EJSIT
European Journal of Science, Innovation and Technology
ISSN: 2786-4936
www.ejsit-journal.com
Volume 6 | Number 3 | 2026

Characterization and Monitoring of Wildlife Trafficking at the Bayangana Checkpoint (Kisangani, DRC)

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ABSTRACT

In the Democratic Republic of the Congo, hunting and the sale of game are essential for feeding families and providing a livelihood for many people. But this activity also threatens the country's rich wildlife. The Bayangana checkpoint, at the entrance to Kisangani, is a key location for observing what is really happening: every day, we see the game harvested from the surrounding forests passing through here.

To better understand this, a study was conducted specifically on this issue. We recorded which animals were being transported, distinguishing between authorized species and protected species. We weighed the shipments whether fresh, smoked, or dried and traced the journey of this meat from the forest to the town.

Observations show that hunting particularly of small mammals such as antelopes, monkeys, and rodents is widespread. This activity peaks during certain seasons, often coinciding with harvest times or when hunting is easier. Most concerning is that strictly protected species continue to be poached and sold, highlighting just how difficult it is to enforce the laws.

Given this situation, it has become urgent to better control access to the city and to help communities find alternative sources of food and income. The stakes are high: we must both preserve the forest and its wildlife and enable people to live with dignity. Striking this balance is the major challenge for the future.

Key words: Characterization, traffic, wildlife, checkpoint, Bayangana

1. INTRODUCTION

In the Democratic Republic of the Congo (DRC), wildlife exploitation goes far beyond mere subsistence. It lies at the intersection of ecological, economic, and food security issues (Fa et al., 2002; Fa et al., 2003; Fa et al., 2015). While it remains a vital source of protein and income for rural communities, the rise of organized commercial hunting, fueled by growing urban demand, seriously threatens the integrity of rural ecosystems (Fa et al., 2003; Nasi et al., 2011). This overexploitation, often occurring outside any regulatory framework, accelerates the erosion of biodiversity in the forests of the Congo Basin.

The wildlife trade is also an informal activity organized around complex networks linking hunting areas to various urban consumption hubs (Wilkie & Carpenter, 1999; Robinson & Bennett, 2000; Bennett et al., 2007). Research on hunting in Central Africa has long highlighted the dilemma between the needs of local populations and the preservation of ecosystems. Studies, such as those by Wilkie and Carpenter (1999), have dissected the functioning of illegal networks, while Fa et al. (2003) have clearly established the link between commercial hunting and the decline of tropical biodiversity.

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Beyond the ecological implications, the movement of game carcasses often preserved by smoking raises significant concerns regarding public health (Van Vliet et al., 2022a; Charis et al., 2023) and food safety (Van Vliet et al., 2015). In this context, transit routes and game checkpoints become key observation points for monitoring these flows. These transit routes and checkpoints make it possible to document the volume of harvests, the taxonomic diversity, and the geographic origin of the species being sold (Lindsey et al., 2011; 2013 and 2015). This is the case with the Bayangana checkpoint, located at the entrance to Kisangani, which serves as a pivotal point in monitoring bushmeat trafficking. Since its establishment as an entry point for wildlife monitoring and control in the Kisangani town, the dynamics of wildlife exploitation have not been documented to understand the level of game harvesting in the forests surrounding the Kisangani town. This lack of information limits the assessment of the effectiveness of regulatory measures and awareness campaigns carried out in Tshopo Province.

Without a rigorous analysis of how these trends are evolving, it is impossible to determine whether current conservation measures are effective. Are we seeing a stabilization, an increase, or a decrease in harvests? Which species are most affected? This study seeks precisely to answer these questions by examining trends between 2022 and 2023, the diversity of species intercepted, and the proportion of protected species within these flows.

The purpose of this study is to fill this gap by documenting the dynamics of wildlife exploitation at the Bayangana checkpoint, a strategic corridor. To achieve this, we have set three specific objectives: first, to identify the species being hunted, highlighting those that are most vulnerable; second, to analyze marketing channels to understand the impact of control measures on this trade; and finally, to propose concrete measures to promote sustainable wildlife management in the Kisangani region.

