



Role of wild mammals in traditional medicine and mystic practices in the province of Oubritenga, Burkina Faso

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ABSTRACT

Local people use corpses and organs of wild animals for medical care and mystical practices. The study aims to inventory the mammal's species which organs are used for the treatment of some diseases or the implementation of some mystical practices. It was an ethnozoological survey which took place from September to December 2018 in 11 markets with 18 traditional practitioners selling wild mammal products. In total, 24 species of wild mammals have been identified and 16 organs listed as medicine for cure 21 diseases. Some of these organs are also involved in 7 mystical practices of local people. Animal parts such as the skin (51.30%) and the bones / the horns (16.23%) are the most sought after on the markets. Traders sources are mainly from Burkina Faso (92.57%) and to a lesser extent from Niger (7.43%). Almost all the concerned species are protected (22 species) in Burkina Faso. Among these species, 4 are vulnerable according to the IUCN criteria. The obvious consequence of these traditional needs for corpses and parts of wild mammals collected by local communities is undoubtedly the depletion of biodiversity. Therefore, this requires the application of conservation rules which guarantee better exploitation of these biological resources.

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INTRODUCTION

Using animals and their products to treat patients suffering from a range of health conditions has a long history and is still common in many parts of the world (Alade et al., 2018; Jugli et al., 2019). According to

several authors, this traditional utilization does not end to curing diseases, but is also known in the field of mystical practices (Nasi et al., 2011; Alves et al., 2012; Camino et al., 2018). Castillo and Ladio, (2019) add that these traditional uses involve at the same time

domestically and wild animals. For Alves and Alves (2011), the medicinal fauna is largely based on wild animals, including some endangered species.

In many African countries, studies have proved the utilization of wild animals and plants in traditional medicine (Yaokokore-beibro et al., 2010; Nasi et al., 2011; Djangoun et al., 2012; McNamara et al., 2016; Ajagun and Anyaku, 2017; Djangoun et al., 2018; Yolidje et al., 2020). In Africa, traditional medicine is one of the richest cultures that people have developed, conserved and passed on from one generation to another (Rivière et al., 2005). The modern medicine effectiveness and the influence of revealed religions have not stopped these empirical practices which remain strong and even in marked progression (Djangoun et al., 2012). In order to cure some diseases or to provide some desired effects, the populations rely on wildlife parts. Wild animals are killed because of conflicts or to use their products in traditional medicine and other traditional practices (Djangoun et al., 2012; McNamara et al., 2016; Djangoun et al., 2018, Kouao et al., 2018). However, many of these animals benefit from protection and surveillance in the protected areas. The hunting of wild animal for medicinal and / or mystical aims is on the way to becoming one of the principal factor of biodiversity loss (Alves and Alves, 2011; Ferreira et al., 2013).

These traditional knowledges related to wild animals are also practiced by people in Burkina Faso. Wild animals' products are sold by traditional practitioners in the markets. These sellers are supplied by products dealers. Unfortunately, little or no work has been done to ascertain the different animal species commonly used in traditional medicine. For this reason, there is a lack of data to support policy decision in terms of the regulation of the activity in general. In addition, the lack of studies on wildlife parts for trade restricts an evaluation of the impact of this activity on the exploited species (Ferreira et al., 2013).

In Burkina Faso, few studies looked into the use of wildlife products in traditional medicine and traditional and mystical practices (Dibloni, 2003; Dibloni et al., 2009; Dibloni, 2011; Dibloni et al., 2013; Ouoba, 2019). Among the authors cited, Ouoba (2019)

research led to conducting this current study by providing baseline information on the species within the study area and the culture of the local population, their mystical practices and traditional medicine. Other studies were carried out on three specific species including hippopotamus (*Hippopotamus amphibius*), roan antelope (*Hippotragus equinus*) and hartebeest (*Alcelaphus buselaphus*), (Dibloni, 2003; Dibloni et al., 2009; Dibloni, 2011; Dibloni et al., 2019). These studies also discuss the importance of species such as *Erythrocebus patas*, *Phacochoerus africanus* and *Hystrix cristata* in mystical practices (Dibloni et al., 2013).

It has been demonstrated that the use of species of high value in traditional medicine reduces their reproductive rates (Kakati et al., 2006). Consequently, Species with these life history traits are considered more prone to extinction and may therefore be less resilient to harvest (Kakati et al., 2006). For example, Primates: Most persecuted of animals – hunted for their meat, fur and animal medicine-based (Mittermeier et al., 2007).

The objective of this study was to give an overview of the medicinal wild mammals' products traffic, to provide information on utilization of these biological and genetic resources in traditional medicine and mystical practices, and to discuss the implication of this practice for a sustainable conservation and use of biodiversity.

MATERIALS AND METHODS

Study area

The province of Oubritenga belongs to the region of the "Plateau Central", Burkina Faso. It is located between 2 ° 15' and 0 ° 20' longitudes West and 11 ° 45' and 13 ° 00' North (Figure 1). It covers about 2,841.112 km² with a population of about 324,000 inhabitants (INSD, 2009a). This population is mainly represented by Mossi, Fulani and Bissas ethnic groups. More than 80% of them practice agriculture, breeding, vegetable farming and the exploitation of forest resources (INSD, 2015).

The Oubritenga is part of the Sudano-Sahelian tropical climate and is characterized by two seasons: a rainy season (June to September) and a dry season (October to May).

The rainfall is erratic and the annual average varies between 750 to 850 mm per year. The ambient temperature varies widely. It is low (minimum: 15 °C) during cool months such as December and January and high (maximum: 45 °C) during hot months from March to May (Kaboré et al., 2007).

