

# Ethnozoology, an Approach to the Conservation of Mammalian Wildlife. Case of the Itombwe Nature Reserve (INR), South Kivu, DR Congo

Olivier-Serval Mushagalusa Mutula<sup>1,2,3</sup><sup>\*</sup>, Robert Chira Mutugi<sup>1</sup>, John Githaiga<sup>1</sup>, John Kalume<sup>2,3</sup>, Charles Kahindo Muzusangabo<sup>2</sup>

<sup>1</sup>University of Nairobi (UON), Nairobi, Kenya

<sup>2</sup>Université Officielle de Bukavu (UOB), Bukavu, DR Congo

<sup>3</sup>Centre de Recherche en Ecologie et Gestion des Ecosystèmes Terrestre (CREGET), Bukavu, DR Congo

Email: \*mushaserval@gmail.com

**How to cite this paper:** Mutula, O.-S.M., Mutugi, R.C., Githaiga, J., Kalume, J. and Muzusangabo, C.K. (2025) Ethnozoology, an Approach to the Conservation of Mammalian Wildlife. Case of the Itombwe Nature Reserve (INR), South Kivu, DR Congo. *Natural Resources*, 16, 133-152.

<https://doi.org/10.4236/nr.2025.164007>

**Received:** November 26, 2024

**Accepted:** April 18, 2025

**Published:** April 21, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

Throughout the world's long history, the protection of nature has been inscribed by populations as an essence that enables them to understand it and remain in close collaboration with it. The Itombwe Nature Reserve, in South Kivu in the Democratic Republic of Congo, is home to the ethnically diverse Bantu and Batwa peoples. Their vast ethnozoological knowledge demonstrates their tenacity to contribute effectively to the conservation of mammalian fauna, in addition to other important aspects of the management and preservation of biodiversity. Through interviews with professional hunters and bushmeat sellers, we identified the concept of use that combines the perceptions and activities of the people of the Itombwe Nature Reserve. A list drawn up of the mammalian fauna in a grid area within a radius of 4 Km<sup>2</sup> shows 43 species divided into 9 orders, including 11 Rodentia, 10 Afrosoricida, 9 Carnivora, 7 Primates, 2 Pholidotes, 1 Cetarthiodactyla, 1 Carniformia, 1 Hydracoidae and 1 Proboscidea. Among these families, the small Rodentia mammal, *Cricetomis emini*, is widely observed. It should be noted that one species is Critically Endangered (CR), 6 Vulnerable (VU), 3 Endangered (EN), 3 Near Threatened (NT) and 30 of Least Concern (LC). Wild mammals are used in the Itombwe Nature Reserve firstly for food, then medicinally (zootherapy) and finally culturally (superstition, amulets, sacredness, taboo, ceremonial use). Taking into account the diversity index (species per mesh), particular attention should be paid to the Malambo, maternities in the local language, located in Mandja, Kitopo, Ngusa and Miki. Ethnozoology's use of wild mam-

mals in the Nature Reserve landscape is proving to be a strategic conservation approach that must be combined to motivate communities to become more involved and to perpetuate their know-how and their interaction with mammalian fauna.

## Keywords

Ethnozoology, Mammalian Wildlife, Conservation, Itombwe Nature Reserve

---

## 1. Introduction

The protection of nature throughout the world has a long history of conserving biodiversity, making reference to human-nature interactions.

Since the chronological tracing of history, it has been found that the ancestors of humans by necessity have meticulously expressed a particular sense to probe nature to increase their chance of survival. Thus, the animals that aroused interest, then became targets of human observation, causing a fundamental cultivated emergence that generated knowledge in zoology, allowing not only to directly exploit animals but also to interact closely in a complementary and equitable manner in the interactions of the natural cycle [1]-[4].

It is demonstrated that the knowledge pronounced on the fauna by indigenous peoples through hunters, guardians of custom, fishermen, breeders, ... who interact more frequently with animals, has attracted the pioneer naturalist philosophers to recognize through their writings these indigenous skills to make zoology emerge as a science by making an essential contribution to the construction of various cases, including the localization, collection, preparation and preservation of new and known animal species [5]-[7] as well as various aspects of animal biology by supporting scientific studies related to fauna.

Although some scholars argue that Indigenous peoples' knowledge in academic research is inaccurate [8] [9], it is increasingly and officially claimed that the applicability of this knowledge of indigenous peoples has many advantages that effectively allow us to understand and respond to ecological problems, intensifying the hazards of conservation in contemporary research [10]-[12].

The important mediators of dialogues in this scenario between indigenous peoples' knowledge and scientific knowledge in a collaborative framework, is presented by ethnozoology. On this, by community perceptions through analysis and interviews with hunters, bushmeat sellers and customary guardians are presented as the basis of the conservation of mammalian wildlife species in the Itombwe Nature Reserve.

This study aims, through the ethnozoological approach, to assess the diversity and relative abundance of mammalian wildlife in the Itombwe Nature Reserve with a view to contributing to the establishment of reference data for conservation.



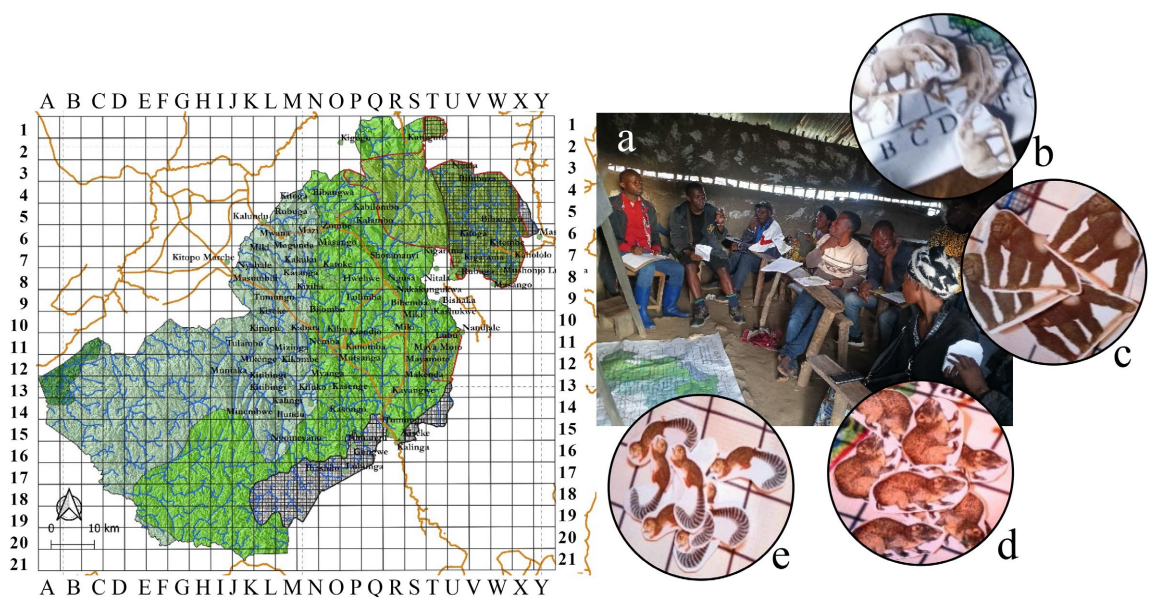
### 2.2.1. Ethnozoological Surveys

Nowadays, many species have become cryptic due to observed pressures, leading to the scarcity of wild mammalian fauna that was once observed directly. As a result, indirect techniques become more advisable to allow the collection of information more quickly with irrefutable clues to inventory most mammals [14]-[16]. As part of this study, ethnozoological surveys were organized among people previously informed of the exercise.

Species identification activities were carried out in a structured manner, in several stages combined and oriented to increase the viability of the data in environments where the supply of bushmeat is very frequent.

Two focus group sessions involving 20 people, a mix of hunters and bushmeat sellers, were held in the villages of Wamuzimu and Kitutu. The species list was based on Doumenge's 1996 list of up to 56 mammalian species, but after these discussions, 43 species were identified. The species classification is supported by images of species from *The Kingdon field guides to African mammals* (2015).

