

Bushmeat Supply Chain: Interactions between Technical and Economic Dynamics and Ecological Pressures on Wildlife in Kongolo (Democratic Republic of the Congo)

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Abstract

This study examines hunting practices, trade, transport, consumption and the ecological pressures faced by the bushmeat supply chain in Kongolo. It draws on surveys, observations and documentary sources to describe the practices of the stakeholders involved and the species encountered. The study reveals a high level of dependence on bushmeat, widespread use of various hunting methods and a decline in wildlife populations, alongside trade in species protected at national level. Bushmeat is sold in the form of carcasses (47.5%) and as fresh meat (40%), and hunting areas are not subject to any closed seasons (69%), with an average of two animals taken per hunting trip (55%). It is sold at a price of 20,000 to 30,000 Congolese francs (equivalent to \$7.14 - \$10.7) for carcasses and less than 100,000 Congolese francs (equivalent to less than \$35.7) for whole game animals; transport is by land, using bicycles (for short distances) and motorbikes to transport the products to a consumption centre. Transport costs vary from one route to another, and supplies are delivered between 2 and 5 times a month (66.7%). As for the conservation status of the species consumed, the situation is a cause for concern, as eight identified species are included on the Congolese government's national list of protected wildlife and are subject to hunting and consumption (*Tragelaphus scriptus*, *Tragelaphus spekii*, *Cercopithecus spp*, *Philantomba monticola*, *Cricetomys gambianus*, *Sylvicapra grimmia*, *Thryonomys gregorianus*, and *Potamochoerus porcus*).

Keywords

Hunting, Supply Chain, Bushmeat, Wildlife, Conservation Status

1. Introduction

Village hunting in Central Africa is an activity that contributes to food security [1] as well as serving as a source of income, and is a common component of household economies in forest areas within the Congo Basin [2]. Indeed, wildlife has always played a very important economic, cultural and nutritional role for the inhabitants of this region [3]. Nevertheless, the harvesting of species across all these areas has always complied with biodiversity conservation standards, which have maintained a balance between hunting grounds and wildlife habitats [4] [5]. It is true that in other cities in Central Africa, bush meat ranks among the most expensive sources of protein; however, it is consumed for reasons of taste or for cultural reasons that remain deeply ingrained [6]-[11] and plays an important role in the nutrition of both rural and urban populations. However, current levels of harvesting are putting the most vulnerable species at risk [12].

In the Democratic Republic of the Congo (DRC), a licence is legally required to hunt, and hunting is permitted only to support the livelihoods of rural populations, not for commercial purposes. Restrictions on hunting practices have been introduced in the legislation and regulations of the countries of the Congo Basin, but these are often not enforced [1]. This activity can lead to the local extinction of the most vulnerable wild animal species and the disruption of ecological processes and biodiversity [13].

Thus, urban consumption of bushmeat generates significant income for all stakeholders in the supply chain, from hunters to end consumers, but these figures are not factored into governments' economic calculations [2]. The desire to consume bushmeat in urban areas largely mirrors rural habits [14], and this trend is evident in Kongolo, as there is a whole chain of people dependent on this resource and it is available as a product of customary value, the hunting of which involves species of least concern and is sold throughout local markets, and is not subject to any legal ban.

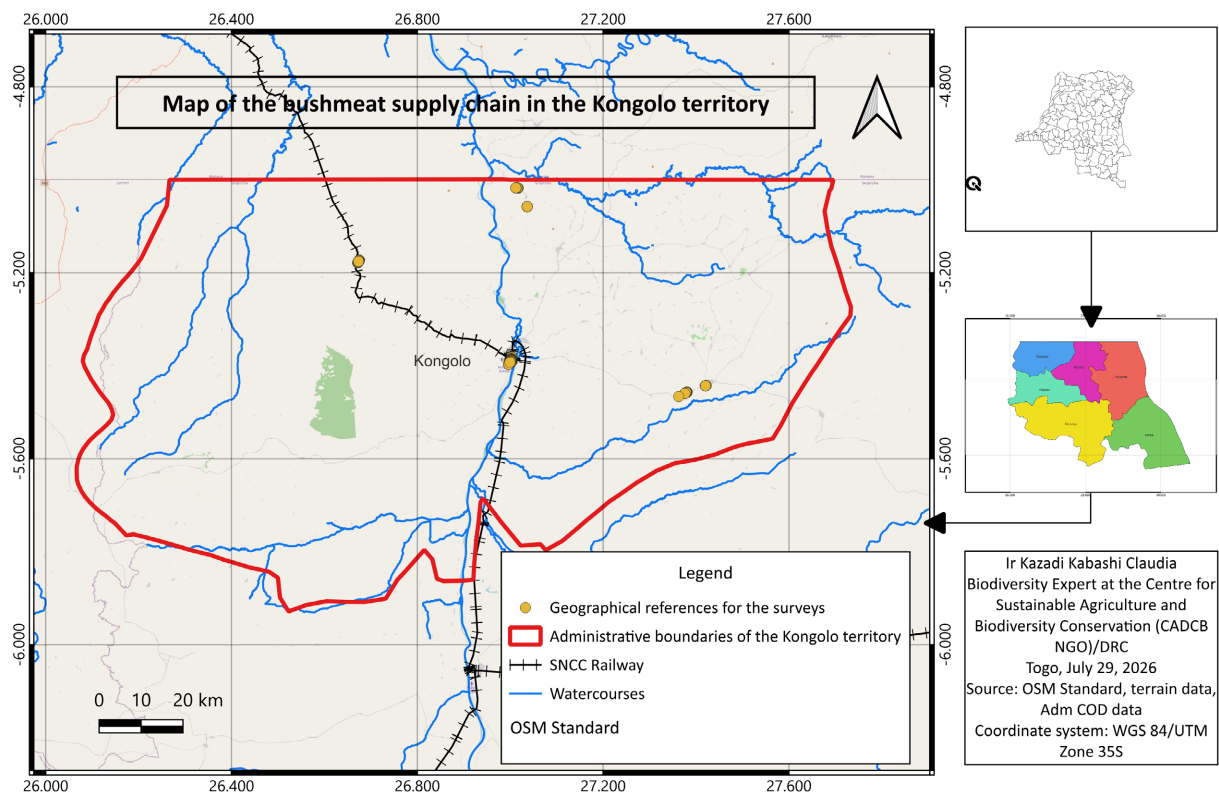
One of the major challenges is to reconcile meeting the food needs of a growing human population with the conservation of an exceptional biological heritage. This harvesting is carried out for food (personal consumption) and subsistence (income) purposes via the supply of food chains to consumption centres at varying distances [15]. This supply chain in Kongolo remains poorly understood, and hunting practices for the exploitation of wildlife remain unclear; whilst the economic challenge and traditional attachment to this bush meat also continue to drive pressure on wildlife; a recent study we published in 2025 on the conservation status of wildlife exploited in the Kongolo territory shows that species are already under pressure given their national status.

To this end, a study on this sector “Interactions between technical and economic dynamics and ecological pressures on wildlife in Kongolo (Democratic Republic of the Congo)” has been launched to seek to understand, in general terms, the structure of this sector and, specifically: to identify the technical and economic characteristics of the sector (hunters, sellers, transporters and consumers); Highlight the ecological consequences of the sector resulting from the exploitation of wildlife.

2. Study Area and Methodology

2.1. Study Area

As shown in **Figure 1**, this study was carried out in the Kongolo territory, in Tanganyika Province, in the Democratic Republic of the Congo, at a latitude of 5.38333° South (or $5^{\circ}22'60''$ S) and a longitude of 26.9833° East (or $26^{\circ}58'60''$ E). The study covered one sector and four chiefdoms, as these represent the various supply routes for bushmeat products: the Munono Sector (at the markets in the villages of Masambi and Mapenge) along the Sola route towards the northern part of the territory on the border with Maniema Province, the Bena Nyembo Chiefdom (at the markets in the villages of Mbulula and Kayungu) along the Mbulula route towards the Nyunzu territory to the east of the territory, bordering the Lwama-Katanga hunting reserve, the Lubunda Chiefdom (at the markets in the villages of Lubunda Gare and Mission) along the Lubunda road towards the



Source: Data collected by the authors, 2024.