The area's vegetation is essentially shrub savannah but woody savannahs and sparse gallery forests can be found along the main rivers such as the Nakambé, the Massili, the Koulottoko, the Nazinon, the Bougoula-Moudi, the Bombore and the Guibga. Floristic species include *Vitellaria paradoxa*, *Parkia biglobosa*, *Lannea microcarpa*, *Tamarindus indica*, *Adansonia digitata*, *Acacia senegal*, *Anogeissus leocarpa* and *Pterocarpus erinaceus*. This rich floristic nature is inhabited by small mammals (*Ourebia ourebi*, *Chlorocebus aethiops*, *Erythrocebus patas*, *Lepus victoriae*, *Cricetomys gambianus*, *Euxerus erythropus*, etc.), reptiles (*Varanus niloticus*, *Varanus exanthematicus*, *Crocodylus niloticus*, *Naja nigricollis*, etc.), and birds (*Accipiter badius*, *Pternistis bicalcaratus*, *Bucorvus abyssinicus*, *Tockus erythrorhynchus*, etc.) (INSD, 2009b).

Data collection and analysis

To achieve the objectives of the study, the data collection and analysis methods used are based on previous similar studies conducted in the world.

Data collection

An inventory coupled with semi-structured interviews was done (Albuquerque et al., 2014; Djagoun et al., 2012; Martinez, 2013; Djagoun et al., 2018) in the public markets of Absouya, Bissiga, Dapélogo, Donsé, Loumbila, Manéga, Nagréongo, Tankounda, Ziniaré, Zitenga and Zoundi (Figure 1), from September to December 2018. It was designed following two steps. Firstly, a prospecting study on the field was conducted. It allowed to find 11 markets in which there is at least one wildlife products seller. The second step was to make an inventory and interviews with all sellers found in the markets. There were 18 respondents overall in the 11 markets. They all belong to the "Mossi" ethnic group and consist of 16 men and 2 women. They were

between 40 and 80 years old. Among these actors, 28% were farmers, pastoralists and traditional healers, 60% were farmers, traditional healers, 6% farmers, knitters and traditional healers and 6% of them were traditional healers (Table 1). The information collected during the interviews are (i) the names in local language of the wild mammal species of which the products are sold by the sellers, (ii) the wild mammal products found on the sellers stalls (Figure 2), (iii) the traditional uses of wild mammal products and (iv) the origins of the wild mammal products found on the sellers stalls.

Species taxonomic identification

The species taxonomic identification has been done following several approaches. It has first been done based on the names and descriptions given by the wild mammals' products sellers (Castillo et al., 2019). Secondly, wild mammal's identification guides were used to confirm the results (Haltenorth et al., 1985; FAN, 2003; Lamarque, 2004). Finally, when there are still doubts on a species identity, an appropriate sample is taken or photographs are snapped and compared to the specimens collected and deposited in scientific collections that is "Laboratoire d'Histoire Naturelle du Centre National de la Recherche Scientifique et Technologique du Burkina Faso" (Vieira et al., 2014). The species that have not been identified with precision were removed from the study. The scientific names of the species were updated based on the site "Mammal species of the world".

Data analysis

The quantitative data analysis has combined many approaches used on previous studies (El-Hilal et al., 2003; Martinez, 2013; Kpétééré et al., 2015; Djagoun et al., 2018; Castillo et al., 2019). The collected data were recorded in Microsoft Excel 2010 software and analyzed using the "dynamic cross" table function. The assessment was oriented on the elements below.

- ✓ The wild mammal species of which products are sold in the market

A list of wild mammal species of which products are sold has been obtained by making

a synthesis of the species identified from all respondents' stalls.

✓ The species use value

The species use value is calculated through the formula used in several studies, shown below (Friedman et al., 1986; Phillips and Gentry, 1993 a-b; Albuquerque et al., 2007; Bruce and Timothy, 2007; Cetto and Heinrich, 2011):

$$UV_i = \frac{\sum_i^n U}{n}$$

Where: UV_i = species i use value; $\sum_i^n U$ = Sum of citations of species i and n = number of traditional practioners interviewed

✓ The different wild mammals' products sold in the markets

A list of wild mammals' products sold in the markets has been produced making a synthesis of the products identified at all the respondents' stalls. The number of sellers possessing each product has also been determined.

✓ The different origins of wild mammals' products sold in the markets

For each identified product, its origin was determined. The citation percentage of each origin was calculated. The citation percentage of an origin is the ratio between the number of citations of this origin and the product of the number of products and the number of respondents.

✓ The different traditional uses (diseases treatments, mystical practices)

The different diseases treatments and mystical practices were determined by making a synthesis of all the sellers' citations.

Wild mammal species conservation statute

All the identified species have been confronted to the national regulation of fauna protection list (MEEVCC, 2017), to the red list of the IUCN (2019) and on the appendices of the CITES (2017) with the aim of knowing their conservation statute in Burkina Faso and throughout the world.

Table 1: Socio-demographic characteristics of the respondents.