Meetings with hunters for semi-structured interviews (one-on-one) allowed us, through a limited list written in the local language, to strengthen reliability on the level of local knowledge of the species, their places of supply in the INR, and the interviewees' use and perception of the INR. The selection of respondents was based on snowball sampling and stopped when we saw repetition in the interview responses [17] [18].



a. Focus group on the spatialization and use of mammals; b. *Loxondonta africana* (Njoku); c. *Gorilla gorilla* (Igwidu); d. *Dendrohydrax arboreus* (Mubinga); e. *Helioscirus rufobrachium* (Kisindi).

**Figure 2.** Mesh map for identifying mammal species in the RNI landscape.

And finally, we drew the spatialization of species, based on existing maps of the INR with small village groupings within it; we distributed each species, one by one, cited by previous surveys in approaches, by name of villages or a known place

and this in a third focus group only axis on the distribution of species, the choice of focus, allowed us to avoid bias, because the choice of the place of observation of a species depended on a decision after a discussion with hunting professionals gathered together [15].

For the distribution of the species (**Figure 2**), a grid of 4 Km<sup>2</sup> grid cells, with numbers on the abscissa and letters on the ordinate, was superimposed on the previously prepared map, and a centroid was placed in each grid cell. In this case, a species X cited in the Katoke sites and located in grid N7, while a species cited in the Kalundu site and located in grid K5 [19]-[21].

### 2.2.2. Data Analysis

Data were collected through interviews based on a structured questionnaire administered using Kobocollect. At the end of the data collection activities, the data were transferred from the database to the Microsoft Excel spreadsheet for statistical analysis.

Statistical analysis was carried out with the assistance of RStudio (version 4.3.0, 2023), to produce explanatory analysis graphs on qualitative and quantitative data. Statistical analysis data on biological indicators were exported into QGIS to produce maps of species distribution in the INR, as cited by hunters on species richness, which represents the number of species cited in the area, dominance

$$\left( D = 1 - \left( \frac{\sum n(n-1)}{N(N-1)} \right) \right), \text{ With } D = \text{Diversity, } n = \text{Number of individuals per species}$$

and  $N = \text{total number of individuals}$  and the Shannon index  $\left( H' = \sum_{i=1}^S pi \log_2 pi \right);$

or  $S = \text{number of species, } pi = \text{proportion of individuals of each species to the total: } ni/N, N = \text{Number of individuals any species, } H' = \text{result of equation}$ ). For each of the species listed, the conservation status was determined based on the species red list, by checking Version 2022-2 on the official IUCN website [17].

With the help of RStudio (version 4.3.0, 2023), a multiple factor analysis graph was produced, to explain trends in the use of species structured in groups, in food, in cultural activities (traditional) and/or in traditional medicine (zootherapy).

## 3. Results

### 3.1. General Characteristics of Informants

**Figure 3** below shows the profile of respondents in the INR landscape, linked together with their activities, gender, age, education level and ethnic group, although the emphasis is on hunters.

The discussions on species have more concerned hunters, because they are the first in direct interaction with the animals through their regular attendance in the hunting areas of the INR. This helps to explain the level of involvement of the latter in conservation, although their professional activities are multiple, in addition to hunting, they are a first-rate supplier of bushmeat, and are mining diggers in addition, one of the illicit activities within the reserve (**Figure 3, Table 1**).

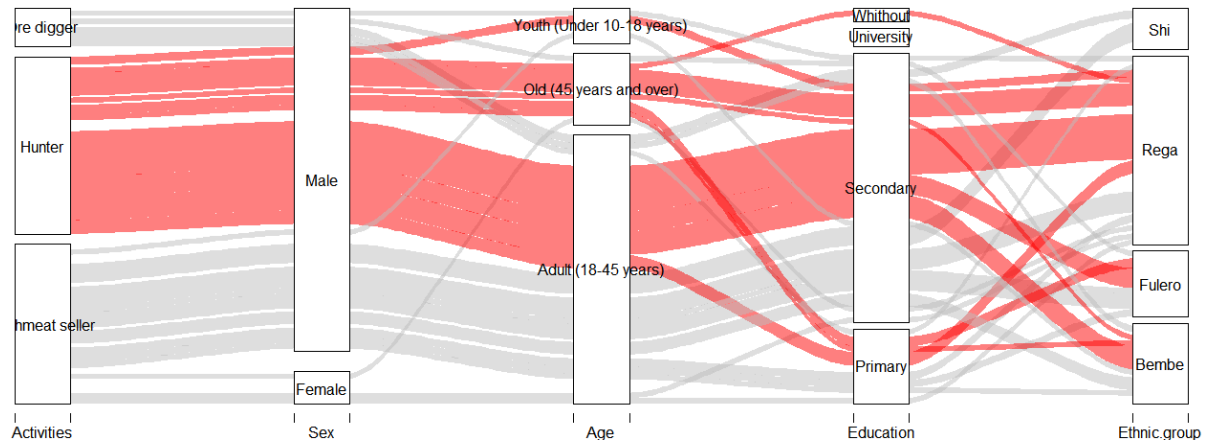


Figure 3. Profile of respondents in the INR landscape.

Table 1. Number of interviewers by profile.

	Activities			Sex		Age			Education				Ethnic.group			
	Bushmeat seller	Hunter	Ore digger	Female	Male	Adul (18 - 45 years)	Old (45 years and over)	Youth (Under 10 - 18 years)	Primary	Secondary	University	Without (level of education)	Bembe	Fulero	Rega	Shi
Effective	179	102	51	57	275	198	77	57	89	179	38	26	83	45	160	45
Percent (%)	53.8	30.8	15.4	17.3	82.7	59.6	23.1	17.3	26.9	53.8	11.5	7.7	25.0	13.5	48.1	13.5

### 3.2. Concept of INR Use in Relation to Conservation

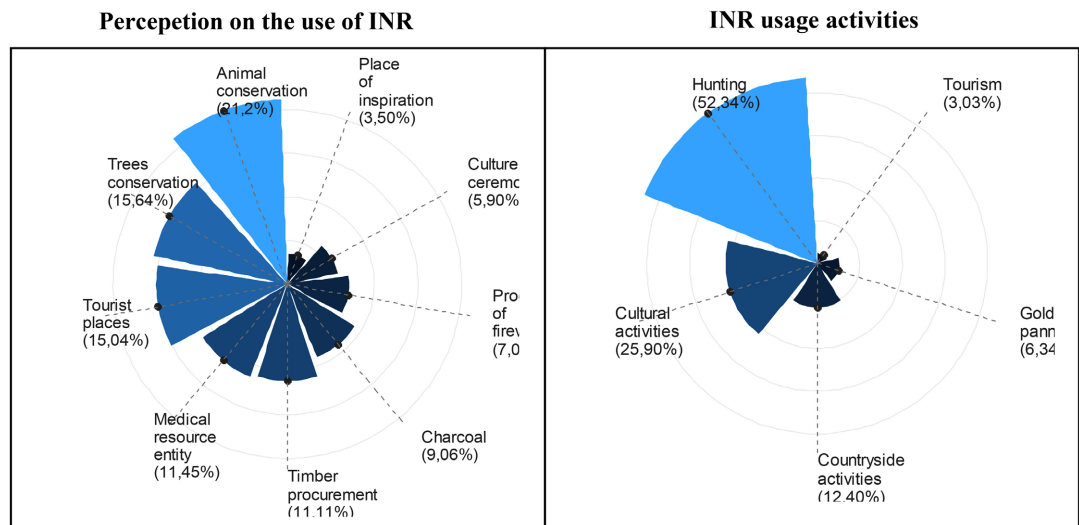


Figure 4. Related concepts of INR usage access to perception and activities.