Figure 1. Map showing the location of the survey sites.

western part of the territory, bordering Lomami National Park, the Bayashi Chiefdom (at the markets in Myamba, Mamba, Chembe Chembe and Kangoyi) in the urban centre of the territory.

Kongolo has a dry-winter savannah climate (Aw) according to the Köppen-Geiger classification and is an area with significant rainfall. Even during the driest month, there is a great deal of rain. Over the course of the year, the average temperature in Kongolo is 21.4°C and average rainfall is 708.3 mm.

2.2. Methodology

2.2.1. Study Procedure

This study employed both qualitative and quantitative approaches. A questionnaire survey, literature review and direct observations were therefore utilised. The literature review helped us to define the research question and investigate the ecology of certain animal species. The survey enabled us to gather field data (relating to hunting techniques, the bushmeat trade and ethnozoological and ecological factors). The questionnaire was designed to collect technical and economic data, as well as data on stakeholders' perceptions of the ecological pressures associated with this sector; direct observations enabled us to identify the wildlife sold as bushmeat. This approach followed the following stages: data collection, data processing and analysis, and finally interpretation.

2.2.2. Sampling Methodology

As shown in **Table 1**, non-probability sampling was used, applying three data collection techniques: snowball sampling, purposive sampling and accidental sampling at the selected site, based on the principle of convenience according to predefined criteria: for hunters, only those who hunt in the villages from which the bushmeat originates and others in the central districts of Kongolo were selected, following initial contact made during our preliminary survey as they were not within the hunting zone, Sellers were selected at random from market stalls in central Kongolo and in the various villages from which the bush meat originated, as this sales practice is not prohibited, Consumers were targeted in various neighbourhoods in the town centre and various villages, as well as at the markets, whilst they were purchasing the meat for consumption; transporters were identified

Table 1. Methodology and sampling techniques.

Stakeholders in the supply chain	Methodology	Main technique	Selection criteria
Hunters	Non-probability sampling	Snowball sampling/Judgemental sampling	Active for > 1 year
Sellers	Non-probability sampling	Accidental visitors to the chosen site/Commodity	Permanent stallholders at markets
Consumers	Non-probability sampling	Accidental visitors to the chosen site/Commodity	Household heads or customers at markets
Carriers	Non-probability sampling	Snowball sampling/Rational selection	Frequency of journeys, main transport routes.

through the hunters and vendors, who put us in touch with them.

2.2.3. Survey Data Collection

Data collection was carried out in three stages: the pre-survey, the selection of the sample and the survey itself. The pre-survey took three days, from 1 to 3 April 2024, and served to identify the various sources of bushmeat, the markets where it is sold and the consumers. Our sampling targeted hunters, sellers, consumers and transporters. Based on this information, the main surveys were conducted from 20 to 30 April 2024, a period of 10 days. As shown in **Table 2**, Interviewers

Table 2. Distribution of respondents at site level.

Sites	Categories	Number of respondents	Percentage
Masambi	Hunters	5	12.5
Mapenge		4	10
Mbulula		7	17.5
Kayungu		4	10
Lubunda		11	27.5
Kongoko town centre		9	22.5
Total		40	100
Masambi	Sellers	5	12.2
Mapenge		5	12.2
Mbulula		4	9.8
Kayungu		1	2.4
Lubunda		6	14.6
Kongoko town centre		20	48.8
Total		41	100.0
Masambi	Consumer	4	4.0
Mapenge		6	5.9
Mbulula		8	7.9
Kayungu		18	17.8
Lubunda		16	15.8
Kongoko town centre		49	48.5
Total		101	100.0
Mapenge	Conveyor	5	27.8
Lubunda		1	5.6
Central Kongolo		10	55.6
Mbulula		1	5.6
Kayungu		1	5.6
Total		18	100.0

surveyed 200 stakeholders, comprising 40 hunters in villages near hunting areas and in hunting camps, 41 vendors at various markets where game products are displayed and sold, 101 consumers in various villages, markets and neighbourhoods in the urban area, and 18 transporters who were contacted via referrals provided by the various vendors. We had a heterogeneous sample comprising stakeholders with different social characteristics, as shown in **Table 3**.

Table 3. Social characteristics of the stakeholders.

Stakeholders in the sector	Gender	N	Age	N	Marital status	N	Level of education	N	Religion	N	Tribal affiliation	N
Hunters	Male	38	Aged 18 to 35	8	Married	34	None	14	Christian	29	Songe	15
					Divorced	2			Muslim	1	Hemba	17
			Aged 36 to 60	31	Separated	1	Primary	14	African belief	2	Bangubangu	2
	Muluba	2										
	Woman	2	Over 60 years	1	Single	3	Secondary	12	Other	8	Muyazi	1
											Other	3
Sellers	Male	2	Aged 18 to 35	19	Married	36	None	10	Christian	32	Songe	7
									Hemba	11		
			Muslim	1	Bangubangu	11						
	Divorced	2			Primary	23	African belief	3	Muluba	6		
			Muyazi	2								
	Woman	39	Aged 36 to 60	22	Separated	3	Secondary	8	Other	5	Mutokakasongo	3
Other											1	
Consumers	Male	77	Aged 18 to 35	30	Married	87	None	31	Christian	82	Songe	15
					Divorced	5					Hemba	46
			Aged 36 to 60	67	Separated	5	Primary	37	African belief	6	Bangubangu	14
	Muluba	9										
	Woman	34	Over 60 years	4	Single	4	Secondary	31	Other	13	Muyazi	6
											Mutokakasongo	6
Carriers	Male	18	Aged 18 to 35	7	Married	17	None	2	Christian	13	Songe	1
											Hemba	10
			Aged 36 to 60	11	Single	1	Primary	6	African belief	1	Bangubangu	1
	Muluba	1										
	Secondary	10	Other	4	Muyazi	3						
					Mutokakasongo	2						

2.2.4. Data Analysis and Processing

The various data sets obtained were downloaded from the Kobotoolbox platform, then saved and processed in Microsoft Excel 2016 using pivot tables; the analyses focused on descriptive statistics of population sizes (relative abundance), and the graphs were generated using the software's charting tool. Species identification was carried out using various field guides: [16]: Species of Congo-Brazzaville CITES 2018; [17]: Species of Gabon CITES 2018; [18]: CITES 2018 Species of Chad; [19]: Identification Guide to Gabonese Wildlife Species Listed under the CITES Convention. Libreville, Gabon, 2012; [20]: KBA online portal; and for national conservation status (ICCN), we used [21]: the Ministerial Decree approving the list of protected animal species in the Democratic Republic of the Congo [22]: the decree relating to the implementing measures for Law No. 82-002 of 28 May 1982 regulating hunting; and for the global status (IUCN), research was conducted on the online portal of the IUCN Red List of Threatened Species [23].

3. Results

3.1. Technical Factors in Hunting

3.1.1. Type of Hunt

As shown in **Figure 2**, regarding the types of hunting practised in the Kongolo territory, 40 responses were collected for a question that allowed only one answer. Two types of hunting were identified, and the study's results show that subsistence hunting is the most common, with 26 respondents (65 per cent), followed by commercial hunting with 14 respondents (35 per cent).

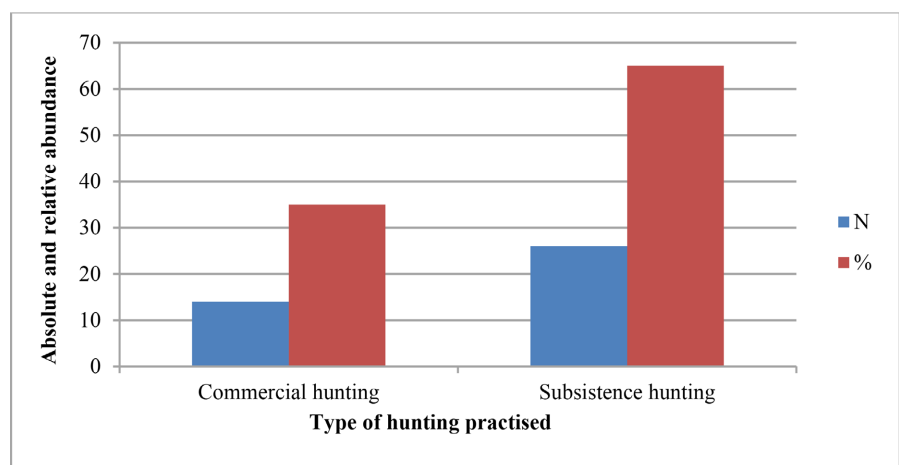


Figure 2. Diagram showing the types of hunting.