2. MATERIAL AND METHODS

2.1. Field of Study

We collected the data at the Bayangana checkpoint on National road 4, at kilometer marker 20. This checkpoint was established more than 10 years ago by the Tshopo Provincial Environmental Coordination Office. It is located at an altitude of 421 meters, at coordinates 0.4623824 degrees north latitude and 25.3532893 degrees east longitude. Its location is strategic: it serves as a key checkpoint for regulating the flow of natural resources. In fact, it intercepts wildlife and plant products, such as timber, originating from rural hunting areas before they reach the urban center of Kisangani.

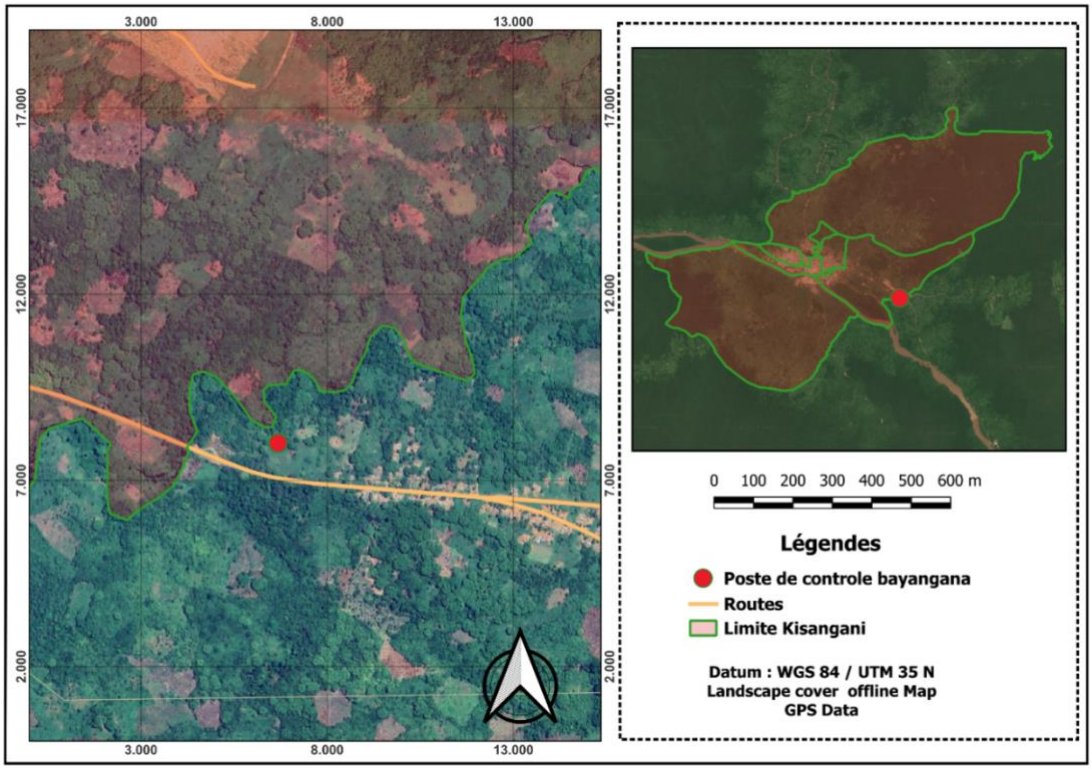

Figure 1: Map of the Bayangana checkpoint (Source: Lonu, 2025)

Our study area is located in the heart of the Congo Basin, a complex ecosystem where the environment directly shapes the presence of game. The climate is equatorial, hot and humid year-round, with average temperatures around 25°C and heavy rainfall of approximately 1,800 mm per year. Although showers are frequent, they reach their peak intensity in May and October. These heavy rains make hunting trails more difficult to access and slow down the supply of goods to local markets.

The landscape is primarily covered by dense lowland rainforest. It features a mix of old-growth forests, dominated by *Gilbertiodendron dewevrei*, and areas of secondary forest that have regenerated following human activities. This variety of habitats supports a wide range of species, particularly among small mammals and forest ungulates, which are the primary targets of commercial hunting in the region.

2.2. Methodological Approach

2.2.1. Data collection procedures

The Bayangana checkpoint is monitored around the clock by sworn officers from the Department of the Environment. This continuous presence, with teams working in shifts day and night, makes it possible to intercept all wildlife trafficking, including nighttime movements, which are often used to evade surveillance of protected species.