The interviewees, both hunters with and without multipurpose activities, evoke a different concept of use (Figure 4), i.e. a service that arises from the INR separately from perceptions and activities. In their concept, perception of use means what the local community considers the INR to be as a place of concerted supply, and activities means what is actually done in the INR, according to the results of

the semi-structured (individual) interviews.

Regarding the perception of the use of the INR, it is demonstrated firstly as a conservation center for animals (21.20%) and trees (15.64%); then, a tourist entity (15.05%), cultural ceremony (5.90%) and inspiration (3.59%) and finally a center for procuring timber (11.11%), coal (9.06%) and heating (7.09%).

Lastly, there are the activities of use in the INR, which can be explained as a place offering the possibility of hunting (52.34%), cultural activities (25.90%), rural activities (12.40%), gold panning (6.34%) and visits (3.03%).

### 3.3. Classification of Mammals According to Ethnozoological Survey

Following interviews with local populations involved in hunting and the sale of bushmeat, the presence of 43 species of mammals was reported in the INR landscape (Table 1). The species described belong to 9 Orders and 18 families. These are: Afrosoricida (10 species), Rodentia (11 species), Carnivora (9 species), Primates (7 species), Pholidotes (2 species), Cetarthiodactyla (1 species), Carniformia (1 species), Hydracoidae (1 species) and Proboscidea (1 species). Among these 43 species of mammals. Although diminished, thirty-six species of Mammals were still found in the INR landscape. According to the IUCN Red List status 2023, in the INR, some species deserve special attention including the primates *Gorilla gorilla* (CR) and the *Pan troglodytes* (EN), then the Pholidota *Manis gigantea* (EN) and *Manis tricuspis* (EN) and finally the Carnivora *Panthera pardus* (VU) (Table 2).

**Table 2.** List of wild mammal species recognized by the INR hunters.

Orders	Families	Scientific names	Code	Local name (Rega & Fouleru)	IUCN 2023. Red List of Threatened Species. Version 2022-2
	Tenrecidae (Potamogalinae)	<i>Potamogales velox</i> (Du Chaillu, 1860)	Pv	Konda	LC
	Suidae	<i>Potamochoerus porcus</i> (Linnaeus, 1758)	Po	Ngulube	LC
		<i>Cephalophus silvicultor</i> (Afzelius, 1815)	Cs	Aseti	NT
		<i>Cephalophus dorsalis</i> (Gray, 1871)	Cdor	Naitimina, Aseti	LC
Afrosoricida		<i>Cephalophus monticola</i> (Thunberg, 1789)	Cm	Aseti	LC
		<i>Cephalophus callipygus</i> (Peter, 1876)	Ccall	Aseti	LC
	Bovidae	<i>Cephalophus leucogaster</i> (Gray, 1873)	Cleu	Kanatuli, Aseti	LC
		<i>Hylocherus meinertzhageni</i> (Ogilby, 1845)	Hme	Ngulube	LC
		<i>Neotragus batesi</i> (De Winton, 1903)	Nbat	Aseti	LC
		<i>Tragelaphus spekei</i> (PL Scaler, 1863)	Tsp	Njalu	LC
Cetarthiodactyla		<i>Syncerus caffer</i> (Sparman, 1779)	Scaff	Mboko	LC
Carniformia	Canidae	<i>Canis adustus</i> (Sundevall, 1847)	Cads	Mabugani	LC

## Continued

	Hyaenidae	<i>Crocuta crocuta</i> (Erxleben, 1777)	Ccrocu	Apuyé	LC
		<i>Felis aurata</i> (Temminck, 1827)	Faurat	Lwa'a	VU
		<i>Felis serval</i> (Severtzok, 1858)	Fserval	Abugulu	LC
	Felidae	<i>Panthera leo</i> (Linnaeus, 1758)	Pleo	Tambwe	VU
		<i>Panthera pardus</i> (Linnaeus, 1758)	Ppard	Ngoyi	VU
Carnivora		<i>Genetta tigrina</i> (Schreber, 1776)	Gtigri	Mukala	LC
	Viverridae	<i>Genetta servalina</i> (Schreber, 1776)	Gserva	Mushimba	LC
		<i>Poina richardsonii</i> (Thomson, 1842)	Prichard	Mushimba	LC
	Mustelidae	<i>Lutra maculicollis</i> (Lichtenstein, 1835)	Lmac		NT
Hydracoidae	Procaviidae	<i>Dendrohydrax arboreus</i> (Fraser, 1855)	Darb	Mubinga	LC
		<i>Manis gigantea</i> (Illiger, 1815)	Mgig	Ikage, Ntuba	EN
	Manidae	<i>Manis tricuspis</i> (Rafinesque, 1820)	Mtricus	Kabanga	EN
		<i>Cercopithecus hamlyni</i> (Pocok, 1907)	Cham	Ngwele, Mbala	VU
		<i>Cercopithecus l'hosti</i> (Sclater, 1899)	Clh	Lubulu	VU
	Cercopithecidae	<i>Papio anubus</i> (Lesson, 1827)	Panb	Akamba	LC
Primates		<i>Procolobus verus</i> (Van Beneden, 1838)	Psp	Kulungu	VU
		<i>Gorilla gorilla</i> (Savage, 1847)	Ggor	Igwidi, Ngila	CR
	Homnidae	<i>Pan troglodytes</i> (Blumenbach, 1776)	Petro	Soho, Alema	EN
	Lorisidae	<i>Perodictus potto</i> (Müller, 1766)	Ppot	Ipumbi	NT
Proboscidea	Elephantidae	<i>Loxodonta africana</i> (Anonymous, 1827)	Lafr	Njoku	LC
	Anomaluridae	<i>Anomalurus beecrofti</i> (Fraser, 1853)	Ab	Lusha	LC
		<i>Atherurus africanus</i> (Gray, 1842)	Aafr	Njiko, Kiko	LC
	Hystriidae	<i>Hystrix cristata</i> (Linnaeus, 1758)	Hcrist	Fumba	LC
	Nesomyidae	<i>Cricetomys emini</i> (Wroughton, 1910)	Cem	Mukumbi	LC
		<i>Epixerus elbi</i> (Temminck, 1853)	Eelbi	Kabushushu	LC
		<i>Epixerus wilsoni</i> (Du Chaillu, 1860)	Ewils	Kulubango	LC
		<i>Funisciurus anerythrus</i> (Thomas, 1890)	Fa	Mukeli	LC
Rodentia		<i>Funisciurus lemniscatus</i> (Le Conte, 1857)	Fl	Moko	LC
	Sciuridae	<i>Helioscirus rufobrachium</i> (Waterhouse, 1842)	Hr	Kisindi	LC
		<i>Paraxerus sp</i> (Forsyth Major, 1893)	Psp	Aholulu	LC
		<i>Protoxerus stangeri</i> (Waterhouse, 1827)	Pst	Kisindi	LC

LC: Least Concern; CR: Critically endangered; EN: Endangered; NT: Near Threatened; VU: Vulnerable.

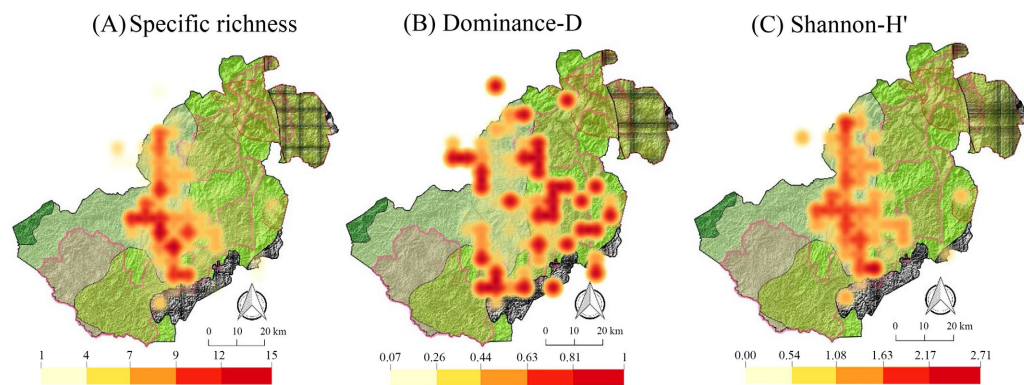
### 3.4. Biological Diversity and Distribution of Wild Mammals

Through semi-structured meetings and focus groups with hunters, locally hunted wild species were listed and spatialized according to different areas known as bushmeat and hunting supply locations as well as observation areas. The spatial

location made is based on local knowledge.