	Variables	Number of respondents	Frequency (%)
Ethnic group	Mossi	18	100
	Total	18	100
Sex	Man	16	88.89
	Woman	2	11.11
	Total	18	100
Age group	[40-50[4	22.22
	[50-60[6	33.33
	[60-70[4	22.22
	[70-80[4	22.22
	Total	18	100
Main activities	Agriculture + breeding + traditional healing	5	27.78
	Agriculture + traditional healing	11	61.11
	Agriculture + weaving + traditional healing	1	5.56
	Traditional healing	1	5.56
	Total	18	100

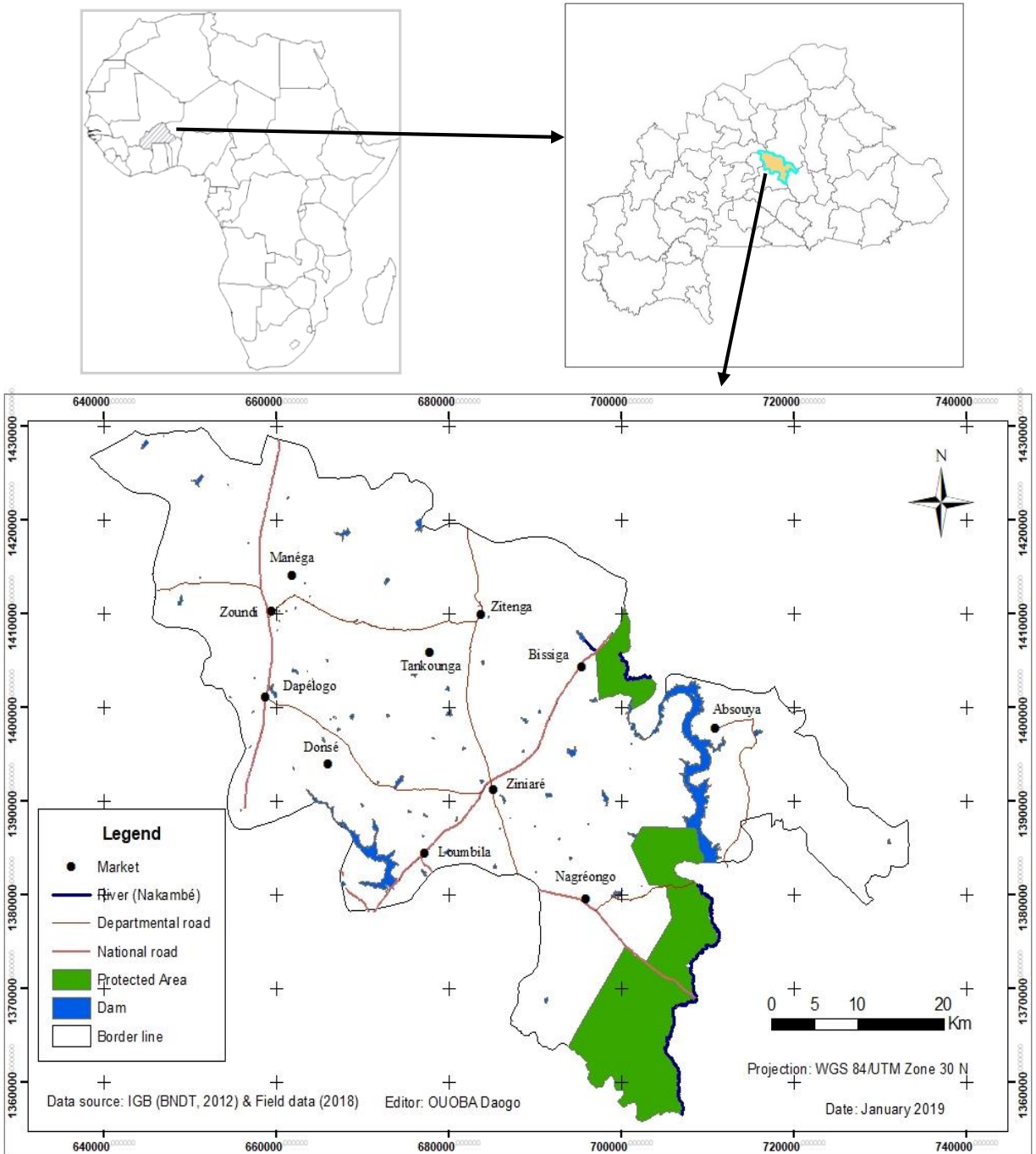


Figure 1: Location map of the province of Oubritenga and markets where surveys were conducted.



Figure 2: Various products of wildlife exhibited by traditional healers in markets in the Province of Oubritenga (Shot: D. Ouoba, October 2018).

RESULTS

The wild mammal's species which products are sold in the market

In total, 24 wild mammal species grouped in to 16 families were identified during the survey (Table 2). The most represented families were the Bovidae (4 species) followed by Felidae (3 species), Cercopithecidae, Hyaenidae and Viverridae (2 species each). All the other families are represented by a single species each (Figure 3).

Table 2 also shows that ten (10) species have a use value greater or equal to 0.5 with the species *Lepus victoriae* (0.83) at the top. The other species have a use value comprise between 0.44 and 0.33.

The different wild mammals' products sold in the markets

The survey identified a total of 16 wild mammal products that are traditionally valued in terms of health and mystical practices in the

province of Oubritenga. Among these products, there are corpses of *Crocidura Cinderella* and *Erinaceus albiventris*, fat and droppings (Figure 5).

Users are interested in the skins, the heads, the bones, the horns, the paws, the fats, the tails, the tongues, the ivory, the quills, the penises, the anuses, the hair, the droppings, the jaws, the hooves, the livers or even sometimes the whole animals (Figure 4). According to the interviewees, the skin (51.30%) is more frequently used. It is followed by the bones / the horns (16.23%), the paws (7.14%), the head (5.19%) and the whole animal (4.55%) (Figure 5).

The different origins of wild mammals' products sold in the markets

The products of wild mammals that are sold by the sellers are mainly from Burkina Faso (92.57%) and Niger (7.43%). In Burkina Faso, five origins were identified. Following the citation order of importance, they originate from Boinsyaré (39.80%), Ziniaré (22.60%), Dori (14.00%), Fada N'gourma (10.77%) and Pouytenga (5.40%) (Figure 6).