As required by the Environmental Coordination Office, all observations were recorded on field forms (date, place of origin, carrier's identity, as well as details on the species, their weight, and their number).

The analysis in this study covers two full years, 2022 and 2023. For each seizure of hunting products, we carefully recorded:

1. For each shipment of game meat intercepted, we recorded the name of the species in the local language (Swahili, Lingala, or, at a pinch, French), the number of animals, their origin, their destination, and the condition of the meat (fresh or smoked, whole or in pieces).

2. The weight of each game animal's carcass was measured by species using a precision electronic scale (Weiheng brand, 50 kg) to accurately calculate the amount of meat harvested.
3. To identify species, we combined the knowledge of field staff (who use local names) with reference guides, such as the « Guide to the Mammals of Africa » (Kingdon, 2006) and the official nomenclature lists of the Department of the Environment.

2.2.2. Data processing and statistical analysis

We first compiled all the data into an Excel file, which we then organized and cleaned. Once this step was complete, we imported the data into R Studio for analysis. To compare the results between 2022 and 2023, we used Student's t-test and the nonparametric Kruskal-Wallis test. If the test revealed a significant difference ($p < 0.05$), we proceeded with Dunn's post-hoc test to identify which groups or periods were responsible for these differences.

3. RESULTS

3.1. Characterization of the species diversity of game animals intercepted at the Bayangana checkpoint

a. Analysis of wildlife harvesting trends and comparative assessment of hunting pressures between 2022-2023.

In the inventories of game seized at the Bayangana checkpoint, we observe varying trends in the harvesting of hunted species over the two consecutive years of this study.

Table 1: A comparison of the species diversity recorded during two years of monitoring at Bayangana

Variables	2022	2023	t	p-value	Decision
Number of species	40	31	1,511	0,2008	DNS
Number of specimens	57567	14928,8	1,6246	0,200,	DNS
Weight in Kg	168787,77	50648,25	1,5381	0,2192	DNS

Caption: DNS : Non significant Difference ; Kg : Kilogramme.

Data collected in Bayangana show that hunting activity along the two main roads (Ituri and Lubutu) slowed between 2022 and 2023. The number of species recorded dropped from 40 to 31 during this study period. The decline is equally marked in terms of volume: the total weight of the catch fell by approximately 70%, and the number of animals intercepted followed the same downward trend. Despite this trend, statistical analyses indicate that the difference is not statistically significant ($p > 0.05$).

b. The Effect of Origin on the Diversity of Game Species Surveyed in Bayangana

With the aim of identifying the areas where hunting pressure affects the greatest number of different species, we sought to determine whether the diversity of hunted animals varied by hunting area, particularly between the two main road corridors. Table 2 presents these variations: it compares the species richness of harvested animals based on their place of origin.

Table 2: A comparison of the species richness of harvested animals based on their place of origin

Variables	RN3	RN4	t	p-value	Decision
Number of species	41	42	0,53566	0,601	DNS
Number of specimens	41486,9	31008,9	0,44938	0,663	DNS
Weight in Kg	115281,07	104154,95	0,16842	0,8694	DNS

Caption: DNS : Non significant difference ; RN3 : National road 3, (axe Kisangani-Lubutu) RN4 : National road 4 (Kisangani-Beni)

The Bayangana checkpoint records game coming from two main roads: National Route 3 and National Route 4. It appears that hunting practices are very similar along these two routes, which means that the variety of species hunted is virtually the same, regardless of their origin.

3.2. Temporal trends in the species composition and biomass of harvested game (2022–2023).

a. Status of collected biodiversity: Analysis of the species richness and abundance of captured species

This section examines the diversity of captured species, focusing on the ten species most frequently recorded at the Bayangana checkpoint during 2022 and 2023.