Of the 42 mammal species inventoried within the INR landscape within the radius of 4 Km<sup>2</sup>, the specific richness (Figure 5(A)) demonstrates that the significant variation in concentration is between 1 and 15 species. Two major areas are characterized overall by positioning themselves as the most diverse in terms of mammal species with 15 species. Although we can observe areas with 1, 4, 7, 9 and 12 species. The comparison of the different diversity indices Dominance-D (Figure 5(B)) and Shannon-H' (Figure 5(C)), also show areas of species concentrations in certain radii, i.e. a concentration at the interval of 0.07 and 1 for Dominance-D, in a representation of 0.26, 0.44, 0.63 and 0.81; and a concentration in the range of 0 and 2.71 for Shannon-H, including among others 0.54, 1.08, 1.63 and 2.17.

The specific richness and diversity index, clarifies overall the concentration areas of the species currently existing in the landscape of the INR. The mammals cited by the hunters are located in the centers, in less accessible environments and protected by the guard services of the Reserve and far from the buffer zone.



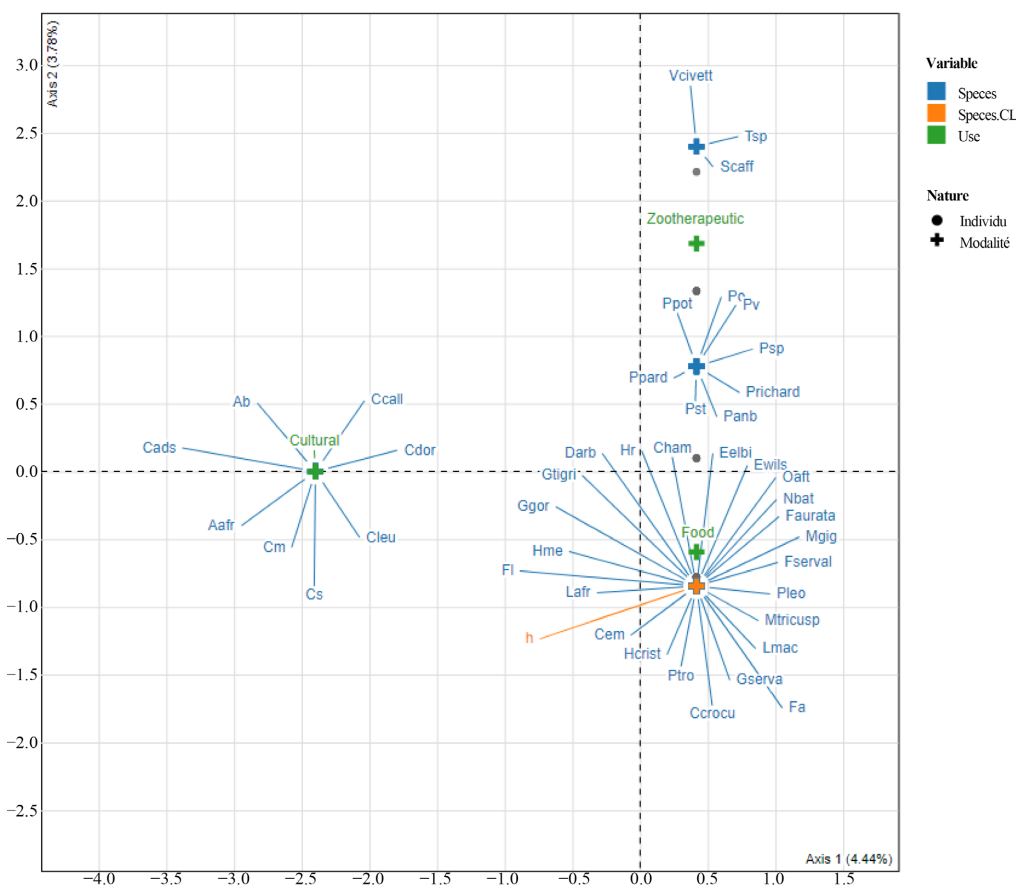
**Figure 5.** Spatial distribution of wild mammal species in the INR: (A) Specific richness; (B) Dominance-D; (C) Shannon-H'.

### 3.5. Value of Traditional Wildlife Conservation Practices

Of 43 species of wild mammals listed during the interviews, the use value of these emerged according to whether they are food (Food; 34 species), medicinal (Zoo-therapy; 12 species) or Cultural (Superstition; 8 species). It turns out that some species are used either in two or three categories. First in food-medicinal (*Canus adustus*); second in medicinal-cultural (*Cercopithecus lhoesti*) third food-Cultural (*Helioscirus ruforbrachium*) and fourth in food-medicinal-Cultural (*Potamochoerus porcus*, *Papio anubus*, ...) as can be seen from the concentration trends of species around uses in Figure 6.

In addition to considering species as food resources, Table 3 gives the particular use of certain species playing a role in medicinal resource used to treat certain normal and supernatural diseases. Those playing the role of cultural resource are used for the ornamentation and enthronement of kings, great chiefs guardian of custom and some people having consideration divine according to their supersti-

tion, if not sanctions can strike the non-initiated people and considered in the local spiritualism. Pholidota *Manis gigantea* (EN) and *Manis tricuspis* (EN) in most of the INR landscape and the Rega ethnic group in particular, they are the two most venerable species, content of its customary consideration, they provide strength, and supernatural competence, unique species specific to the king for his enthronement. On this, sanctions that can lead to the death of two or three generations of a family for the person who killed them without the permission of the king or chief guardian of custom and spiritualist, if it is captured or found, the chiefs are informed before any use whatsoever. The pangolin is the emblematic species of the Batwa and Bantu rega and sacred in the INR landscape; it is very sacred.



**Figure 6.** Multiple correspondence analysis (MCA) of concentration trends of wild mammals around the uses.

**Table 3.** Description of species linked to their uses by communities bordering the INR.

Scientific names	Current situation in the INR landscape	Type of local use			Reason for ban
		Medical (Zootherapeutic)	Culture and Spiritual		
			Worn	Sanction	
<i>Atherurus africanus</i>	Decreases	The bone is used to heal the fracture			

**Continued**

<i>Cricetomys emini</i>	Stable	The hairs are used to treat kwashiorkor (mal nutrition)		
<i>Felis aurata</i> ( <i>Caracal aurata</i> ; <i>Profelis aurata</i> )	Decreases		Its skin is used in the manufacture of ornaments to classify the rank of custom guardians	
<i>Felis serval</i> ( <i>Leptailurus serval</i> )	Decreases			
<i>Gorilla gorilla</i>	Decreases		Bones are used to give physical strength	
<i>Loxodonta africana</i>	Decreases	Bones are used to heal fractures. The intestines are used to treat stomach aches	Faeces is used to find a lost person	
<i>Lutra maculicollis</i> ( <i>Hydrictis maculicollis</i> )	Decreases	The stomach is used to cure poison		Talking about one's spiritual use to the uninitiated leads to the death of the whole family Very guarded spiritual use by the guardian of custom
<i>Manis gigantea</i>	Decreases			Dead
<i>Manis tricuspis</i> ( <i>Phataginus tricuspis</i> )	Decreases		Its skin is used in the manufacture of the great King's hat	Can bring a curse on the whole family and its descendants Totem animal, sacred it cannot be killed or touched except the Kings
<i>Pan troglodytes</i>	Decreases	The femur is used to prevent cesarean section for pregnant women		
<i>Panthera leo</i>	Decreases		Its skin and tail are used in tradition	The death of all members of the family
<i>Panthera pardus</i>	Decreases		The skin, teeth are used for the King's ornaments	
<i>Peroictus potto</i>	Decreases	The hairs are used to heal burns and bones to facilitate motherhood	Bones are used to give children great muscle shape, especially at birth, and to give them the strength to hold something strongly with their hands.	
<i>Potamochoerus porcus</i>	Decreases	The hairs are used to treat burns and other skin diseases.	The tooth is offered to the King for ceremonies and ornament (Drum, etc.)	
<i>Syncerus caffer</i>	Decreases	The carniere forehead bone is used to treat acute headaches	The skin for making drums and the horns for trumpets	

