" sale of bushmeat at increased prices**

		restaurant, decreased harassment from military & police, possible arrival of more NGOs (source of employment)	
Negative points already experienced or anticipated	Increased prices for agricultural & manufactured goods, "looting" of forest & natural resources by people from the outside, motor vehicle accidents, diseases	Increased # of restaurants, increased price of food including bushmeat – because of increased demand, increased bushmeat commerce, less bushmeat available for villagers/residents because travelers will buy it all to leave the Reserve and sell it elsewhere at a higher price, outsiders will come so destroy the forest to obtain gold, wood & other construction materials because they come from regions where these materials are scarce, increased poaching, road accidents, & diseases. Demographic pressure.	Increased prices for certain manufactured goods & agricultural products, increased population & intensification of agriculture, **increased prices for bushmeat** & other forest products such as wood,

HUNTING ZONES

Participatory mapping of hunting territories

The foundation for establishing hunting zones is participatory mapping. Reserve managers need to know the limits of clan hunting territories and who uses them. Once clan limits are documented for a village or a group of villages the next step is to understand how hunting territories are used, for example how do snare hunters and net hunters divide up the forest? What are the affinities between Mbuti hunters and Bantu? What is the recommended harvest for the territory based on estimates of production, the area, and the number of hunters, and the method being used?

Photo 6: mapping with Mbuti chiefs in Epulu (E. Brown)

Participatory mapping has been conducted with hunters in more than 12 clans in Nduye, Bandisende, Eboyo-Bapukeli, Epulu, and Salate. This activity begins with a meeting of hunters where they trace their clan hunting territory limits on the ground or on paper and then a plan is made to send a group out into the forest to take geographic waypoints with GPS units.

This experience has shown the diversity and flexibility of how hunting territories are organized and used. In **Epulu and Eboyo-Bapukeli** hunting territories are generally for net hunters only and there are not recognized groups of snare hunters. The hunting territories run perpendicular to the main road (RN4) and are defined by different clans. Because of affinities there is movement between territories, but the boundaries are quite well known by the hunters.

In **Bandisende** there is a more established group of Bantu snare hunters as well as Mbuti net hunters who comprise four clans that have claims to hunting territories that run perpendicular and south from the main road (see map in Appendix 1).

In **Salate**, there are no internal hunting territory limits within the area covered by the village of Salate and even between Salate and Molokay (the neighboring village to the west) but there are distinct limits between Salate and Ebiane (the neighboring village to the east). Also in Salate, Bantu snare hunters and Mbuti net hunters share the territory where generally net hunters hunt closer to the RN4 and snare hunters go further into the forest.

In **Nduye**, snare hunting is more common and there are different sectors of the forest used by Bantu snare hunters and Efe archers. Understanding the overlaps of hunting territories between different clans and how hunters using different methods divide up their hunting territories is critical for creating hunting zones and management guidelines for the zones that specify who is authorized to hunt where and with what method.

In none of the study sites did we follow all hunters or a sample of both Bantu and Pygmy hunters. In the future it is recommended that for each hunting zone to establish who is hunting there. This is not to say that snare hunting will be formally legalized in the Reserve, the management committee has not yet come to that conclusion. However, in the meantime it is better to make management decisions based on the most complete picture that we can create – which means talking to snare hunters and understanding how they work in order to make more realistic projections of game off take and estimated sustainable hunting levels.

SUBSISTENCE HUNTING POLICY FOR THE RESERVE

A working group formed by the Reserve management team decided that the critical elements that should be considered once a hunting zone is mapped and its area (km^2) known include the following:

- Estimated sustainable off take of animals permitted per area (km^2) – See appendix 2
- Methods permitted, where and by whom
- Do the hunters want to instate a hunting calendar with closed and open seasons?
- Who is authorized to follow hunters into their forest camps (e.g. traders who leave the Reserve via secondary foot paths)
- Where should areas of "core conservation" be placed and how might these reduce the available hunting grounds of certain clans?
- The roles of different authorities must be clarified. For instance one Collectivity Chief in the Reserve sells snare hunting permits in his administrative unit. Not only is this against Reserve regulations, but it causes confusion over the role of ICCN in regulating hunting.
- Once zones are established and management structures and rules agreed upon, these rules must be enforced and monitored.