Table 3: The ten most frequently recorded species in 2022 and 2023 at the Bayangana checkpoint

Year	Scientific name	Number of specimens	Weight in kg
2022	*Cercopithecus ascanius*	21632	47151,9
	Cricetomys gambianus	10445	5359,3
	Cephalophus dorsalis	7602	53091,37
	Cercocebus agilis	4267	13532,6
	Philantomba monticola	4038	6973,93
	Atherurus africanus	2904	4188,7
	Lophocebus albigena	2134	7881,97
	Cercopithecus nictitans	1138	4012,2
	Potamochoerus porcus	1094	15107,5
	Cephalophus nigrifrons	455	2768,9
2023	*Cephalophus dorsalis*	5582	32198,85
	Cricetomys gambianus	3793,7	1508,5
	Philantomba monticola	2176,6	3353,3
	Cercopithecus ascanius	1624	3086,5
	Potamochoerus porcus	851	7464,9
	Atherurus africanus	564	697,3
	Tragelaphus spekei	92	789,6
	Cephalophus silvicultor	67	882,2
	Cephalophus nigrifrons	66	327,2
	Cercopithecus wolfi	15	38,4

When comparing the two years of the study, we observe a notable change in the game species intercepted at the Bayangana checkpoint. In 2022, three species recorded at Bayangana were dominant: the monkey (*Cercopithecus ascanius*), the Gambian rat (*Cricetomys gambianus*), and the dorsal duiker (*Cephalophus dorsalis*). In 2023, however, a shift was observed in the species recorded: the dorsal duiker (*Cephalophus dorsalis*) became the most frequently intercepted species. In addition, new species have been recorded among the top ten most frequently recorded species, including the sitatunga (*Tragelaphus spekii*) and the yellow-backed duiker (*Cephalophus silvicultor*).

b. Temporal trends in harvested game biomass (2022–2023)

We present the results of data on changes in game biomass recorded at the Bayangana monitoring station during this two-year study period. Table 4 presents a quarterly analysis of the game biomass recorded in 2022 and 2023 at this same station.

Table 4: A quarterly analysis of the game biomass recorded in 2022 and 2023 at this same station

Quarter	Average ± SD	CV	DUNN TEST
Q1	37.3 ± 45.2	121	a
Q2	40.7 ± 45.9	113	b
Q3	29.0 ± 44.4	153	c
Q4	26.1 ± 37.4	143	c
Weight. Kg per quarter 2022 et 2023(K-W=176.53 et p-v < 2,200)			

Caption: Q1 : First quarter ; Q2 : Second quarter ; Q3 : Third quarter and Q4 : Fourth quarter.

Upon examining the game biomass data collected from 2022 to 2023, we observe significant variations from one quarter to the next. The second quarter (Q2) stands out clearly with the highest average biomass (40.7 kg, with a range of ±45.9 kg). This quarter (Q2) indicates that this is the period when measurements are most stable. Variability is relatively low, suggesting that harvests were more consistent, or that the volumes recorded tended to be more uniform.

In contrast, the indicators for Q3 and Q4 are alarming. We observe increased variability in the data, reflecting a structural irregularity in harvests during this period. This discrepancy reveals variability in game harvests: most harvests are small, but they are interspersed with occasional large catches, which creates an imbalance in the figures. The contrast in hunting patterns is evident in Q1 and Q2, suggesting a change in hunting practices during the first half of the year.

C. Year-over-year changes in the species composition of game (2022–2023)

Table 5 presents a quarterly analysis of this diversity over these two years.

Table 5: A quarterly analysis of this diversity over these two years

Quarter	Average ± SD	CV
Q1	60.2 ± 101.0	167
Q2	97.1 ± 143.0	148
Q3	32.5 ± 48.0	148
Q4	33.9 ± 45.2	133
Specific wealth by quarter for 2022 and 2023 (K-W = 4.676, p-v = 0.1971)		

Caption: Q1 : First quarter ; Q2 : Second quarter Q3 : Third quarter et Q4 : Fourth, CV : Coefficient of variation, K-W : kruskall Wallis

We observed a distinct seasonal pattern in species diversity based on the analysis of game species recorded in Bayangana. Species richness was highest in the second quarter, with an average of 97.1 species (± 143.0), and gradually declined during the third and fourth quarters. Although the difference between the peak in Q2 and the lows in Q3 and Q4 is visible, there is no statistically significant difference (K-W = 4.676; p = 0.1971).