These markets are located respectively in the center (the Central region), in the Sahel (the Sahelian region) and in the eastern part (the Eastern region and in Center-East region) of the country.

Diseases treated with the products of wild mammal species

At the end of the interviews, 21 diseases treated by wild mammals' products were listed (Table 3). The use of *Civetticis civetta* anus to

treat madness and the *Loxodonta africana* bone to heal stunted children are cited to be the most wanted by the users (8 respondents). The least cited are the use of the *Syncerus caffer brachyceros* tail to heal rib pain and the *Erythrocebus patas* to heal stomach aches, breast pain, dizziness, coughing (8 respondents).

Mystical practices using the products of wild mammal species

In total 7 mystical practices using wild mammal products were cited by the sellers (Table 4). These practices involve seven wild mammals' species. Among them, the use of *Lepus victoriae* tongue to attract "good luck" is the most cited (10 respondents) although the use of the *Crocidura cinderella* corpse to make "children courageous" is the least cited (2 respondents).

Wild mammals' species conservation status

Table 5 shows that almost all the species (22 species) listed are entirely protected then forbidden from hunting in Burkina Faso except *Hippotragus equinus*, *Syncerus caffer brachyceros* and *Panthera leo* which are partially protected. According to IUCN (2009) classification, four (04) species is in the category Vulnerable (VU), one species in the category Non-Evaluated (NE) and the rest in the category Least Concern (LC). As for the CITES (2017), only one species is listed on Annex I of endangered species (*Loxodonta africana*) and the remaining species are either on the Annex II, III or on non-evaluated category.

Table 2: List of wild mammal species identified in the stalls of traditional healers.

Families	Scientific names	Local names (Mooré)	U-V
Bovidae	<i>Hippotragus equinus</i> É. Geoffroy Saint-Hilaire, 1803	Wilpelogo	0.44
	<i>Ourebia ourebi</i> Zimmermann, 1783	Walaga	0.39
	<i>Sylvicapra grimmia</i> Linnaeus, 1758	Gnisri	0.28
	<i>Syncerus caffer brachyceros</i> Gray, 1837	Wenafo	0.44
Cercopithecidae	<i>Chlorocebus aethiops</i> Linnaeus, 1758	Wâamba	0.44
	<i>Erythrocebus patas</i> Schreber, 1775	Wam miga	0.39
Elephantidae	<i>Loxodonta africana</i> Blumenbach, 1797	Wobgo	0.78
Erinaceidae	<i>Atelerix albiventris</i> Wagner, 1841	Yugempende	0.33
Felidae	<i>Felis silvestris</i> Schreber, 1777	Wegnouga	0.33
	<i>Panthera leo</i> Linnaeus, 1758	Bongnega	0.50
	<i>Panthera pardus</i> Linnaeus, 1758	Abga	0.33
Galagonidae	<i>Galago senegalensis</i> É. Geoffroy, 1796	Luanfidiga	0.33
Hippopotamidae	<i>Hippopotamus amphibius</i> Linnaeus, 1758	Yemdé	0.50
Hyaenidae	<i>Crocuta crocuta</i> Erxleben, 1777	Katré	0.61
	<i>Hystrix cristata</i> Linnaeus, 1758	Syemde	0.50
Leporidae	<i>Lepus victoriae</i> Thomas, 1893	Swamba	0.83
Muridae	<i>Cricetomys gambianus</i> Waterhouse, 1840	Rayuuga	0.44
Mustelidae	<i>Mellivora capensis</i> Schreber, 1776	Kiègna	0.39
Orycteropidae	<i>Orycteropus afer</i> Pallas, 1766	Tantouri	0.56
Scuridae	<i>Euxerus erythropus</i> E. Geoffroy, 1803	Kiiga	0.33
Soricidae	<i>Crocidura cinderella</i> , Thomas, 1911	Sabtonsgo	0.67
Suidae	<i>Phacochoerus africanus</i> Gmelin, 1788	Reogo	0.50
Viverridae	<i>Civettictis civetta</i> Schreber, 1776	Parignégo	0.61
	<i>Genetta genetta</i> Linnaeus, 1758	Piifo	0.33