**4. Discussion**

The knowledge of the interviewed stakeholders, 332, including professional hunt-

ers and the bushmeat seller, open to sharing according to different identification classes, made it possible to highlight the concept of using the INR, to draw up the list of wild mammalian fauna and the spatialization of species in meshed areas according to their concentration. Indeed, out of the total of 42 species of wild mammals reported by the surveys, one species was Critically Endangered (CR), 6 Vulnerable (VU), 3 Endangered (EN), 3 Near Threatened (NT), and all the others are Least Concern (LC), *i.e.* 30 species, according to the IUCN 2023 Red List.

This indicates not only the good knowledge of wild mammalian fauna by the populations living near the INR Reserve, but also the importance of the surveys carried out among them. It is recognized that ethnozoological surveys can provide more information on mammalian wildlife, unlike standard inventories, which most often take record time [22]-[25]. In this way, local knowledge is strengthened by its quality by being permanently perpetuated by populations who are always in interaction with wild fauna [6] [26].

The perception of use and knowledge of wildlife resources by the different communities in the INR landscape demonstrates the specific way in which each human society relates to the biodiversity that surrounds it, being intimately linked to its vision of the world and its representations. The protection of biodiversity depends entirely on the perception demonstrated by the level of knowledge of the communities that live in interaction with their environment, thus constituting the very vital essence of their attachment to nature. Taking into account indigenous knowledge and the attitudes of the latter that have made it possible to maintain and manage until now become key elements in understanding the evolutionary description of mammalian fauna in a region described by technological evolution and the rise of human globalization on the discernible level of modern societies living around the Reserves. It turns out that several authors recommend a thorough analysis of the perceptions of local populations before taking them into account in understanding the real threats weighing on wildlife as well as in planning conservation actions [27]-[30].

The areas, according to the grid within the radius of 4 Km<sup>2</sup>, which demonstrate the concentration of individuals as indicated by the distribution by the specific richness, species require more special attention in the INR. Comparison of the different diversity indices Dominance-D and Shannon-H', reveals areas of intensified protection in the reserve, such as the sites constituting the maternity wards of the animals, called Malambo in local terms, located in Mandja, Kitopo, Ngusa and Miki [31]-[35].

Zoological groups are represented by *Afrosoricida* (10 species), *Rodentia* (10 species), *Carnivora* (9 species), *Primates* (9 species), *Pholidotes* (2 species), *Cetarthiodactyla* (1 species), *Carniformia* (1 species), *Hydracoidae* (1 species) and *Proboscidea* (1 species). The most abundant is the small mammal of the *Rodentia*, *Cricetomys emini* which is very cosmopolitan observed, a species of least concern (LC) according to IUCN 2023. Several reasons could explain this situation including the management and the carrying of very numerous young.

Consequently, according to the criteria of the International Union for Conservation of Nature (IUCN 2023, Version 2022-2) [22] [36], the presence of species such as *Gorilla gorilla*, *Pan troglodytes*, *Cercopithecus l'hoesti* and *Cercopithecus hamlyni*, *Manis gigantea* and *Manis tricuspis*, *Panthera pardus*, *Syncerus caffer*, *Tragelaphus spekei* reinforces the conservation value of the INR. These species can be considered as “*Flagship species*” on which conservatives could base themselves to negotiate financial partnerships for better protection of the INR [36]-[38].

Indeed, the species of medium-sized mammals reported by the interviewees constitute proof that the Reserve is not yet completely emptied of its faunal potential. Although many large mammals that could have been considered “*emblematic*” have disappeared or become rare, the *Bovidae* and *Sciuridae* represent a relatively important faunal background. It is therefore not an exaggeration to consider that these two forests are not yet affected by the syndrome of “*Empty forest*” [39] [40].

Scrupulously, it is prohibited and punishable by law any use of wild animals, without any authorization in compliance with the established regulations [14] [41] [42], several factors including poverty associated with the lack of inspection in certain places [43]-[45] is most likely the reason why these communities use wild mammals for food and medicinal purposes (Zootherapy), although for cultural purposes (enthronement, celebration, dowry, superstition, amulet, sacred character, taboo, traditional medicine, ceremonial use, etc.) for some cases, some species are spared from this threat, which leads these communities to use wild mammals as described in different literature [46]-[50]. This allows to establish the Human-Wildlife relationship in the complex role of hunting and protection of mammalian wildlife [23] [51]-[54].

The involvement of men in hunting is important, because it is also one of the primary activities in the occurrence and addition to the source of family income, after hunting one can sell and eat a part [5] [17] [53]. Women are more involved in the commercial activities of bushmeat. This difference probably leads men to consume more meat because they are more in contact with the available natural resources than women [2] [55] [56].

In addition to the use of mammals for food, our results showed that mammals also play a role in traditional medicine. Following similar current studies in several tropical forest regions including Brazil, ... studies show that the majority of animals used for medicinal purposes are wild animals [57] [58] because it is said that species with effective medicinal properties are wild animals, this transmission of zootherapeutic and transcendental knowledge learned by the younger generation from older people, called ancestors [18] [59]. It is worth noting that superstition has been shown to be common among communities, with both men and women seeming to share the same beliefs that some species of wild mammals are bad luck, with particular emphasis on the pangolin. Local beliefs, such as for mystical and religious purposes, cannot be underestimated as they may have a nega-

tive impact on species associated with conservation; as elucidated by other similar works in tropical and semi-arid forests [23] [33]. However, some species are associated with divine creatures, totemic of certain clans which include the Batwa and the Bantu, not only in the forests but in the majority culture of the province of South-Kivu.

Given the strong pressures observed on wild mammalian fauna in sub-Saharan Africa, in the DRC and in the INR in particular, species have become cryptic [6] [17] [60]-[64] associated with strong disturbances of the natural habitat, which leads to the local loss of the original charismatic species and the appearance of invasive species.

## 5. Conclusions

This study provides a comprehensive overview of the mammalian wildlife of the Itombwe Nature Reserve. It reveals that the reserve is home to a relatively rich and diverse mammalian fauna. Indeed, the presence of 42 species known to hunters during ethnozoological surveys was reported.

Our study showed that the use of wild mammals in the INR landscape is still a common practice and that the current conservation strategies adopted that establish certain areas as conservation units, must be reviewed because they still have a deficit especially in terms of community education in the use of wildlife. Probably, it is demonstrated that the motivation of communities to practice hunting is poverty and particularly the lack of applicability of the law; cultural traditions are less influential on the species. Nevertheless, it is important to mobilize the community in the preservation process (Conservation), because it is very difficult to impose conservation policies in communities where wild animals have always been considered essential resources. In order to avoid ethical conflicts between human needs and wildlife conservation, these policies should take into account the social and cultural aspects of local communities in the management of the use of mammalian wildlife.

Thanks to these measures, anthropogenic impacts on threatened species will most likely be reduced. Ethnozoological studies with broader bases clearly demonstrate that conservation is closely linked to the perception and hazards of society and community in the forest landscape and in the case of the INR.

## Implications for Conservation

Our results corroborate previous studies showing that ethnozoological approaches contribute effectively to the conservation of mammalian fauna, based on the local knowledge of hunting professionals and bushmeat sellers [17] [44]. Indeed, our methodology has provided data on a wide range of small and large, abundant and rare species that make up the diversity of mammals in the Itombwe Nature Reserve, rivaling most mammal survey protocols used in ecological sciences and as proposed by different researchers, and is applicable and adaptable in different regions of Africa where accessibility to certain areas is severely complex

following the probable situation observed.