3.3. A comparative analysis of the Congolese national protection status (ICCN) and the IUCN Red List category for species in Bayangana

a. Structure of game harvests in Bayangana by legal protection category, as defined by the Congolese Institute for Nature Conservation

To understand the situation regarding game harvesting, we relied on Law No. 14/003 on nature conservation in the DRC. This legislation classifies species into three categories: those that are fully protected, those whose exploitation is regulated (partially protected), and those that are authorized (unprotected). This analysis is crucial for determining the legality of game captured in the various areas where hunting takes place.

By applying these criteria to our data, we can assess the extent of illegal exploitation in the area. Classifying species according to their protection status allows us to determine whether harvesting primarily targets resilient species or whether it is harming wildlife strictly protected by the Congolese government.

Table 6 shows the distribution of game recorded in Bayangana according to its protection status as defined by the Congolese Institute for Nature Conservation (ICCN).

Table 6: The distribution of game recorded in Bayangana according to its protection status as defined by the Congolese Institute for Nature Conservation (ICCN)

	RN3		RN4		P-value	
CS	N.specimens	Weight/kg	N. specimens	Weight/ kg	Specimens	Weight/Kg
N. P	11260	8503,1	6541,7	6178,2	DNS	DNS
P. P	30058,9	106205,27	24210,7	97023,95	DNS	DNS
F. P	168	572,7	256,5	952,8	DNS	DNS
Total	41486,9	115281,07	31008,9	104154,95	_	_
Average	13828,97	38427,02	10336,3	34718,32	_	_
S. D	15110,13	58831,46	12419,75	54021,48	_	_
CV%	109,26	153,10	120,16	155,60		

Caption: CS : Conservation status, NP : unprotected, PP : Partially protected ; F.P : Full protected ; S.D : Standard deviation

Partially protected species account for the majority of specimens recorded along both routes, with a small proportion of fully protected species. This indicates that species with moderate conservation status are the primary target of exploitation. Despite this ongoing exploitation of fully protected species, there are no significant differences between the two routes.

b. Taxonomic characterization and assessment of the threat status (IUCN) of the intercepted species

To go beyond simply tallying seizures and measure the actual impact of poaching along the two routes leading to the Bayangana post, we relied on the IUCN Red List. The idea is to cross-reference our data with the threat status of each species whether it is classified as “Endangered” or “Vulnerable.” This allowed us to determine whether the illegal trade primarily targets endangered animals, which would significantly increase the pressure on local biodiversity.

This internationally recognized IUCN Red List is a game-changer. Instead of classifying seized animals by weight or market value, we have assessed them based on their conservation importance. This is a valuable tool for identifying the true “flagship species” of wildlife trafficking in Bayangana—those that, because they are the most threatened, require urgent and targeted protection.