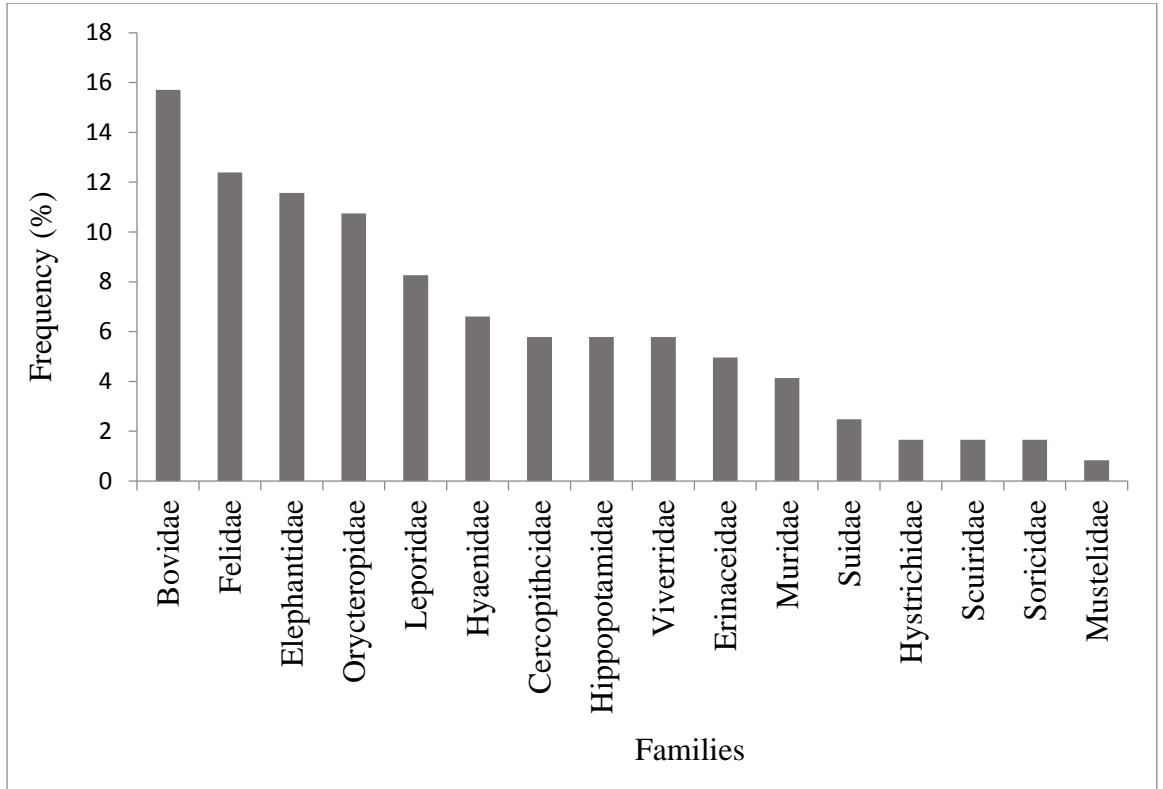


Figure 3: Frequencies of wild mammal's species families listed from traditional healers.





Figure 4: Some products of wild mammal species exhibited by traditional healers in markets for sale (1: Retail trade of cuts of an elephant’s skin, 2: Skins of patas, 3: Box with corpses of hedgehogs, 4: Paws of hares, 5: A hand of an aardvark, 6: A hand of a baboon). (Shot: D. Ouoba, October 2018).

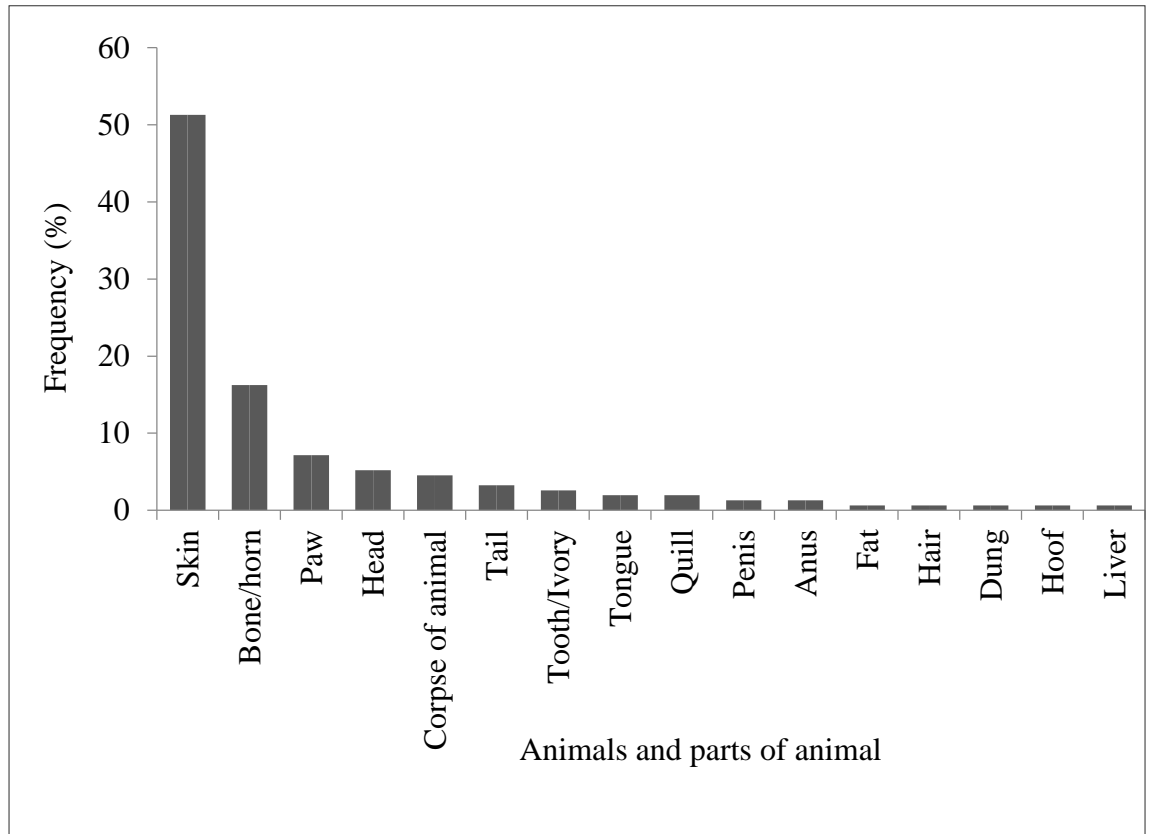


Figure 5: Frequencies of wild mammals’ products listed from traditional healers.