Therefore, in wildlife conservation management, it is important that ethnozoological knowledge is taken advantage of, enabling understanding, succinct evaluation and offering a clear vision of the consideration of riparian communities towards the Itombwe Nature Reserve, albeit with small rifts of change that may relate to the interests and priorities of time and reality across generations.

## Acknowledgements

We would like to thank firstly the people who agreed to interview us in our investigations, then Mwami Longangi and the head of the ICCN station in Itombwe Seguin B. for welcoming us and allowing us to carry out our work in the proper form. To the Carnegie Foundation via the RUFORUM-GTA scholarship for supporting his research, the Centre for Research in Ecology and Management of Terrestrial Ecosystems (CREGET) of the Official University of Bukavu in the DR Congo for having made available a support team in the field and the Department of Biology of the University of Nairobi in Kenya for having followed the progress of the work via Dr Catherine W. Lukhoba.

## Funding

The authors declare to have received the following financial support for the research, writing and/or publication of this article: The authors did not receive any financial support for the research, writing and/or publication of this article.

This work would not have been possible without the institutional support of ICCN, Centre de recherche en écologie et gestion des écosystèmes terrestres (CREGET) of the Université officielle de Bukavu in DR Congo, and the Department of Biology of the University of Nairobi in Kenya. This work was funded by the Carnegie Foundation Research Initiative via the RUFORUM-GTA grant, which supported her academic research.

## Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## References

- [1] Magner, L.N. (2002) A History of the Life Sciences, Revised and Expanded. 3rd Edition, CRC Press. <https://doi.org/10.1201/9780203911006>
- [2] Mshana, G., Mchome, Z., Aloyce, D., Peter, E., Kapiga, S. and Stöckl, H. (2021) Contested or Complementary Healing Paradigms? Women's Narratives of COVID-19 Remedies in Mwanza, Tanzania. *Journal of Ethnobiology and Ethnomedicine*, **17**, Article No. 30. <https://doi.org/10.1186/s13002-021-00457-w>
- [3] Nunes, V.F., Macedo Lopes, P. and Gonçalves Ferreira, R. (2021) Monkeying around Anthropocene: Patterns of Human-Nonhuman Primates' Interactions in Brazil. *Ethnobiology and Conservation*, **10**, Article 22. <https://doi.org/10.15451/ec2021-04-10.23-1-32>

- [4] Turvey, S.T., Crees, J.J. and Di Fonzo, M.M.I. (2015) Historical Data as a Baseline for Conservation: Reconstructing Long-Term Faunal Extinction Dynamics in Late Imperial-Modern China. *Proceedings of the Royal Society B: Biological Sciences*, **282**, Article 20151299. <https://doi.org/10.1098/rspb.2015.1299>
- [5] Abdul-Latiff, M.A.B., Afiqah, M.A., Zahari, F., Othman, N., Haris, H., Najmuddin, M.F., *et al.* (2021) The Ethnozoology, Wildlife Utilisation and Hunting Practices of the Semoq Beri Tribe in Pahang. In: Abdullah, M.T., Bartholomew, C.V. and Mohammad, A., Eds, *Resource Use and Sustainability of Orang Asli*, Springer International Publishing, 109-136. [https://doi.org/10.1007/978-3-030-64961-6\\_9](https://doi.org/10.1007/978-3-030-64961-6_9)
- [6] Hill, R., Adem, Ç., Alangui, W.V., Molnár, Z., Aumeeruddy-Thomas, Y., Bridgewater, P., *et al.* (2020) Working with Indigenous, Local and Scientific Knowledge in Assessments of Nature and Nature's Linkages with People. *Current Opinion in Environmental Sustainability*, **43**, 8-20. <https://doi.org/10.1016/j.cosust.2019.12.006>
- [7] Joa, B., Winkel, G. and Primmer, E. (2018) The Unknown Known—A Review of Local Ecological Knowledge in Relation to Forest Biodiversity Conservation. *Land Use Policy*, **79**, 520-530. <https://doi.org/10.1016/j.landusepol.2018.09.001>
- [8] Gilchrist, G., Mallory, M. and Merkel, F. (2005) Can Local Ecological Knowledge Contribute to Wildlife Management? Case Studies of Migratory Birds. *Ecology and Society*, **10**, Article 20. <https://doi.org/10.5751/es-01275-100120>  
<http://www.ecologyandsociety.org/vol10/iss1/art20/>
- [9] Rist, L., Shackleton, C., Gadamus, L., Chapin, F.S., Gowda, C.M., Setty, S., *et al.* (2016) Ecological Knowledge among Communities, Managers and Scientists: Bridging Divergent Perspectives to Improve Forest Management Outcomes. *Environmental Management*, **57**, 798-813. <https://doi.org/10.1007/s00267-015-0647-1>
- [10] Brook, R.K. and McLachlan, S.M. (2008) Trends and Prospects for Local Knowledge in Ecological and Conservation Research and Monitoring. *Biodiversity and Conservation*, **17**, 3501-3512. <https://doi.org/10.1007/s10531-008-9445-x>
- [11] Capistrano, J. and Lopes, P. (2012) Crab Gatherers Perceive Concrete Changes in the Life History Traits of *Ucides Cordatus* (Linnaeus, 1763), but Overestimate Their Past and Current Catches. *Ethnobiology and Conservation*, **1**, Article 7. <https://doi.org/10.15451/ec2012-8-1.7-1-21>
- [12] Nascimento, C.R.B., Risso, W.E. and dos Reis Martinez, C.B. (2016) Lead Accumulation and Metallothionein Content in Female Rats of Different Ages and Generations after Daily Intake of Pb-Contaminated Food. *Environmental Toxicology and Pharmacology*, **48**, 272-277. <https://doi.org/10.1016/j.etap.2016.11.001>
- [13] Doumenge C. and Schilter C. (1997) Les Monts Itombwe. D'une enquête environnementale et socio-économique à la planification d'interventions au Zaïre. 269 p. [https://agents.cirad.fr/pjjimg/charles.doumenge@cirad.fr/Itombwe\\_final.pdf](https://agents.cirad.fr/pjjimg/charles.doumenge@cirad.fr/Itombwe_final.pdf)
- [14] Fifanou, V.G., Ousmane, C., Gauthier, B. and Brice, S. (2011) Traditional Agroforestry Systems and Biodiversity Conservation in Benin (West Africa). *Agroforestry Systems*, **82**, 1-13. <https://doi.org/10.1007/s10457-011-9377-4>
- [15] O.Nyumba, T., Wilson, K., Derrick, C.J. and Mukherjee, N. (2018) The Use of Focus Group Discussion Methodology: Insights from Two Decades of Application in Conservation. *Methods in Ecology and Evolution*, **9**, 20-32. <https://doi.org/10.1111/2041-210x.12860>
- [16] Palinkas, L.A., Horwitz, S.M., Green, C.A., Wisdom, J.P., Duan, N. and Hoagwood, K. (2015) Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. *Administration and Policy in Mental Health and Mental Health Services Research*, **42**, 533-544.