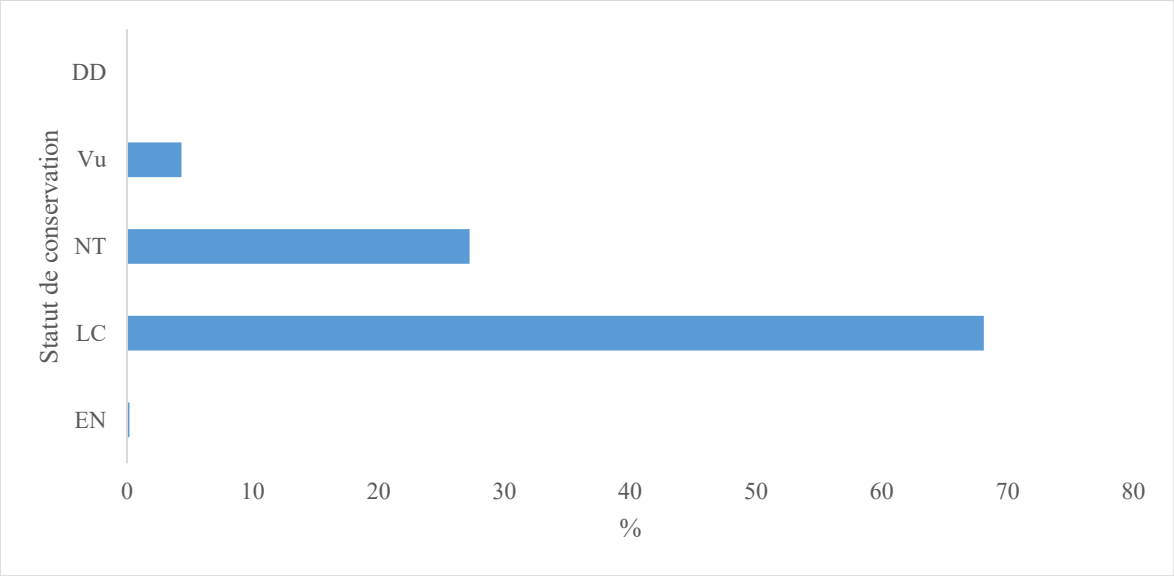

Figure 2: Proportion and conservation status (IUCN) of game animals recorded in Bayangana

In Bayangana, the vast majority of game animals intercepted are classified as "Least Concern" (LC), accounting for 68.16% of cases, followed by species classified as "Near Threatened" (NT), at 27.24%.

Species considered threatened—and therefore at high risk of extinction—are much less common. These include the "vulnerable" (VU) category, which accounts for 4.34% of the game intercepted in Bayangana, as well as the "endangered" (EN) category, at 0.22%. This suggests that hunting pressure in the two main game supply routes directly threatens the region's most vulnerable species.

4. DISCUSSION

a. Characterization of hunting pressure and wildlife monitoring in Bayangana through the analysis of game intercepts

Between 2022 and 2023, bushmeat harvesting in Kisangani showed a marked decline in the number of game animals recorded at Bayangana. In this study, we observed a 70% decrease in the biomass of game animals intercepted at Bayangana, and the number of different species recorded fell from 40 to 31. Despite this decline, there is no significant difference. This leads us to believe that the supply system around Kisangani, as monitored at the Bayangana station, is highly unpredictable, and the amount of game available in the peri-urban areas of Kisangani varies greatly, in an almost random manner (Wilkie et al., 2011).

This decline could also be explained in another way: faced with inspections at the Bayangana checkpoint, trade networks are adapting and becoming more discreet. In other words, some of the bushmeat trade heading toward the city now evades surveillance (Van Vliet et al., 2019). What we observe in Bayangana is therefore the result of a complex mix: on the one hand, certain species are becoming biologically scarce, and on the other, traffickers are reorganizing their operations to avoid barriers (Fa et al., 2022). Despite this observation, we must remain cautious. The lack of solid statistical evidence suggests that hunting pressure has not necessarily decreased in reality. It may simply have become more heterogeneous, or hunters may be circumventing checkpoints more effectively.

One worrying sign, however, is that nine species were not recorded in Bayangana in 2023. This loss suggests that pressure is now reaching the deepest forests, particularly due to the deterioration of the RN3 and RN4 roads. It is a biological sign that biodiversity is eroding

in wildlife habitats, likely due to the combined effects of hunting and agriculture, which fragment habitats. This dynamic, as observed in this study, is also seen in other African regions. Once the game in the immediate vicinity is depleted, hunters are forced to set up camps farther and farther away. Along the RN3 and RN4 highways, we see a spatial reflection of the degradation occurring along the roads, manifested by the disappearance of wildlife from the forest edges, and hunting activity shifting deeper into the forests, illustrating the concept of the "empty forest" (Benítez-López et al., 2017).

The loss of these 9 species (from 40 to 31 species) in the Bayangana inventory also illustrates how demand from urban markets such as Kisangani creates a clear gradient of deforestation, and this may indicate that the Kisangani region has reached a tipping point. The most vulnerable species (primates and ungulates) are gradually disappearing from the local trade, giving way to more resilient but less diverse species (Ingram et al., 2021; Nebesse, 2022; Chausson et al., 2019). This means that we cannot say with certainty that hunting pressure has actually decreased. This variation could simply be due to chance, or, more worryingly, reflect an adaptation by traffickers who are becoming more discreet to circumvent controls (Nasi & Fa, 2022; Wilkie et al., 2016; Van Vliet et al., 2023b).

The disappearance of these nine species sends a strong signal. It suggests that hunting, driven by demand from Kisangani, is now encroaching on the last remaining forest refuges, far from the roads. This is the well-known phenomenon of the "empty forest": with the most accessible animals having disappeared, hunters must venture deeper into the forest, setting up remote camps (Nebesse, 2022). The deterioration of the RN3 and RN4 roads is likely accelerating this process by fragmenting habitats.