3.1.2. Hunting Techniques

As the results in **Figure 3** indicate, the interviews with hunters yielded 109 responses, as this was a question that allowed for multiple answers. The results show that hunting is predominantly carried out using a spear in conjunction with dogs, with 25 responses (22.9 per cent), followed by hunting with nylon snares, with 23 responses (21.1 per cent), hunting with wire snares (20 responses, 18.3 per cent)

and hunting nets (19 responses, 17.4 per cent), hunting with a bow (15 responses, 13.8 per cent) and, finally, hunting with firearms (7 responses, 6.4 per cent).

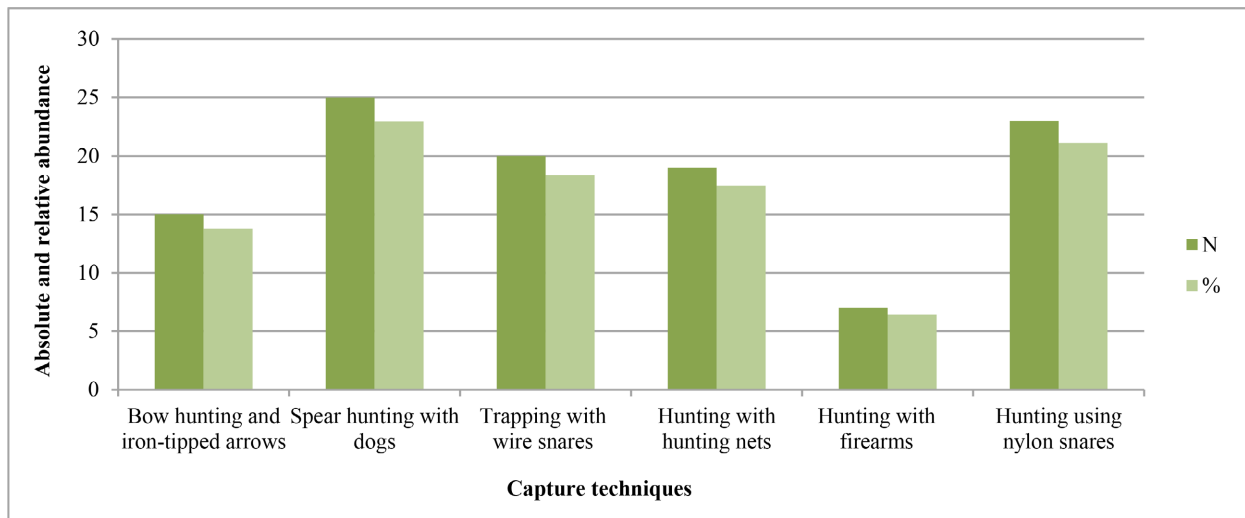


Figure 3. Diagram showing hunting capture techniques.

3.1.3. Average Catch per Hunting Trip

As shown in **Figure 4**, we received 40 responses regarding the average catch, as this was a single-answer question. The results show that the average catch per hunting trip is 2 animals (game), with 22 responses (55 per cent), followed by 3 animals (game) with 12 responses (30 per cent), 4 animals (game) with 4 responses (10 per cent) and, rarely, 1 animal (game) with 2 responses (5 per cent).

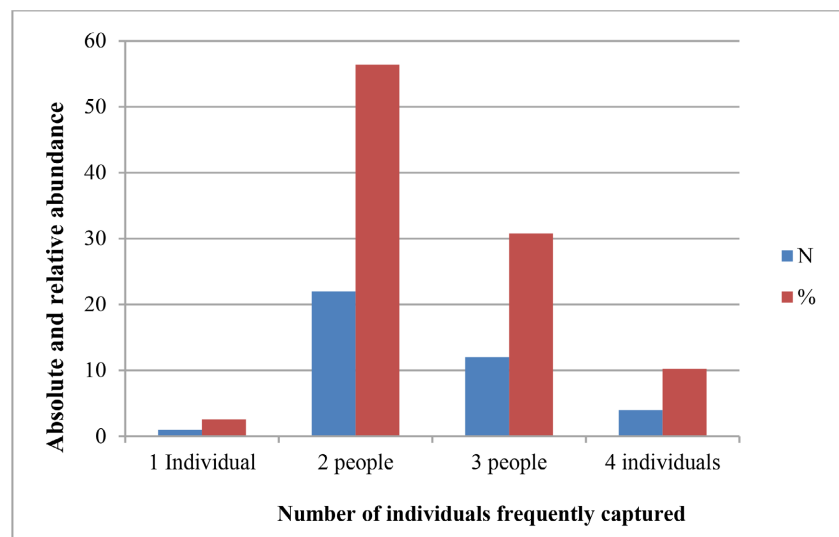


Figure 4. Graph showing the average number of game caught per hunting trip.

3.1.4. Travel Time to Reach the Hunting Location

As the results in **Figure 5** show, the journey time to the hunting location yielded 40 responses, as this was a single-answer question. The analysed data show that 33 respondents (82.5 per cent) travel for between 1 and 5 hours, 5 respondents

(12.5 per cent) travel for between 5 and 10 hours, and 2 respondents (5 per cent) take more than a day to reach the hunting location.

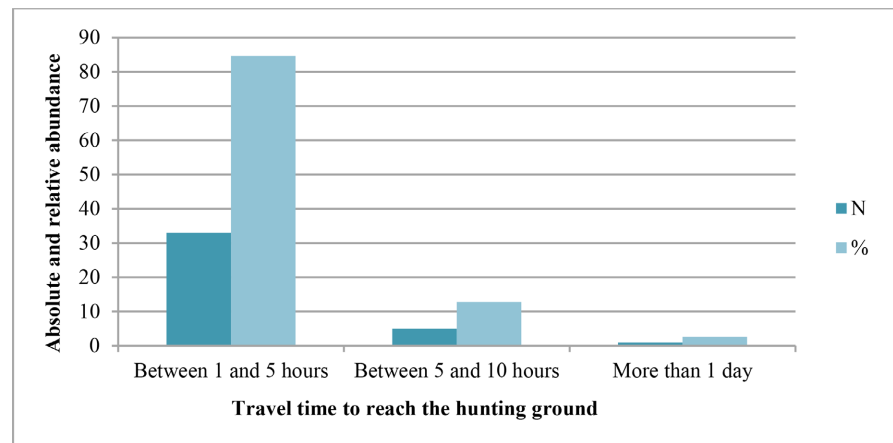


Figure 5. Graph showing the journey time to reach the hunting site.

3.1.5. The Form and Condition of Bush Meat as Described by the Respondents

The results are shown in **Figure 6**. As regards the form in which bush meat is sold, 83 responses were collected from our respondents, as this was a multiple-choice question. Hunters supply bush meat to traders in various forms; the most common form is whole carcasses, cited in 53 responses (63.9 per cent), followed by a combination of both forms (mixed) with 25 responses (30.1 per cent), and, rarely, the whole animal, with 5 responses (6 per cent).

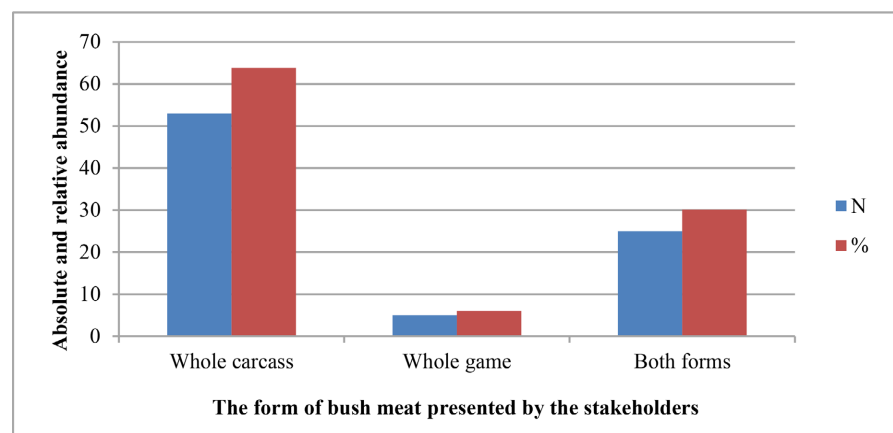


Figure 6. Diagram showing the form of bush meat presented by the stakeholders.