- <https://doi.org/10.1007/s10488-013-0528-y>
- [17] van Vliet, N., Muhindo, J., Kambale Nyumu, J., Mushagalusa, O. and Nasi, R. (2018) Mammal Depletion Processes as Evidenced from Spatially Explicit and Temporal Local Ecological Knowledge. *Tropical Conservation Science*, **11**, 1-16.  
<https://doi.org/10.1177/1940082918799494>
- [18] Van Luijk, N., Soldati, G.T. and da Fonseca-Kruel, V.S. (2021) The Role of Schools as an Opportunity for Transmission of Local Knowledge about Useful Restinga Plants: Experiences in Southeastern Brazil. *Journal of Ethnobiology and Ethnomedicine*, **17**, Article No. 34. <https://doi.org/10.1186/s13002-021-00461-0>
- [19] Sayer, J.A., Margules, C., Boedhihartono, A.K., Sunderland, T., Langston, J.D., Reed, J., *et al.* (2017) Measuring the Effectiveness of Landscape Approaches to Conservation and Development. *Sustainability Science*, **12**, 465-476.  
<https://doi.org/10.1007/s11625-016-0415-z>
- [20] Sayer, J., Sunderland, T., Ghazoul, J., Pfund, J., Sheil, D., Meijaard, E., *et al.* (2013) Ten Principles for a Landscape Approach to Reconciling Agriculture, Conservation, and Other Competing Land Uses. *Proceedings of the National Academy of Sciences*, **110**, 8349-8356. <https://doi.org/10.1073/pnas.1210595110>
- [21] Sandker, M., Campbell, B.M., Ruiz-Pérez, M., Sayer, J.A., Cowling, R., Kassa, H., *et al.* (2010) The Role of Participatory Modeling in Landscape Approaches to Reconcile Conservation and Development. *Ecology and Society*, **15**, Article 13.  
<https://doi.org/10.5751/es-03400-150213>
- [22] Alves, R.R.N. and de Faria Lopes, S. (2018) The Role of Ethnozoology in Animal Studies. In: Alves, R.R.N. and Albuquerque, U.P., Eds., *Ethnozoology*, Elsevier, 467-479. <https://doi.org/10.1016/b978-0-12-809913-1.00024-7>
- [23] Barbosa, J.A.A., Aguiar, J.O. and da Nóbrega Alves, R.R. (2018) Hunting Practices and Environmental Influence: A Brief Overview with an Ethnozoological Approach. *Gaia Scientia*, **12**, 36-58. <https://doi.org/10.22478/ufpb.1981-1268.2018v12n3.39942>
- [24] Joiris, D.V. and Logo, P.B. (2014) La gestion participative des forêts en Afrique centrale. *Revue d'ethnoécologie*. <https://doi.org/10.4000/ethnoecologie.1960>
- [25] Wajner, M., Tamburini, D. and Zamudio, F. (2019) Ethnozoology in the Mountains. What Does the Cognitive Salience of Wild Animals Tell Us? *Ethnobiology and Conservation*, **8**, Article 9.  
<https://www.ethnobiococonservation.com/index.php/ebc/article/view/299>  
<https://doi.org/10.15451/ec2019-07-8.09-1-23>
- [26] Vergara-Rios, D., Montes-Correa, A.C., Urbina-Cardona, J.N., De Luque-Villa, M., E. Cattán, P. and Granda, H.D. (2021) Local Community Knowledge and Perceptions in the Colombian Caribbean towards Amphibians in Urban and Rural Settings: Tools for Biological Conservation. *Ethnobiology and Conservation*, **10**, Article 24.  
<https://doi.org/10.15451/ec2021-05-10.24-1-22>
- [27] Bernárdez-Rodríguez, G.F., Bowler, M., Braga-Pereira, F., McNaughton, M. and Mayor, P. (2021) Conservation Education Promotes Positive Short- and Medium-Term Changes in Perceptions and Attitudes towards a Threatened Primate Species. *Ethnobiology and Conservation*, **10**, Article 31.  
<https://doi.org/10.15451/ec2021-09-10.31-1-16>
- [28] Fitts, L.A., Cruz-Burga, Z.A., Legatzke, H. and de los Ángeles La Torre-Cuadros, M. (2022) Is Timber Management a Realistic Conservation Alternative for Indigenous Amazonian Communities? *Ethnobiology and Conservation*, **11**, Article 2.  
<https://doi.org/10.15451/ec2022-01-11.02-1-31>

- [29] Nieman, W.A., Schultz, B.C., Wilkinson, A. and Leslie, A.J. (2021) Stakeholders' Perceptions of Mammal Occurrence and Abundance on Agricultural Properties Bordering the Boland Mountain Complex, South Africa. *African Zoology*, **56**, 104-116. <https://doi.org/10.1080/15627020.2021.1885990>
- [30] De Sousa, T.B.B., Da Silva, T.C. and Ramos, M.A. (2021) What Factors Can Influence Children's Perception of Forests Today and in the Future? *Ethnobiology and Conservation*, **10**, Article 19. <https://doi.org/10.15451/ec2021-04-10.19-1-13>
- [31] Freire Filho, R.G., Pinto, T. and Bezerra, B.M. (2018) Using Local Ecological Knowledge to Access the Distribution of the Endangered Caatinga Howler Monkey (*Alouatta ululata*). *Ethnobiology and Conservation*, **7**, Article 10. <https://doi.org/10.15451/ec2018-08-7.10-1-22>
- [32] Harissou, Y., Abdoulaye, A., Hema, E., et al. (2020) Abondance et distribution des mammifères de la Réserve de Biosphère Transfrontalière du W Niger (RBT W Niger). *Journal of Animal and Plant Sciences*, **43**, 7513-7524.
- [33] Murwendo, T., Murwira, A. and Masocha, M. (2020) Modelling and Predicting Mammalian Wildlife Abundance and Distribution in Semi-Arid Gonarezhou National Park, South Eastern Zimbabwe. *Ecofeminism and Climate Change*, **1**, 151-163. <https://doi.org/10.1108/efcc-05-2020-0016>
- [34] Pang, S.E.H., Zeng, Y., De Alban, J.D.T. and Webb, E.L. (2022) Occurrence-Habitat Mismatching and Niche Truncation When Modelling Distributions Affected by Anthropogenic Range Contractions. *Diversity and Distributions*, **28**, 1327-1343. <https://doi.org/10.1111/ddi.13544>
- [35] Victoire Sikpo, S.M., Sika, P.L., Koue-Bi, T.M. and Yaokokore-Beibro, K.H. (2023) Richesse spécifique, abondance et biomasse de la faune sauvage dans la filière viande de brousse du marché du District de Yamoussoukro (Côte d'Ivoire). *International Journal of Biological and Chemical Sciences*, **17**, 1557-1573. <https://doi.org/10.4314/ijbcs.v17i4.21>
- [36] Jarić, I., Normande, I.C., Arbieu, U., Courchamp, F., Crowley, S.L., Jeschke, J.M., et al. (2023) Flagship Individuals in Biodiversity Conservation. *Frontiers in Ecology and the Environment*, **22**, e2599. <https://doi.org/10.1002/fee.2599>
- [37] Smith, A.M. and Sutton, S.G. (2008) The Role of a Flagship Species in the Formation of Conservation Intentions. *Human Dimensions of Wildlife*, **13**, 127-140. <https://doi.org/10.1080/10871200701883408>
- [38] Thomas-Walters, L. and J Raihani, N. (2017) Supporting Conservation: The Roles of Flagship Species and Identifiable Victims. *Conservation Letters*, **10**, 581-587. <https://doi.org/10.1111/conl.12319>
- [39] Benítez-López, A., Santini, L., Schipper, A.M., Busana, M. and Huijbregts, M.A.J. (2019) Intact but Empty Forests? Patterns of Hunting-Induced Mammal Defaunation in the Tropics. *PLOS Biology*, **17**, e3000247. <https://doi.org/10.1371/journal.pbio.3000247>
- [40] Redford, K.H. (1992) The Empty Forest. *BioScience*, **42**, 412-422. <https://doi.org/10.2307/1311860>
- [41] Lhoest, S., Fonteyn, D., Daïnou, K., Delbeke, L., Doucet, J., Dufrêne, M., et al. (2020) Conservation Value of Tropical Forests: Distance to Human Settlements Matters More than Management in Central Africa. *Biological Conservation*, **241**, Article 108351. <https://doi.org/10.1016/j.biocon.2019.108351>
- [42] Phuthego, T.C. and Chanda, R. (2004) Traditional Ecological Knowledge and Community-Based Natural Resource Management: Lessons from a Botswana Wildlife Management Area. *Applied Geography*, **24**, 57-76.