CONCLUSION

The Okapi Faunal Reserve (OFR) is a human-inhabited protected area where a pilot land use management system is in place for the creation and management of subsistence zones. These zones are of finite size and their longevity and resilience will be determined, in part, by the number of resource users. Experience gained during the first years of land use zoning in the OFR has shown the importance of baseline biological and socio-economic data for continued monitoring and evaluation, the necessity of capacity building and community participation in land use planning and conservation, and the need to link biodiversity conservation and livelihood improvements.

The impact of hunting in different sectors of the OFR depends on the level of demand for meat, the access to markets and transport of meat, the level of enforcement of regulations, and the way hunting territories are managed. As road rehabilitation facilitates travel between large towns, demand for bushmeat will certainly grow. Clear management guidelines for hunting zones and enforced regulations are necessary.

Wildlife conservation in a vast protected area with a small team of ICCN guards requires strategic enforcement, focusing on entrance and exit points. It is also necessary to build the capacity of hunters and local authorities to form management committees for their hunting territories. These hunting management committees will ensure that local/resident/indigenous hunters and their communities benefit more from bushmeat than do immigrants and people passing through the OFR along the RN4 or coming from large towns around the periphery of the Reserve.

FUTURE RESEARCH AND MONITORING RECOMMENDATIONS

- Document and monitor the link between hunters and restaurants. We do not know how many of the animals caught by snare and net hunters went directly to restaurants.

- Continue monitoring vehicle and bicycle passage through the Reserve as the road opens in the next several months.

- Continue monitoring roadside restaurants and sale of bushmeat for household consumption

- Begin forming management committees for hunting zones – pilot sites will be Epulu/Eboyo, Bandisende, Salate and Nduye. These committees will elaborate zone-specific use guidelines which may include hunting calendars (closed seasons).

- Better understand and document the overlaps and conflicts between Bantu snare hunters and Pygmy net hunters & archers and the role of patron-client relationships in controlling the sale, trade, and export of bushmeat.

- Document and monitor the number of snare hunters and the number of Mbuti & Efe hunting clans. In hunting territories where both snares and nets or bows & arrows are used by the population, the off take by each method should be estimated.

- If a complete ban on snares is unrealistic in terms of enforcement, then Reserve managers should provide harvest recommendations based on the size and productivity of a hunting zone, the number of hunters, and the efficiency of the hunting method.

- Based on the fact that the resident population of the Reserve is permitted to hunt for consumption and to gain revenue for basic needs, and that restaurants are unregulated, it is recommended that export of bushmeat beyond Reserve boundaries be strictly forbidden. A clear policy must be written and enforced so that bushmeat does not leave the Reserve for resale in distant markets.

- ICCN must be capable of control so called “pistes secondaires” or secondary access routes. These footpaths bypass the ICCN checkpoint and serve as conduits for exporting bushmeat to markets outside the Reserve where demand and prices are high.

- There mush be bushmeat confiscations at ICCN Reserve border posts so that people may start to find smuggling too much of a risk.

- Efforts should be continued to encourage dialogue between local authorities and the Reserve. The Reserve managers need the cooperation of local chiefs who can effectively grant or deny access to their hunting zones to outside buyers/traders.