As shown in **Figure 7**, regarding the condition of bush meat, we collected 258 responses from our respondents, as this was a multiple-choice question. The meat is presented in four different forms, the most common being smoked meat (76 responses, 29.5 per cent), followed by dried meat (74 responses, 28.7 per cent), fresh meat (40 responses, 26.4 per cent) and, finally, roasted meat (68 responses, 15.5 per cent).

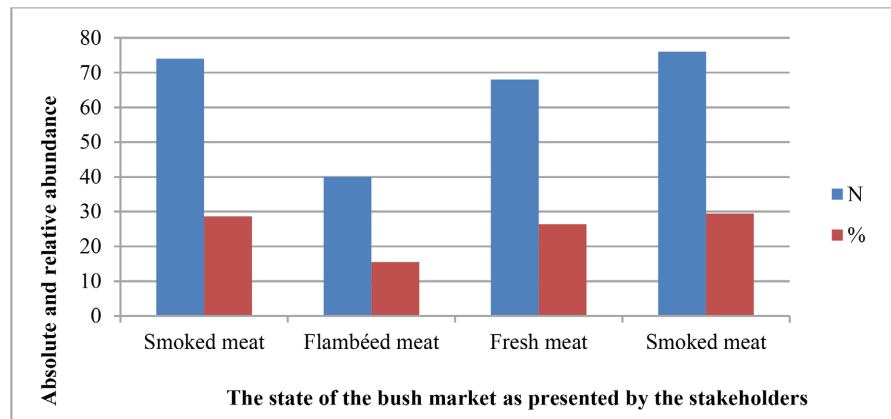


Figure 7. Diagram showing the form of bush meat as reported by the respondents.

3.1.6. The Hunting Closed Season

As shown in **Figure 8**, the question regarding the hunting closed season yielded 40 responses, as it was a single-answer question. The results show that many hunters do not observe a closed season ($N = 27$ or 69 per cent), whilst others observe it between October and December each year ($N = 13$ or 31 per cent).

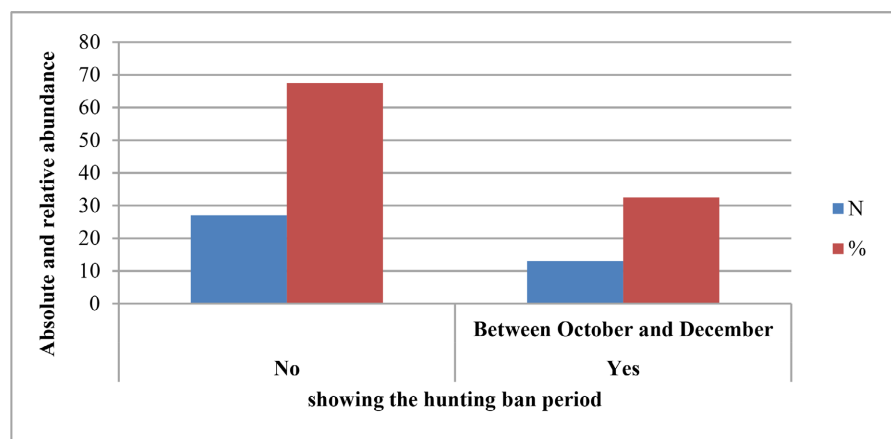


Figure 8. Chart showing the hunting ban period.

3.1.7. Alternative Activities If Bush Meat Were to Disappear

The results regarding alternative activities should bush meat were to disappear, as shown in **Figure 9**, yielded 84 responses from our respondents, as this was a multiple-choice question. The results show that 33 respondents (39.3 per cent) would turn to livestock farming, 31 respondents (36.9 per cent) would engage in trade, 12 respondents (14.3 per cent) would undertake other activities, 6 respondents (7.1 per cent) would take up farming and, finally, 2 respondents (2.4 per cent) would prefer to become civil servants.

3.2. Economic Purpose and Cultural Context of Bush Meat in Kongolo

The Sellers

1) Motivation for this profession

Regarding the motivation for this trade, we collected 84 responses from our

respondents, as shown in **Figure 10**, as this was a multiple-choice question. The results of our study show that 42 respondents (75 per cent) engage in the trade for financial gain, 12 respondents (21.4 per cent) do so out of habit, and finally 2 respondents (3.6 per cent) carry on the trade because they have inherited it.

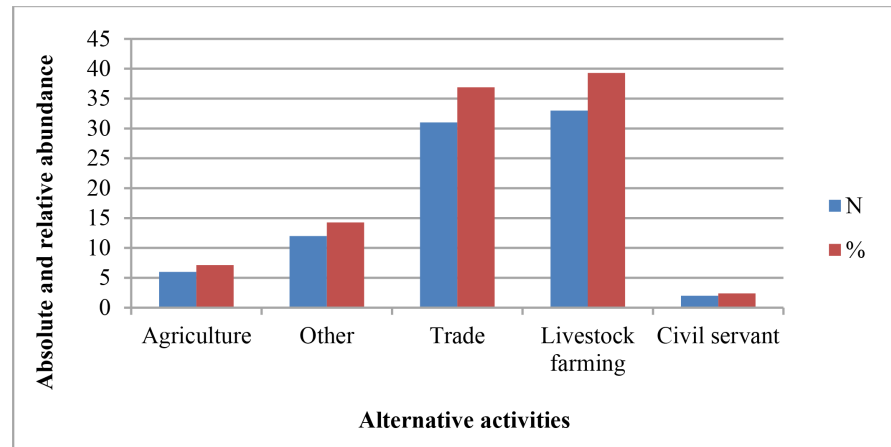


Figure 9. Alternative activities if bush meat were to disappear.

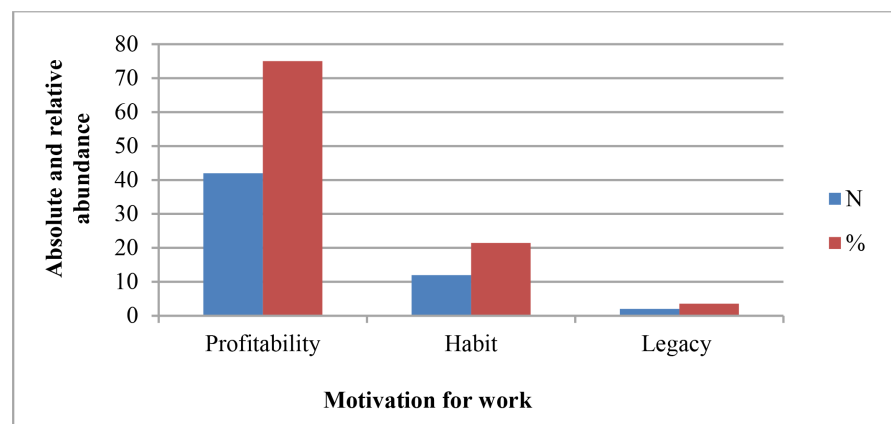


Figure 10. The motivations of stakeholders for bushmeat harvesting.

2) The price of bush meat carcasses and whole game

As shown in **Figure 11** and **Figure 12**, the selling price of bush meat carcasses and whole game: on this question, we received 41 responses from our respondents, as it was a single-answer question. The results show that carcass meat ranks first, with average prices ranging from 20,000 Fc to 30,000 Fc ($N = 21$) or (62 per cent), followed by prices ranging from 30,000 Fc to 40,000 Fc ($N = 7$) or (20 per cent), between 10,000 Fc and 20,000 Fc ($N = 3$) or (9 per cent), less than 10,000 Fc ($N = 2$) or (6 per cent) and, rarely, for more than 50,000 Fc ($N = 1$) or (3 per cent), whilst whole game carcasses are sold for less than 100,000 Fc ($N = 7$) or (100 per cent).