- <https://doi.org/10.1016/j.apgeog.2003.10.001>
- [43] Turvey, S.T., Bryant, J.V. and McClune, K.A. (2018) Differential Loss of Components of Traditional Ecological Knowledge Following a Primate Extinction Event. *Royal Society Open Science*, **5**, Article 172352. <https://doi.org/10.1098/rsos.172352>
- [44] Van Vliet, N., L'haridon, L., Gomez, J., Vanegas, L., Sandrin, F. and Nasi, R. (2018) The Use of Traditional Ecological Knowledge in the Context of Participatory Wildlife Management. In: Alves, R.R.N. and Albuquerque, U.P., Eds., *Ethnozoology*, Elsevier, 497-512. <https://doi.org/10.1016/b978-0-12-809913-1.00026-0>
- [45] Zhang, L., Guan, Z., Fei, H., Yan, L., Turvey, S.T. and Fan, P. (2020) Influence of Traditional Ecological Knowledge on Conservation of the Skywalker Hoolock Gibbon (*Hoolock tianxing*) Outside Nature Reserves. *Biological Conservation*, **241**, Article 108267. <https://doi.org/10.1016/j.biocon.2019.108267>
- [46] Ferreira Abrão, C., Ribeiro de Oliveira, D., Passos, P., Rodrigues Pereira Freitas, C.V., Ferreira Santana, A., Lopes da Rocha, M., *et al.* (2021) Zootherapeutic Practices in the Amazon Region: Chemical and Pharmacological Studies of Green-Anaconda Fat (*Eunectes murinus*) and Alternatives for Species Conservation. *Ethnobiology and Conservation*, **10**, Article 15. <https://doi.org/10.15451/ec2021-02-10.15-1-27>
- [47] Alves, Â.G.C., Ribeiro, M.N., Arandas, J.K.G. and Alves, R.R.N. (2018) Animal Domestication and Ethnozootechny. In: Alves, R.R.N. and Albuquerque, U.P., Eds., *Ethnozoology*, Elsevier, 151-165. <https://doi.org/10.1016/b978-0-12-809913-1.00009-0>
- [48] Boakye, M.K. (2018) Influence of Ethnicity on Cultural Use of Pangolins in Ghana and Its Implications on Their Conservation. *Ethnobiology and Conservation*, **7**, Article 13. <https://www.ethnobiococonservation.com/index.php/ebc/article/view/249>
- [49] Bobo, K.S., Aghomo, F.F.M. and Ntumwel, B.C. (2015) Wildlife Use and the Role of Taboos in the Conservation of Wildlife around the Nkwende Hills Forest Reserve; South-West Cameroon. *Journal of Ethnobiology and Ethnomedicine*, **11**, Article No. 2. <https://doi.org/10.1186/1746-4269-11-2>
- [50] Turvey, S.T., Fernández-Secades, C., Nuñez-Miño, J.M., Hart, T., Martinez, P., Brocca, J.L., *et al.* (2014) Is Local Ecological Knowledge a Useful Conservation Tool for Small Mammals in a Caribbean Multicultural Landscape? *Biological Conservation*, **169**, 189-197. <https://doi.org/10.1016/j.biocon.2013.11.018>
- [51] Alves, R.R.N. and Barboza, R.R.D. (2018) The Role of Animals in Human Culture. In: Alves, R.R.N. and Albuquerque, U.P., Eds., *Ethnozoology*, Elsevier, 277-301. <https://doi.org/10.1016/b978-0-12-809913-1.00015-6>
- [52] Alves, R.R.N. and da Silva Policarpo, I. (2018) Animals and Human Health. In: Alves, R.R.N. and Albuquerque, U.P., Eds., *Ethnozoology*, Elsevier, 233-259. <https://doi.org/10.1016/b978-0-12-809913-1.00013-2>
- [53] Rija, A.A., Critchlow, R., Thomas, C.D. and Beale, C.M. (2020) Global Extent and Drivers of Mammal Population Declines in Protected Areas under Illegal Hunting Pressure. *PLOS ONE*, **15**, e0227163. <https://doi.org/10.1371/journal.pone.0227163>
- [54] Tamburini, D., Zamudio, F. and Cáceres, D. (2021) Multiple Assessments to Value Wild Animals in the Analysis of Human-Wildlife Relationships: A Case Study in the Dry Chaco of Córdoba, Argentina. *Ethnobiology and Conservation*, **10**, Article 29. <https://doi.org/10.15451/ec2021-08-10.29-1-21>
- [55] Alves, R.R.N., Mota, E.L.S. and Dias, T.L.P. (2018) Use and Commercialization of Animals as Decoration. In: Alves, R.R.N. and Albuquerque, U.P., Eds., *Ethnozoology*, Elsevier, 261-275. <https://doi.org/10.1016/b978-0-12-809913-1.00014-4>
- [56] Gonedelé-Bi, S., Kramoko, B., Bené, J.C.K., Koné, I., Luiselli, L. and Gaubert, P. (2022) Year-Round Longitudinal Monitoring of a Bushmeat Market in Central-West-

- ern Côte d'Ivoire: Implication for Wildlife Conservation. *Journal for Nature Conservation*, **70**, Article 126297. <https://doi.org/10.1016/j.jnc.2022.126297>
- [57] Alves, R.R.N., de Sousa Neta, R.O., de Brito Trovão, D.M., de Lucena Barbosa, J.E., Barros, A.T. and Dias, T.L.P. (2012) Traditional Uses of Medicinal Animals in the Semi-Arid Region of Northeastern Brazil. *Journal of Ethnobiology and Ethnomedicine*, **8**, Article No. 41. <https://doi.org/10.1186/1746-4269-8-41>
- [58] Mootoosamy, A. and Fawzi Mahomoodally, M. (2014) A Quantitative Ethnozoological Assessment of Traditionally Used Animal-Based Therapies in the Tropical Island of Mauritius. *Journal of Ethnopharmacology*, **154**, 847-857. <https://doi.org/10.1016/j.jep.2014.05.001>
- [59] Zank, S., Hanazaki, N. and De Melo, C.R. (2021) Gender and Ethnic Equity: What Can We Learn from Ancestral and Indigenous Peoples to Deal with Socio-Environmental Issues? *Ethnobiology and Conservation*, **10**, Article 16. <https://doi.org/10.15451/ec2021-02-10.16-1-9>
- [60] Hilaire Bohoussou, K., Bertin Akpatou, K. and Alphonse Yao, K. (2022) État des Lieux de la Faune Sauvage Mammalienne dans le Département de Sipilou, Ouest de la Côte d'Ivoire. *European Scientific Journal, ESJ*, **18**, 76-94. <https://doi.org/10.19044/esj.2022.v18n36p76>
- [61] Bohoussou, K.H., Akpatou, K.B., Kouassi, Y.W.R. and Kpangui, K.B. (2018) Diversité des Mammifères et valeur pour la conservation des reliques forestières au sein d'une concession agro-industrielle au sud-ouest de la Côte d'Ivoire. *Vertigo*, **18**, 1-24. <https://doi.org/10.4000/vertigo.19947>
- [62] Gonedélé Bi, S., Koné, I., Béné, J.C.K., Bitty, E.A., Yao, K.A., Kouassi, B.A., *et al.* (2017) Bushmeat Hunting around a Remnant Coastal Rainforest in Côte d'Ivoire. *Oryx*, **51**, 418-427. <https://doi.org/10.1017/s0030605315001453>
- [63] Lidicker Jr., W.Z. (2015) Mammalian Conservation: Scientific Frontiers and Socio-political Pitfalls. *Therya*, **6**, 1-10. <https://doi.org/10.12933/therya-15-241>
- [64] Perkins, L. (1998) Conservation and Management of Orang-Utans *Pongo pygmaeus* ssp. *International Zoo Yearbook*, **36**, 109-112. <https://doi.org/10.1111/j.1748-1090.1998.tb02891.x>