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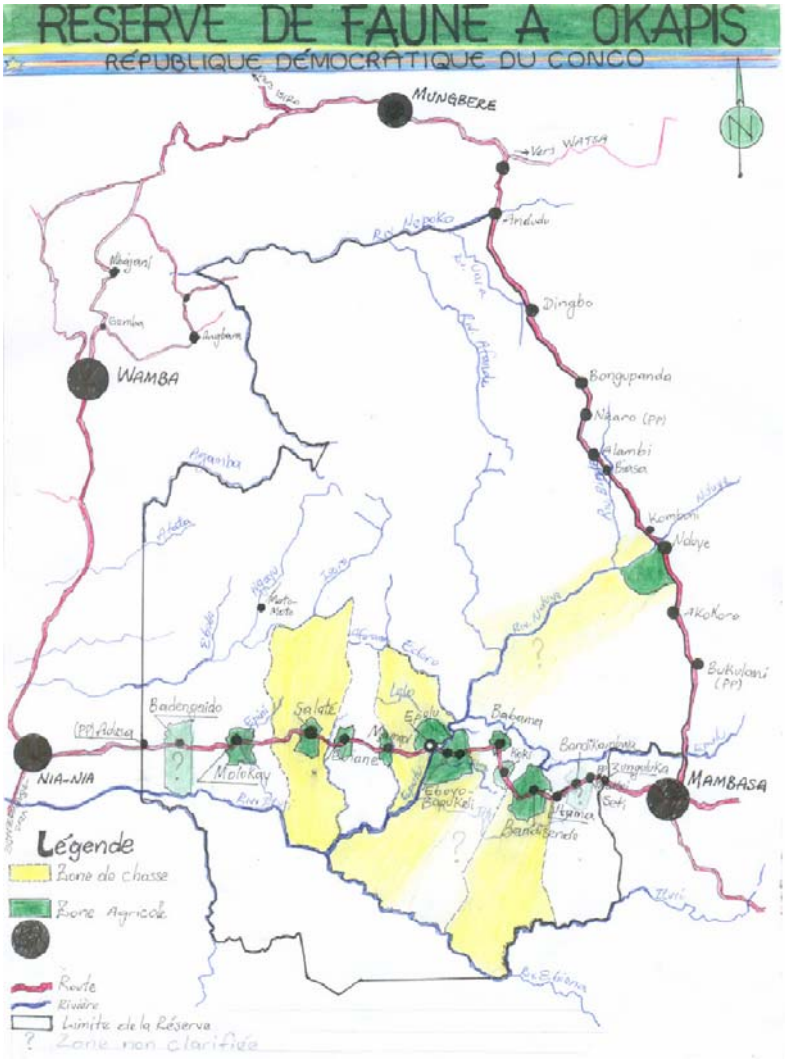
Appendix 1: Map of the Okapi Faunal Reserve showing Agriculture & Hunting Zones



This sketch map shows the location of hunting and agriculture zones in the OFR. Green patches represent agriculture zones and yellow areas are hunting territories (that have not yet been officially deemed hunting zones). The red roads clearly show the importance of monitoring transportation networks in this Reserve. The large population centers are marked with large black circles compared to smaller villages marked by small black circles. The east-west road bisecting the Reserve from Mambasa to Nia-Nia is the Route Nationale 4 (RN4) which is being rehabilitated.

Appendix 2: Density, Production, and Maximum Sustainable Harvest

	Density (#/km^2)				Max. Production (#/km^2/year)				Max. Sustainable Harvest (#/km^2/year)			
	low prod. forest - no hunting	high prod. forest - no hunting	Hunted forest	Average Density	low prod. forest - no hunting	high prod. forest - no hunting	Hunted forest	Average Production	low prod. forest - no hunting	high prod. forest - no hunting	Hunted forest	Average estimated sustainable harvest
Blue Duikers	10.2	20.6	14.8 - 17.8	15.85	3.86	7.79	6.16	5.93	1.54	3.11	2.46	2.37
Red Duikers*	11.2	24.2	8.2 - 8.7	13.08	3.2	6.91	2.41	4.17	1.28	2.76	0.97	1.67

*Red Duikers includes: *Cephalophus nigrifrons, C. leucogaster, C. callipygus, C. dorsalis, C. sylvicultor,* and *Hyemoschus aquaticus.*

Density estimates are taken from Hart 2000. The average density was calculated by adding density estimates for low and high productivity forests and a high and low density estimate for hunted forests (forests with active hunting camps found at different distances to a road and with different levels of market pressure and snare hunting). Maximum production was calculated using the following formula developed by Robinson and Redford (1991):

$$P_{max} = (0.6D \times \lambda_{max}) - 0.6D$$

D is the density, and λ_{max} is the maximum finite rate of increase of the population (λ_{max} has been estimated for both red and blue duikers). Maximum sustainable off takes were calculated using Robinson and Redford's recommendation that for short-lived (5-10 years) species such as duikers, harvest levels should not exceed 40% of production.

More accurate density levels can be calculated based on forest composition (high productivity mixed-species forests vs. low productivity monodominant forests), and area (km^2) of specific hunting zones. This will enable Reserve managers to calculate more reliable estimates of maximum production and to recommend maximum sustainable off take limits to hunters based on the size and productivity of their respective hunting zones.