Another factor to consider is the role of climate. In Tshopo Province, the hunting season is dictated by the rains (Nebesse, 2022). The decline observed between 2022 and 2023 may therefore not be solely a matter of wildlife density but could also be a consequence of flooding or the condition of forest trails, which either facilitate or hinder the transport of game to Kisangani. Hunting activity shifts in response to flood-prone areas, which directly alters the types of game recorded at posts such as Bayangana.

b. Hunting dynamics and interannual variations in wildlife harvesting in habitats bordering the RN3 and RN4 axes

A striking fact is that the composition of bushmeat recorded at Bayangana has become very similar along the two axes (RN3 and RN4). This does not reflect ecological uniformity, but rather an integrated market where urban demand from Kisangani dictates its dynamics. Hunters, wherever they are, target the same high-value species and create a synchronized pressure front that sweeps across the entire region.

The study also raises a critical health risk. The exclusive presence of bats (*Eidolon helvum*) along the RN3 axis, animals known to be virus reservoirs, makes this route a zoonotic risk corridor. This requires an urgent revision of control protocols at Bayangana, with appropriate protective equipment for agents and strengthened epidemiological surveillance.

Data from Bayangana show that hunting pressure is not decreasing; it is reorganizing and intensifying in more remote areas. The RN3 and RN4 are no longer independent hunting zones, but the arteries of the same bio-economic system undergoing depletion. According to Hart et al. (2022), when road axes cease to be independent niches and become arteries of a system undergoing faunal depletion, the risk of ecological collapse becomes systemic. Consequently, regulatory strategies can no longer be segmented. A cross-cutting management approach is required, as the depletion of resources on one transport axis is intrinsically linked to their decline on the other, irreversibly compromising ecological resilience and regional food security in Tshopo (Ingram et al., 2021).

c. Influence of seasonal cycles on wildlife exploitation and interception at Bayangana

The study conducted at the Bayangana control post reveals that the diversity of hunted species varies across seasons, under the influence of three key elements: animal behavior, climatic conditions, and local socio-economic realities.

It is in the second quarter that the greatest variety of bushmeat is observed at Bayangana. This period coincides with sustained demand for bushmeat in Kisangani, providing rural households with a source of income (Ingram et al., 2021). In the field, the onset of rains also marks the fruiting of trees such as *Uapaca* and *Gambeya*, which attract many frugivorous mammals and ungulates, making them more visible and more mobile for reproduction, thus more vulnerable to hunting (Van Vliet et al., 2022b).

This relative abundance seems to confirm that resilient species, such as blue duikers and certain rodents, withstand intense hunting pressure. In heavily exploited areas, biomass tends to stabilize around these fast-reproducing species, maintaining a regular flow of harvests (Fa et al., 2022).

This harvesting structure also reveals a false sustainability: the bushmeat trade in Tshopo relies on a silent erosion of near-threatened species. To curb this trend, it is urgent to establish a seasonal biological rest period, especially during the second quarter (Q2), the period of maximum pressure. Such a measure would protect the reproductive cycles of vulnerable species and help restore the biological capital of the region. Without this, the collapse of biodiversity and local food security will become inevitable.

The decrease recorded between July (Q3) and November (Q4) does not necessarily indicate a decline in biodiversity. It is rather explained by several constraints. Heavy rains flood lowlands and degrade tracks, limiting hunters' movements and damaging their traps. Roads become impassable, which often prevents the transport of bushmeat from deeper and more diverse forest areas (Abernethy et al., 2016; Fonteyn et al., 2023).

Contrary to the dry season, when animals gather near water points, the rains disperse them over a wider territory, making them harder to intercept. Moreover, communities turn to agricultural activities during sowing or harvesting periods, relegating hunting to a secondary activity. This shift mechanically reduces the diversity of species brought to the control post. A similar phenomenon has been observed in Gabon: when farmers spend more time in the fields, they mainly capture large species such as bush pigs or cercopithecines that raid crops (Coad et al., 2023).

Recent studies in the Congo Basin confirm that the dry season, often centered on Q2, is the most productive for hunting. Animals are more accessible, forest visibility is better, and agricultural activity slows down, allowing hunters to increase their outings (Rowcliffe et al., 2003; Carvalho et al., 2016; Kyale et al., 2019; Van Vliet et al., 2023b).