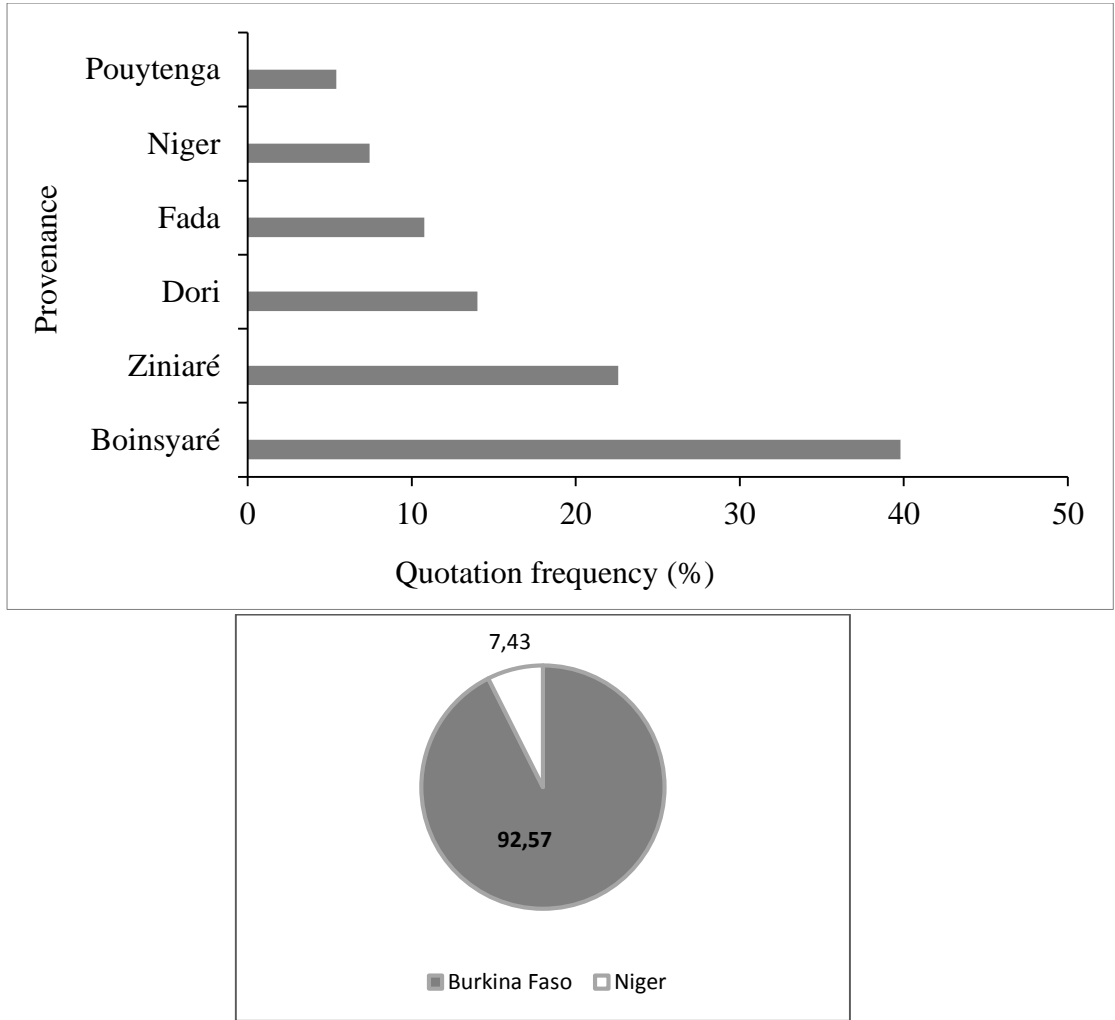


Figure 6: Frequencies of wild mammals 'products origins.

Table 3: List of diseases cured by the products of wild mammal species according to the traditional healers.

Diseases treated	Species	Products	Number of respondents
Madness	<i>Civetticis civetta</i>	Anus	8
Stunted children	<i>Loxodonta africana</i>	Bone	8
Stomach aches, fatigue	<i>Atelerix albiventris</i>	Corpse	7
Fragility of children's bones	<i>Panthera leo</i>	Skin	7
Sore mouth	<i>Hippopotamus amphibius</i>	Tongue	6
Rheumatism	<i>Hippotragus equinus</i>	Bone	6
Men's sexual weakness	<i>Hystrix cristata</i>	Penis	6
Fragility of children's bones, ear pain	<i>Phacoecerus africanus</i>	Fat	6

Men's sexual weakness	<i>Syncerus caffer brachyceros</i>	Penis	6
Migraines	<i>Hystrix cristata</i>	Head	5
Stunted children, fragility of children's bones	<i>Phachocercus africanus</i>	Bone	5
Stomach aches, breast pain, dizziness, coughing	<i>Chlorocebus aethiops</i>	Skin	4
Toothaches	<i>Cricetomys gambianus</i>	Head	4
Headaches	<i>Hippotragus equinus</i>	Skin	4
Breast pain	<i>Hystrix cristata</i>	Skin	4
Wounds, shin pain	<i>Orycteropus afer</i>	Skin	4
Wounds, dizziness	<i>Ourebia ourebi</i>	Skin	4
Malaria	<i>Civetticis civetta</i>	Skin	3
Coughing	<i>Hystrix cristata</i>	Quill	3
Stunted children, wounds, shin pain, malaria, madness	<i>Loxodonta africana</i>	Skin	3
shin pain	<i>Orycteropus afer</i>	Leg	3
Men's sexual weakness	<i>Mellivora capensis</i>	Bone	3
Men's genital organs' Wounds, Body wounds	<i>Sylvicapra grimmia</i>	Skin	3
Migraines	<i>Syncerus caffer brachyceros</i>	Bone/horn	3
Stomach aches, breast pain, dizziness, coughing	<i>Erythrocebus patas</i>	Skin	2
Rib pain	<i>Syncerus caffer brachyceros</i>	Tail	2

Table 4: The Uses of the products of mammalian fauna in mystical practices.