3.3. Transporters

3.3.1. Methods and Means of Transporting Bush Meat

To understand how bush meat is transported, we examined the routes and means

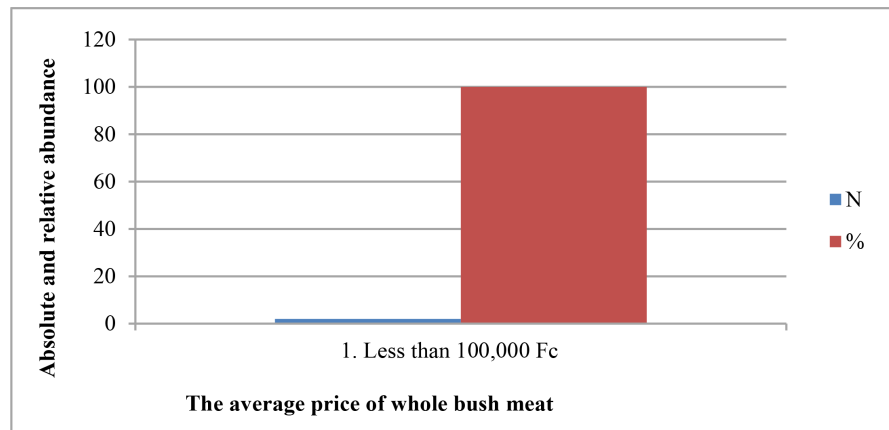


Figure 11. Diagram showing the prices of bush meat carcasses sold.

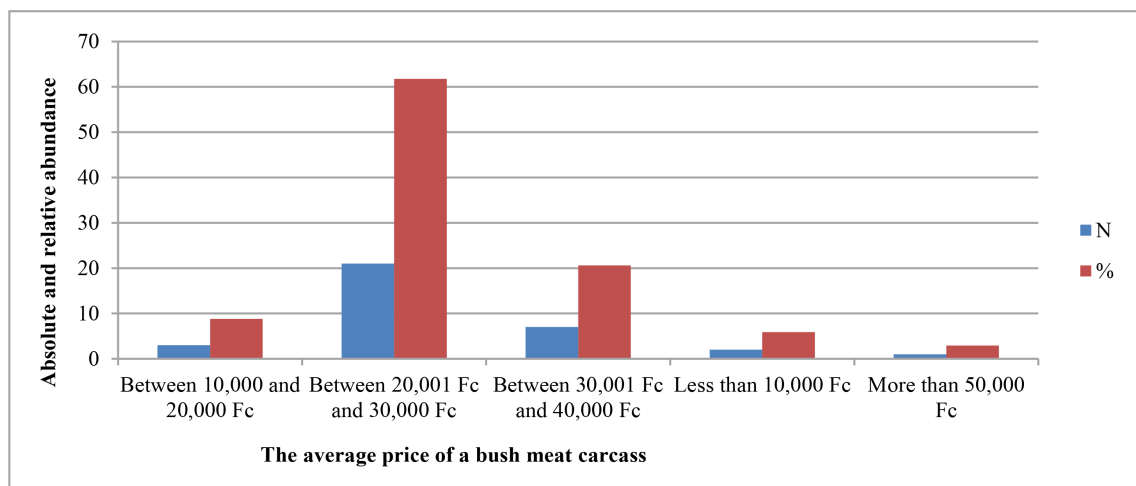


Figure 12. Diagram showing the price and whole carcass weight of bush meat sold.

of transport used to move bush meat. We received 18 responses to the survey, as this was a single-answer question. It is generally transported by land, with 11 respondents (61 per cent) using a bicycle as their mode of transport, on average 2 to 5 times a month, and 7 respondents (39 per cent) using a motorbike, on average 2 to 5 times a month, as shown in **Figure 13**.

3.3.2. Type of Packaging Used for Transporting Bush Meat

Regarding the type of packaging, 27 responses were collected from our respondents. Various types of packaging were cited by the transporters: as shown in **Figure 14**, they use different types of packaging to transport bush meat: the carrier bag, with 13 responses (48 per cent), followed by the woven basket with 7 responses (26 per cent), the wire mesh cage with 6 responses (22 per cent) and, finally, the travel bag with 1 respondent (4 per cent).

3.3.3. Transport Costs by Route of Origin of Bush Meat

Regarding transport costs, we collected 40 responses from respondents as this was a multiple-choice question. The results show that the cost of transport depends

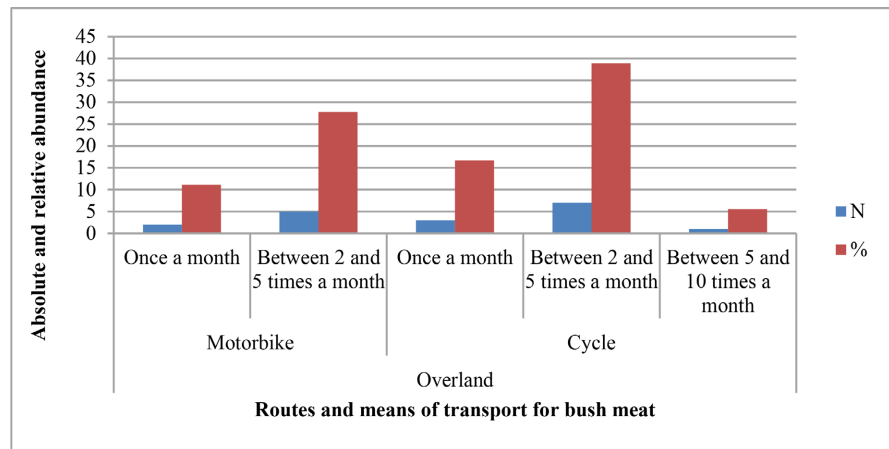


Figure 13. Diagram showing routes and means of transport for bush meat.

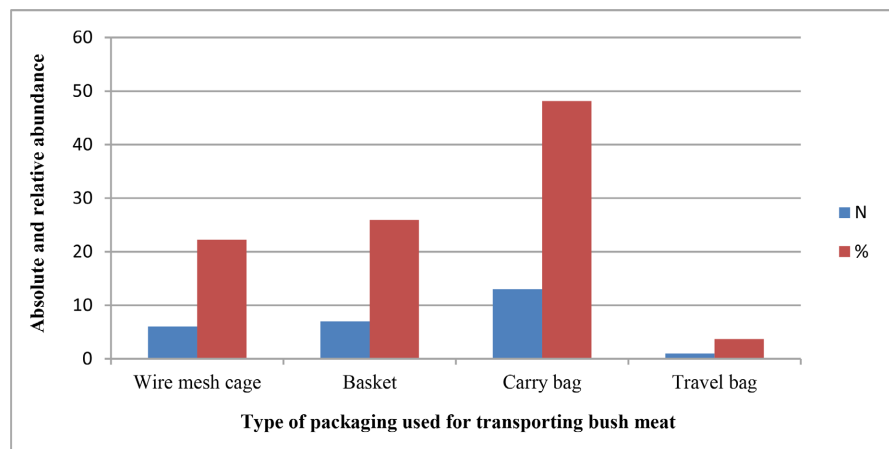


Figure 14. Diagram showing the type of packaging used for transporting bush meat.

on the route: for the Kateya-Kongolo route, it ranges from 60,000 to 90,000 Fc, with 1 response (100 per cent); and on the Lubunda-Kongolo route, the cost ranges from 30,000 to 60,000 Fc, with 10 responses (83.3 per cent) and less than 30,000 Fc with 2 responses (16.7 per cent); on the Mbulula-Kongolo route, the price ranges from 30,000 to 60,000 Fc with 8 responses (80 per cent), 60,000 to 90,000 Fc with 1 response (10 per cent) and less than 30,000 Fc with 1 response (10 per cent). On the Munono-Kongolo route, the fare is 30,000 to 60,000 Fc with 12 responses (87.5 per cent), 60,000 to 90,000 FC with 1 response (7.1 per cent) and under 30,000 FC with 1 response (7.1 per cent); on the Sola-Kongolo route, the price is less than 30,000 FC with 2 responses (66.6 per cent) and 30,000 to 60,000 FC with 1 response (33.3 per cent), as shown in **Figure 15**.

3.4. Consumers

3.4.1. Motivations for Consuming Bush Meat

We received 104 responses regarding the motivation for consuming bush meat, as this was a multiple-choice question. As the results shown in **Figure 16** indicate, there are two main reasons motivating consumers of bush meat: predominantly

for the taste, with 101 responses (97 per cent), and rarely for its aphrodisiac properties, with 3 responses (3 per cent).