Species richness follows the same trend, with peaks in Q2, although captures remain highly variable depending on the area or hunter. As shown in some studies, bushmeat availability can fluctuate significantly from one month to another depending on exploited habitats, which partly explains these irregularities (Van Vliet et al., 2023b).

Ultimately, the dynamics observed at Bayangana align with a well-known seasonal pattern in Central Africa: bushmeat abundance peaks at the end of the dry season and then gradually declines with the onset of rains (Bachand et al., 2024; Ingram et al., 2020).

d. Conservation status and vulnerability of exploited fauna

The analysis of animals intercepted at the Bayangana control post reveals a complex situation. We observe that hunting mainly targets partially protected species, which appear to constitute the backbone of bushmeat in the Kisangani region (Van Vliet et al., 2023a). These animals, still relatively abundant or tolerated, provide essential protein and income to local communities.

The dominance of partially protected species may appear as a form of adaptation, but it conceals vulnerability. The constant pressure on these animal populations, combined with the poaching of threatened species, requires increased vigilance. The uniformity of the situation argues for a conservation strategy at the scale of the entire area rather than isolated actions.

However, the continued presence, even in small quantities, of fully protected species is alarming. It shows that legal prohibition is not always sufficient as a deterrent. Several factors explain this: traps such as snares capture animals indiscriminately. In addition, specific demand exists for certain rare species in urban markets, encouraging some hunters to take risks.
Interestingly, hunting pressure is similar across the two road axes studied. This indicates that hunters throughout the Bayangana region use similar techniques and face similar ecological and regulatory constraints..

e. Analysis of the vulnerability of harvested fauna: an approach based on the IUCN Red List

The analysis of animals seized at the Bayangana control post provides an alarming picture of wildlife status in Tshopo Province. By classifying these harvests according to IUCN threat categories, it becomes clear that exploitation goes far beyond subsistence needs and dangerously erodes the region's natural capital.

The fact that most intercepted animals are classified as "Least Concern" (68.16%) shows that hunting relies on fast-reproducing species, such as small rodents or blue duikers. As elsewhere in the Congo Basin, this concentration on resilient species is often a sign of the "empty forest syndrome" (Van Vliet et al., 2023a). Large mammals have already disappeared from areas near RN3 and RN4, forcing hunters to rely on smaller, less valuable prey that will eventually also become depleted (Coad et al., 2019).

The most worrying figure in this study is that more than a quarter of captures involve "Near Threatened" species (27.24%). This represents an emerging ecological red zone in the Kisangani region. The fact that nearly 30% of bushmeat falls into this category shows that hunting pressure is actively pushing a significant portion of biodiversity toward critical status (Luiselli et al., 2018).

Although less frequent, the presence of "Vulnerable" (4.34%) and "Endangered" (0.22%) species is extremely serious. Ecologically, the loss of even a single individual of an endangered species is significant. These data show that rarity no longer protects species from hunting. On the contrary, rarity may increase market value, encouraging deeper forest poaching (Trefon, 2023).

CONCLUSION

Data collected at the Bayangana control post between 2022 and 2023 reveal an alarming situation. Behind an apparent 70% decrease in intercepted bushmeat and reduced species diversity, the entire hunting dynamic has changed—and not for the better. Trafficking networks are adapting, and local wildlife is paying a heavy price.

This study highlights four essential points:

- Forests around Kisangani are becoming depleted: 9 species were not recorded in 2023. Hunters must now travel much farther, sometimes over 40 km, to find bushmeat.
- Biodiversity is on the brink of collapse: nearly one-third of bushmeat consists of threatened species.
- Economic and health risks are increasing: organized trade and zoonotic risks are rising.
- Seasonality plays a key role: hunting peaks when species are most vulnerable.

To avoid biodiversity collapse, it is necessary to go beyond simple monitoring. Active and integrated management must be implemented, including seasonal hunting bans and the development of alternative protein sources (fish farming, poultry farming).

Ultimately, the future of Tshopo's forests depends on a fragile balance: regulating bushmeat trade while ensuring food security for local communities. This is the challenge that authorities and populations must face together.

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