Mystical practices	Species	Products	Number of respondents
Transforming a bad luck into a good luck	<i>Lepus victoriae</i>	Tongue	10
Being protected from curses	<i>Crocuta crocuta</i>	Tongue	8
Making children courageous	<i>Lepus victoriae</i>	Leg	8
Providing capacities for mimicry	<i>Panthera leo</i>	Skin	8
Protecting against poison	<i>Hystrix cristata</i>	Quill	7
Transforming a bad luck into a good luck	<i>Genetta genetta</i>	Dung	7
Making children courageous	<i>Crocuta crocuta</i>	Dung	6
Providing capacities for mimicry	<i>Syncerus caffer brachyceros</i>	Skin	6
Protecting against machete	<i>Phachocercus africanus</i>	Tooth	5
Protecting against genies' and wizards' attacks	<i>Civetticis civetta</i>	Tail	4
Transforming a bad luck into a good luck	<i>Syncerus caffer brachyceros</i>	Bone/horn	4
Making children courageous	<i>Hystrix cristata</i>	Head	3
Making children courageous	<i>Crocidura cinderella</i>	Corpse	2

Table 5: Conservation Statute of the 25 wild mammal species listed under the legislation of Burkina Faso, the IUCN 2019 red list and the CITES 2017 appendices.

Species	Legislation of Burkina Faso ¹	IUCN Red List Categories ²	Appendices of CITES ³
<i>Hippotragus equinus</i>	IIB	LC	NL
<i>Ourebia ourebi</i>	IIB	LC	NL
<i>Sylvicapra grimmia</i>	IIB	LC	NL
<i>Syncerus caffer brachyceros</i>	IIB	NT	NL
<i>Chlorocebus aetiops</i>	IA	LC	II
<i>Erythrocebus patas</i>	IA	LC	II
<i>Loxodonta africana</i>	IA	VU	I
<i>Atelerix albiventris</i>	IA	LC	NL
<i>Felis silvestris</i>	IA	LC	II
<i>Panthera leo</i>	IIB	VU	II
<i>Panthera pardus</i>	IA	VU	II
<i>Galago senegalensis</i>	IA	LC	II
<i>Hippopotamus amphibius</i>	IA	VU	II
<i>Crocota crocuta</i>	IA	LC	NL
<i>Hystrix cristata</i>	IA	LC	NL
<i>Lepus victoriae</i>	IIB	LC	NL
<i>Cricetomys gambianus</i>	IIB	LC	NL
<i>Mellivora capensis</i>	IA	LC	III
<i>Orycteropus afer</i>	IA	LC	NL
<i>Euxerus erythropus</i>	IA	LC	NL
<i>Crocidura cinderella</i>	IA	LC	NL
<i>Phacochoerus africanus</i>	IIB	LC	NL
<i>Civettictis civetta</i>	IIB	LC	III
<i>Genetta genetta</i>	IA	LC	NL

¹: IA = Fully protected species, no hunting; IIB = Partially protected species, likely to be hunted and captured;

²: LC = Least concerned, VU = Vulnerable, EN = Endangered, NT = Nearly threatened;

³: I = threatened with extinction, II = species whose specimens trade must be regulated to avoid incompatible exploitation with their survival, III = species that any Party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting their exploitation, and as needing the co-operation of other Parties in the control of trade, NL = Not currently listed).

DISCUSSION

The use of wild mammal products in traditional medicine and mystical practices in the Province of Oubritenga concerns 25 species. 16 different products of wild mammal were found on the traditional healers and sellers' stalls. These products come from Burkina Faso (92.4%) and Niger (7.6%). They are used to treat 21 different human diseases. 7 of these products are also used by the population to obtain mystical desired effects. Almost all listed species (22 species) are entirely protected, then forbidden from hunting in Burkina Faso. Only four (4) species are classified in the category "Vulnerable" on the IUCN (2019) red list. Regarding the CITES (2017) classification, *Loxodonta africana* is an "Endangered species".

As for Burkina Faso, among the 25 species listed in the Oubritenga Province, two are known by the population around the "Ranch de gibier de nazinga" and the "Réserve de biosphère de la mare aux hippopotames" for their importance in pharmacopeia, mystical and cultural practices (Dibloni, 2003; Dibloni et al., 2009; Dibloni, 2013). These species are *Hippotragus equinus*, *Hippopotamus amphibius*, *Erythrocebus patas*, *Phacochoerus africanus* and *Hystrix cristata*.

According to Dibloni (2003), the populations around "Ranch de gibier de Nazinga" cited the *Hippotragus equinus*'s organs as being components in the treatment of headaches, malaria, HIV/AIDS. For these populations, the male hippotrague's genital organ combined with other products is an efficient aphrodisiac. In this study, the skin of *Hippotragus equinus* is used to cure Headaches and Rheumatism, the quill of *Hystrix cristata* for Coughing, the skin of *Erythrocebus patas* for stomach aches, breast pain, dizziness and coughing.

In addition, surveys conducted around the "Réserve de biosphère de la mare aux hippopotames" in Burkina Faso, the population confirmed that the burned bones of the *Hippopotamus amphibius*'s tail treat sinusitis. Its skin treats itching (Dibloni, 2011; Dibloni et al., 2013). In the same area, the hands and the tail of the *Erythrocebus patas*, the hair of the

Phacochoerus africanus and the spine of the *Hystrix cristata* are used for desired effects (mystical effects and well-being) (Dibloni et al., 2013).