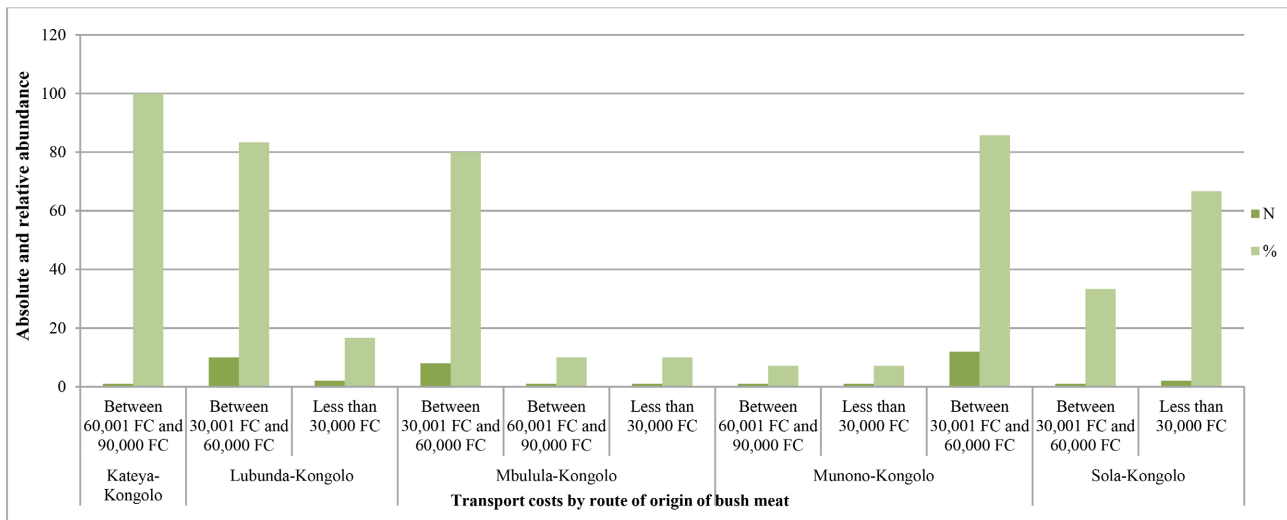


Figure 15. Graph showing transport costs by route of origin of bushmeat.

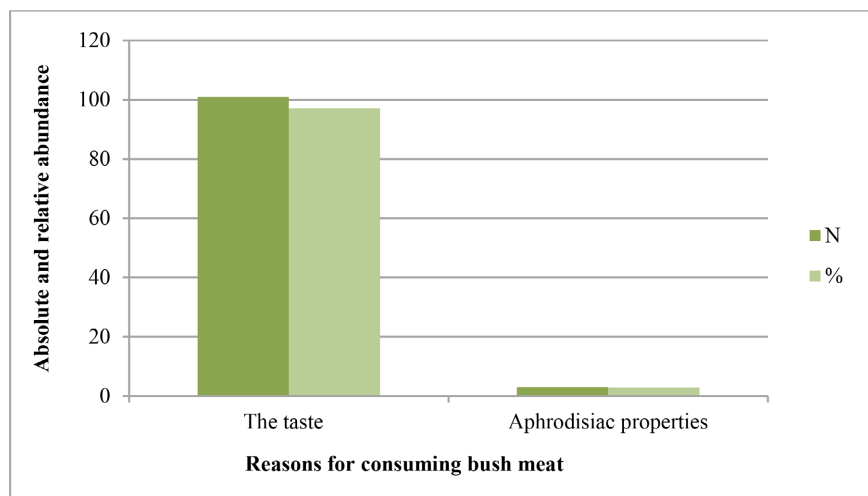


Figure 16. Diagram showing the reasons for consuming bush meat.

3.4.2. Weekly Frequency of Bush Meat Consumption

We received 101 responses regarding the frequency of bush meat consumption, as this was a single-answer question. As the results in **Figure 17** show, 68 respondents (67 per cent) eat bush meat more than once a week, followed by 27 respondents (27 per cent) who eat it twice a week, and finally 6 respondents (6 per cent) who eat it three times a week.

3.4.3. Prohibitions on the Consumption of Bush Meat

Following interviews with consumers, we collected 101 responses as the question had a single choice of answer. As shown in **Figure 18**, the results show that many consumers are unaware of any taboos regarding the consumption of a particular species as bush meat, with 78 responses (77 per cent), whilst the remaining 23

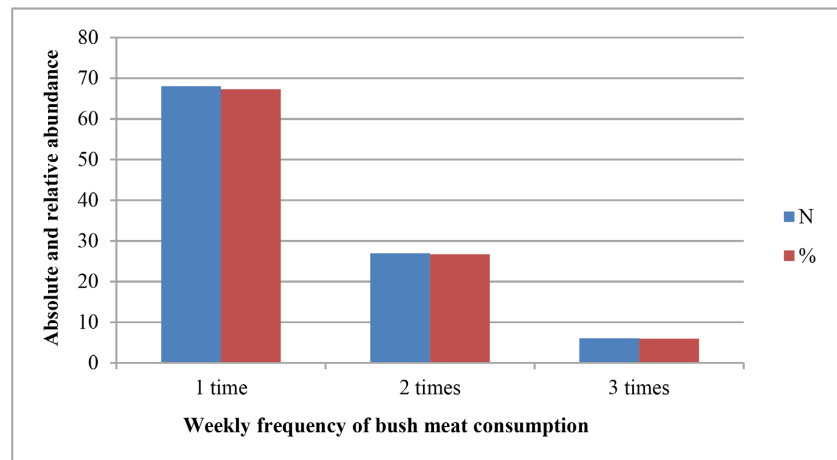


Figure 17. Diagram showing the weekly frequency of bush meat consumption.

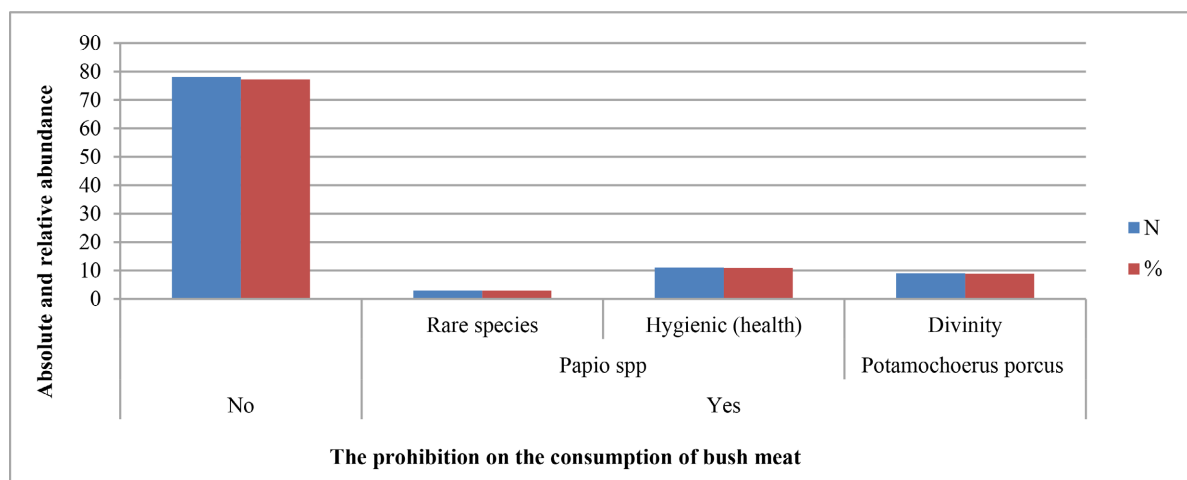


Figure 18. Graph showing restrictions on the consumption of bush meat.

responses (23 per cent) cited taboos for different species (*Papio spp.* and *Potamochoerus porcus*) and for various reasons (rare species, religious beliefs, and hygiene or health).

3.5. The Ecological Consequences of Hunting on Wildlife

3.5.1. Assessment of Species Availability among Hunters

As shown in **Figure 19**, the assessment of game species availability among hunters yielded 40 responses, as this question offered a single-choice answer. The results, based on the accounts of the hunters contacted, show that game species have become scarce, with 21 respondents (52 per cent) citing several reasons: deforestation, with 10 responses (25 per cent), followed by a decline in game populations, with 6 responses (15 per cent), and finally an increase in the number of hunters, with 5 responses (12.5 per cent); and secondly, the scarcity of game, cited by 19 respondents (48 per cent) for several reasons: deforestation, with 13 responses (32.5 per cent), followed by a decline in game populations, with 4 responses (10 per cent), and finally an increase in the number of hunters, with 2 responses (5 per cent).

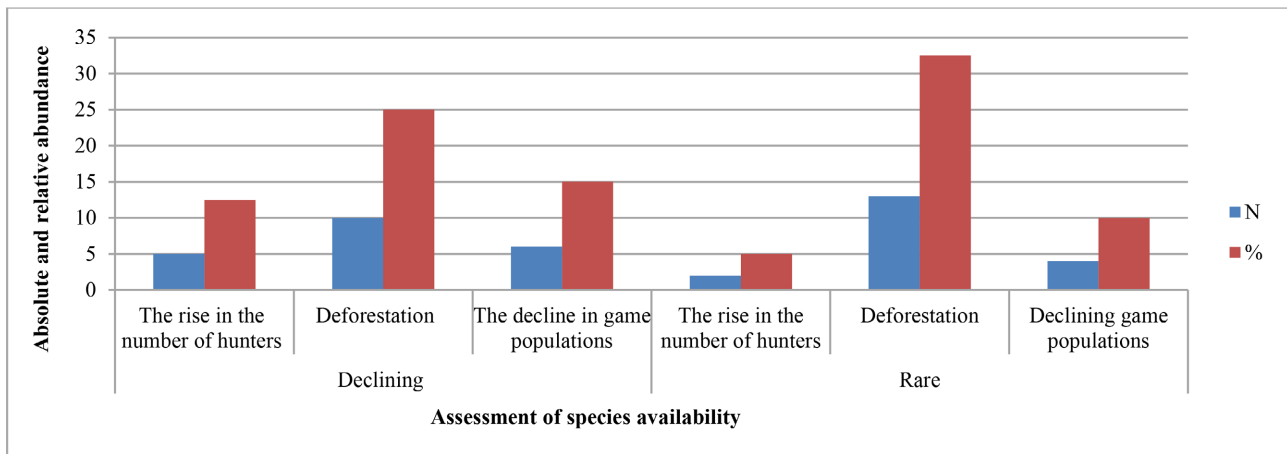


Figure 19. Chart showing the assessment of species availability.

3.5.2. Species Harvested by Stakeholders

Various carcasses and whole game animals were counted and recorded; a total of 496 observations of carcasses and whole game animals were noted amongst the stakeholders during our surveys. As shown in **Table 4**, the results regarding the species found indicate that *Tragelaphus scriptus* was the most common, with 202 observations; this species is fully protected by the ICCN and classified as of Least Concern by the IUCN. It was followed by *Thryonomys gregorianus*, and *Potamochoerus porcus*, with 90 observations, and classified as “Partially protected” by the ICCN and “Least Concern” by the IUCN; *Papio spp.* with 58 records (11.7 per cent), which are “Unprotected” according to the ICCN and “Least Concern” according to the IUCN; *Sylvicapra grimmia* with 42 sightings, which is a “Partially Protected” species according to the ICCN and of “Least Concern” for the IUCN; *Philantomba monticola* with 6 sightings, which is “Partially Protected” by the

Table 4. Table of species collected and their conservation statuses.

Common name in French	Local name	Scientific name	ICCN status	IUCN status	N	%
Monkey	Makako	<i>Cercopithecus spp</i>	PP	LC	2	0.4
Blue Cephalophe	Mbuluku	<i>Philantomba monticola</i>	PP	LC	6	1.2
Gambian giant rat	Nyama na mbabu	<i>Cricetomys gambianus</i>	PP	LC	2	0.4
Water guib	Pongo Maziba	<i>Tragelaphus speki</i>	TP	LC	4	0.8
Grimm’s duiker	Swala	<i>Sylvicapra grimmia</i>	PP	LC	42	8.5
Aulacode	Simbiliki	<i>Thryonomys gregorianus</i>	PP	LC	90	18.1
Harnessed guib	Pongo	<i>Tragelaphus scriptus</i>	TP	LC	202	40.7
Baboon	Soko mutu	<i>Papio spp</i>	N/A	LC	58	11.7
Red river hog	Nguruwe wa pori	<i>Potamochoerus porcus</i>	PP	LC	90	18.1
Total					496	100

Key: PP: Partially protected, TP: Fully protected, NP: Unprotected, LC: Least Concern.

ICCN and of “Least Concern” for the IUCN; *Tragelaphus spekii*, with 4 sightings (0.8 per cent), which is fully protected by the ICCN and classified as of Least Concern by the IUCN; and finally, *Cricetomys gambianus*, with 2 sightings (0.4 per cent), which is partially protected by the ICCN and classified as of Least Concern by the IUCN.

4. Discussion

4.1. Technical Factors Relating to Hunting

Two types of hunting have been identified in the Kongolo region, in contrast to Cameroon, where a study identified three: subsistence hunting, commercial hunting and sport hunting [24]. Subsistence hunting generally involves the taking of wildlife species for consumption within the community [25] [26]. Subsistence hunting, the impact of which was once negligible, has now evolved into commercial hunting that is harmful to game species [27]. For hunters, the distinction between subsistence hunting and commercial hunting is often blurred, given that hunting contributes to both food supply and income [28]. With these significant changes, subsistence hunting has become non-selective, targeting species once prohibited by social norms, taboos, customs and totems [29]; and from the moment the surplus of hunted game was incorporated into the local commercial circuit, hunting pressure has intensified, mainly due to the increase in human population, the refinement of hunting tools and the loss of cultural practices amongst communities living around hunting grounds [30]-[32].

Hunting in Kongolo employs various hunting techniques, reflecting an activity characterised by diverse yet rudimentary methods; in contrast, in other regions such as Cameroon, commercial hunters use sophisticated weapons and operate with the support of administrative and political elites [13]. Focused solely on sales and profit, commercial hunting has become a dangerous practice for wildlife, as hunters target large species that can provide a significant amount of marketable meat [32]. In Kongolo, hunting takes place not far from the villages, which reduces the travel time to the hunting grounds; however, commercial hunting requires travelling long distances.

To this end, bush meat in Kongolo is often sold in various forms and states, but rarely as whole carcasses, as large game animals need to be butchered to facilitate transport, whilst whole carcasses are more commonly found amongst smaller game animals, in various states, though less frequently in a smoked state. This method improves preservation and facilitates transport to urban areas. Unfortunately, in Kisangani, most consumers (surveyed) prefer to eat bush meat fresh; in their view, in this state, the animal still retains all its nutritional properties and the meat tastes good [33]. In the CAR, bush meat has a short shelf life [34]; fresh meat keeps for only one to two days in tropical climatic conditions. It is therefore important to improve preservation either through smoking (drying over a low heat in a stream of hot, smoky air) or through freezing [34]-[36]. Smoke-drying is the method most commonly adopted in Central Africa, driven more by necessity than

by consumer preference [35] [36].

It is clear that hunting does not follow a closed-season rotation in one part of the study area, whilst in another area it takes place from October to December and appears to be less prevalent compared with the study area as a whole. This lack of a rest period for the forests is observed in many areas where the disappearance of traditional hunting methods (for example, the rotation of hunting zones) allows unrestricted access to wildlife resources and their concentration areas, with negative consequences for the sustainability of hunting [28].

4.2. Economic Purpose and Cultural Context of Bushmeat

For commercial purposes, the bush meat found on the local market is predominantly sold in smoked form, cut into pieces, at an average selling price of 20,000 to 30,000 Fc (equivalent to \$7.14 - \$10.7 at the 2024 exchange rate) for carcasses, and less than 100,000 Fc (equivalent to less than \$35.7 at the 2024 exchange rate) for whole game animals. The selling prices of bush meat in urban areas depend on a wide range of factors, such as the species, the condition (fresh or smoked), the degree of processing, the quantities available and the quality of the meat [2]. According to [33], the consumption of bush meat in Kisangani and Yangambi is influenced by several factors, including price, culture, religion, etc., as the price charged for bush meat is significantly lower than the price of a kilogram of beef (12,000 Congolese francs, or approximately 8 US dollars at the 2019 exchange rate). The price of bush meat, when compared with other sources of protein, influences its consumption [6]. In certain areas where there is a preference for smoked and fresh meat, it is therefore important to improve preservation methods, either through smoking (drying over a low heat in a stream of hot, smoky air) or by freezing.