The number of 25 listed mammals in our study area is less than 87, 28 and 26 species respectively found Djagoun et al. (2012) on Benin territory, Ajagun and Anyaku (2017) at Ogbomoso in the Oyo State and Jugli et al. (2019) in North-East India. This may be due to several factors like the low number of sellers in the study area, the local unavailability of wildlife resources, the sellers did not show all their products. Another important factor is the loss of traditional knowledge related to medicinal animals caused by the lack of interest of young people for this activity. According to Jugli et al. (2019), the problem is that traditional healers are often reluctant to share their knowledge and young people are nowadays less and less interested in learning about the "old ways".

In this study, 21 different human diseases have been cured by medicinal mammals. This number of diseases is close to 21 diseases found in Brazil (Barbosa et al., 2018). In Ethiopia, it's 18 different diseases that have been listed. (Yirga et al., 2011). This high number of diseases proves that populations conserve their traditional knowledge despite the effectiveness of modern medicine. On the other hand, poverty pushes population to have recourse to this traditional medicine which is generally available and affordable for all (Rivière et al., 2005; Jugli et al., 2019). Finally, this could explain the inefficiency of modern medicine regarding certain human diseases (Azanlin, 2015; Jugli et al., 2019). The study has also reported 7 mystical practices related to wild mammals identified in the area of study. For example, the tooth of *Phacochoerus africanus* is used to strengthen the body and resist machete attacks, the tail of *Civetticis civetta* to protect against genies and wizards' attacks. In literature, similar traditional practices have been recorded. For example, the heart of the *Syncerus caffer brachyceros* makes a person brave in scary situations, its horn and its tail are respectively used to counter the sorcerer

attacks and malediction (Azanlin, 2015). Parts of *Hippopotamus amphibius* are used to free people from bewitchment in Nigeria (Ajagun et al., 2017).

The wild mammal products sellers get their supplies from Burkina Faso and Niger. Burkina Faso is the main supplier. These results confirm similar previous research (Djagoun et al., 2012; Ogoanah and Omijie, 2017). That means that the supply chain does not end in Burkina Faso but also concerns other countries. Indeed, the markets of wild fauna products are found all over the world and are supplied by a strong traffic. This traffic is an organized network and often international (Alves and Alves, 2011; Whiting et al., 2011; Ferreira et al., 2013).

According to the study, many listed species are forbidden to hunt in Burkina Faso. Among these species, 4 are vulnerable species according to IUCN (2019). These results are close to those of Djagoun et al. (2012). It shows that the utilization of wild mammals in traditional medicine and mystical practices are a threat to these species. This threat in Burkina is a general fact in the world because it is cited in IUCN 2019 red list.

The list of the 25 identified species in this study is not exhaustive because it only concerns species that are formally identified. Those for which there were relevant doubts, were declared undetermined and unclassified in this study. DNA test on the unclassified species should allow to obtain a complete list. Additionally, the results regarding mystical practices and the diseases treated by wild mammals are statements based on experiences transmitted from generation to generation. Future researches might be oriented on the isolation and the experimentation of the active principles of the medicinal wild mammals.

The study showed that many of the wild mammal species which products are sold in the markets are forbidden to hunt in Burkina Faso. These biological and genetic resources came from an unsustainable exploitation of wild fauna. The activity is illegal, and actors do not have technical and scientific support until now. It may cause biodiversity loss because according to Djagoun et al. (2012), the non-

sustainable use of medicinal animals is a potential threat for species survival.

This fact raises several questions: (i) the ineffectiveness of regulatory texts for the exploitation and the marketing of wildlife products or the application of these texts; (ii) the ignorance of the negative impacts of their activity on the wild fauna in general and on rare or endangered species in particular and also (iii) the frustrations of the populations caused by the unfair benefits sharing arising from the exploitation of these wildlife resources.

Ogoanah and Omijie (2017) points out that, if the activity persists and even increases because of the demand, this could be due to an inadequate enforcement of the law in the field of wildlife. According to Costa-Neo (2005), environmental policies and measures taken against the trade of medicines originated from animals should also take into account the lucrative nature of the activity for practitioners. As for Djagoun et al. (2012), instead of sending animal therapy practitioners to prisons or creating policies aimed at forcing traders to abandon such practices, decision-makers should try to contextualize this form of human / nature link in its cultural dimension.

Since the users of these wildlife products find satisfaction in their practices, it is imperative to reconcile these needs with the need to conserve the concerned species. To achieve this, it would be necessary to deepen the researches on the biology of medical animal species and the biochemical composition of the healing organs and parts of these species. For the moment, it is urgent to organize and supervise the different actors, raise awareness and educate them on the need to conserve these wildlife resources. The populations must understand that the preservation of their traditional knowledge on animals and their products to treat diseases and perform mystical practices depends on the availability of the raw material, i.e. animals (Jugli et al., 2019). In addition, as recommended by Ouoba (2009), i) in order to avoid the poaching of these species, it would be wise to involve the associations of traditional healers during hunting periods so that they recover products that are not generally not consumed and, ii) initiatives should be

developed for the promotion of the most used species such as the lion and the aardvark and others.

Conclusion

This study concludes that wild mammals play an important role in traditional medicine and mystical practices for local communities in Oubritenga province. It inventoried 16 different products of 25 species of wild mammals. The interviews revealed that these products are used by populations to treat 21 human diseases and carry out 7 mystical practices. These products come from Burkina Faso (92.4%) and Niger (7.6%). Among the inventoried species, 22 are fully protected by the law of Burkina Faso, 4 are vulnerable according to IUCN criteria. This data will help biodiversity managers to better design strategies for conservation and sustainable use of wildlife in Burkina Faso.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

DO and OTD developed the research protocol. DO and YO collected the data. DO and OTD analysed the data. DO wrote the manuscript. OTD, KM and BGK revised the manuscript.

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