Consequently, the main mode of transport for distributing the meat is generally by land, using bicycles and motorbikes to transport the products to a consumption centre. Transport costs vary from one route to another depending on the distance from the centre of Kongolo (the Kongolo-Kateya, Kongolo-Sola, Kongolo-Mbulula, Kongolo-Monono and Kongolo-Lubunda routes), and supplies are delivered between two and five times a month. In Gabon and Cameroon, once out of the forest, bush meat is then transported by all available modern means (motorised canoes, lorries, bush buses or trains). As a general rule, the product is transported by the collector, due to the risk of theft and, above all, to sort out the various “arrangements” necessary for the transit of this product, whose legal status is unclear [34]. Game meat arrives in Brazzaville via six main routes. These consist of three land routes (National Roads 1 and 2, and the Mayama Road), the railway, the waterway and the air route. There are no suitable vehicles allocated to the transport of bush meat, and current transport conditions are not appropriate for the transport of this foodstuff intended for consumption [2].

To this end, the consumption of bush meat is a matter of taste for the inhabitants of Kongolo and is a traditional food for which there is no substitute. As noted

by [37], the consumption of bush meat is primarily explained by its biological qualities and the social habits of the consumers, which makes the issue of bush meat consumption even more complex. In Gabon, bush meat is prized for reasons such as its taste, dietary habits and cultural attachment [38] [39]. It is consumed during festive ceremonies and to satisfy personal cravings, whilst its by-products are used as traditional remedies [38] [40] [41]. The Kongolo community does not have many dietary taboos, but certain meats are forbidden for various reasons (deity, hygiene, endangered species), and we observe that this meat features weekly in the community's dishes, which demonstrates a social attachment to it. In Gabon, certain bush meats are also prohibited for consumption because they are fully protected species or totems [42]. In contrast to Kisangani, which is facing a decline, if not the disappearance, of wild animals in the area, cultural values are no longer strictly observed in dietary practices, and dietary taboos are being abandoned [43].

4.3. Ecological Consequences for Harvested Wildlife

Today, respondents' perceptions regarding the availability of species are cause for concern, as game has become scarce and is in decline due to human activities (deforestation), whilst hunting areas remain open, with an estimated average catch of two individuals per hunting trip, as demonstrated by [33]; the loss of forest cover and, consequently, the disappearance of certain animal species are believed to be at the root of the changes in Yangambi. According to [44], whilst hunting is considered one of the main drivers of overexploitation, logging also contributes to it. Numerous assessments of wildlife sustainability in the tropical forests of the African region have highlighted the increasing unsustainability of hunting and its associated ecological impacts [45]. It is therefore urgent to control the removal of wildlife species across the various regions [2]. Although humans have been hunting in the forests of Central Africa for millennia, there are several reasons why hunting is not a sustainable activity everywhere and for all species [9].

As for the conservation status of the species identified by the stakeholders, the situation is a cause for concern, as the majority of the species being exploited are included on the Congolese government's list of protected wildlife (*Tragelaphus scriptus*, *Tragelaphus spekii*) and are fully protected species (*Cercopithecus spp.*, *Philantomba monticola*, *Cricetomys gambianus*, *Sylvicapra grimmia*, *Thryonomys gregorianus*, and *Potamochoerus porcus*) are partially protected species; their consumption reflects a strong attachment to this meat and requires regulation to ensure compliance with law enforcement measures in this part of the country. As regards their global status, the entire list is not of conservation concern. Wildlife is exploited, but according to the local perception of respondents in this part of the country, species are beginning to decline and become scarce. According to [33], it is recommended to discourage the consumption of threatened species, whilst permitting the harvesting of more resilient species, to promote the formal trade in these species, and to seek alternative sources of protein for local popula-

tions, as the forest is being depleted, indeed, even species listed on the IUCN Red List are being consumed as bushmeat in the Yangambi and Kisangani areas. In tropical forests, three major challenges arise in relation to the consumption of bushmeat: the loss of biodiversity due to overexploitation, the socio-economic dependence of local communities on this resource, and the risks of zoonotic diseases (Ebola, HIV, Lassa, etc.). These issues require a comprehensive approach that integrates ecological, social and health dimensions [46]. Thus, throughout tropical Africa, the excessive hunting of wildlife for consumption remains a difficult problem, whilst donors and governments continue to commit to investing in the conservation and sustainable use of nature [47]. Across the tropical region, this shift from subsistence hunting to commercial hunting is attracting significant attention from decision-makers, as the socio-economic needs of hunters have increased, with adverse consequences for wildlife ecology; various once-resilient species have become rare, and hunting now targets species that are protected by law.

Nine species of mammals have been identified in the Kongolo area as commonly hunted species, reflecting the population's reliance on this source of protein. However, across Central and West Africa as a whole, around 129 species of vertebrates are consumed, including 91 mammals; duikers account for more than a third of the animals hunted, followed by rodents, primates and antelopes [46]. In Kisangani and Yangambi, several species are consumed, but the most commonly cited are the African atherure (*Atherurus africanus*), duikers (*Cephalophus dorsalis*, *Cephalophus nigrifrons* and *Philantomba monticola*), the Gambian rat (*Cricetomys emini*) and the potamochoere (*Potamochoerus porcus*) [33]. Thus, whilst it is true that the depletion of wildlife resources in Kongolo is much more closely linked to issues of deforestation, for the sake of food security and the livelihoods of the inhabitants of the Kongolo territory, they have so far continued to rely largely on resilient species, which do not pose a major threat. According to [2], these dependent populations would be adversely affected if these wildlife resources were to be completely depleted; they would also suffer in the event of a total ban on hunting and trade if no alternative solutions were offered.

5. Conclusions

The aim of this study was to investigate the structure of the bushmeat supply chain in Kongolo and, specifically: to identify the technical and economic characteristics of the supply chain; and to highlight the ecological consequences of the supply chain resulting from the exploitation of wildlife.

The findings indicate that commercial hunting is much more widespread in Kongolo and takes place not far from the villages, as hunters spend less time travelling to reach the hunting grounds. It involves the use of various trapping equipment and different techniques, which incur additional financial costs. These practices pose a constant threat to wildlife ecology, as they are non-selective and unsustainable for the conservation and survival of our tropical forests. Bush meat is often sold in various forms, but rarely as whole carcasses, as large game must be

butchered to facilitate transport. Transport is generally by land, using bicycles and motorbikes to take the produce to a consumption centre. Transport costs vary from one route to another depending on the distance from the centre of Kongolo. The consumption of bushmeat is a matter of taste for the inhabitants of Kongolo and is a traditional food for which there is no substitute. Among the species harvested, the majority are protected under Congolese law; only one species enjoys no protection under Congolese law, and according to the IUCN, the entire list of species is classified as “Least Concern”. However, the situation could change if this consumption continues to target species protected by national or international law; it may be exacerbated by demand and the fact that it is regarded as a traditional food, with few dietary restrictions based on religious, hygiene, health or conservation grounds.

The Congolese government must take action to ensure compliance with Congolese hunting legislation and plan rapid interventions to raise awareness and introduce alternative livelihoods for communities living near tropical forests, thereby safeguarding their food security and promoting sustainable hunting in accordance with Congolese standards, including the requirement for hunting licences to ensure compliance with biodiversity conservation legislation.

Author Contributions

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Photo Appendix



Bush meat in Kongolo, sold by a vendor



Bush meat in Kongolo, sold by a vendor



Bush meat in Kongolo sold by a vendor



Bush meat in Kongolo: a vendor on the left and a transporter on the right



Bush meat in Kongolo sold by a vendor



Bush meat in Kongolo from a vendor



Bush meat in Kongolo from a vendor



Bush meat in Kongolo, sold by a vendor at the market



Bush meat in Kongolo from a vendor on the left and nylon lines from a hunter on the right