

Interactions between people and game mammals in a Brazilian semi-arid area

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In addition to being a cultural activity, hunting practices in the Brazilian North eastern semi-arid region have implications for the conservation of many animal species. Wild mammals are used for different ends; however, their use as a food resource is the most common, and the by-products are used for other purposes. The aim of the present study was to analyse the traditional uses of the wild mammals of a municipality of the semi-arid region of Paraíba state, Brazil, and to assess the socioeconomic context related to such uses. A total of 15 species were mentioned by interviewees. These species fell into the following categories of use: food resource (9 species), elaboration of handicrafts (2), medicinal (2), captive breeding (2) and trade (1). Additionally, seven other species were hunted because they were considered dangerous or capable of causing profit damages. Among the species cited in the food resource category, *Galea spixii* and *Euphractus sexcinctus* (six-banded armadillo) showed the highest use values (UV) (0.51 and 0.46, respectively). Socioeconomic factors were found to influence hunting practices. Our results suggest the need for public policies that consider the elaboration of educational programs aimed at the sustainable management and conservation of wildlife and the socioeconomic and cultural context of the individuals involved in hunting.

Keywords: Mammals, Ethnozoology, Paraíba semi-arid, Sustainable management

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Throughout history, evidence of the relationships between humans and other animals has varied. These relationships reflect an ancient and extremely important connection for human societies, which have narrow dependency interactions with faunal resources¹⁻¹⁰. These interactions also contribute to the formation of emotional bonds between people and other animals. For example, many species have been and continue to be kept as pets, especially birds and mammals and more recently reptiles and amphibians¹¹⁻¹³. The connections between humans and other animals are studied by ethnozoology^{3,14}. Marques¹⁵ defined ethnozoology as the interdisciplinary study of thoughts and perceptions (knowledge and beliefs), feelings (affective representations) and behaviours (attitudes) that mediate the relationships between human populations and animal species in the surrounding ecosystem. Worldwide, wild animals are

used for several purposes, including food, therapeutic uses, cultural activities, trade of live animals, animal parts or by-products for many purposes, and possibly a combination of all of these uses¹⁶. The use of wildlife becomes even more important in areas such as the Brazilian North eastern semi-arid region¹⁷⁻¹⁹, which is dominated by the Caatinga biome and is home to more than 28 million people. However, the Caatinga has been severely modified; indeed, it is one of the Brazilian biomes that has been most altered by human activities^{20,21}. In this context, the aim of the present study was to analyse the traditional uses of wild mammals by the inhabitants of the rural municipality of Lagoa Seca, Paraíba (PB), Brazil, and to characterize the socioeconomic and cultural contexts related to these uses. We expect that the results may provide data to support conservation and management strategies for the most exploited species and to promote an understanding of local traditional knowledge

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regarding the uses of these resources to intensify effective actions aimed at the study of the sustainable management of wild mammals.

Methods

Study area

The present study was conducted in the rural communities of Cumbe, Jucá do Cumbe, Amaragi and Sítio Gruta Funda, all of which belong to the municipality of Lagoa Seca (07° 10' 15" S, 35° 51' 14" W) (Fig. 1). The municipality is located within the Agreste meso-region and includes the Borborema Plateau geo-environmental unit in the semi-arid region of Paraíba state, Brazil. The vegetation of the unit is composed of sub-deciduous and deciduous forests that are characteristic of semi-arid areas. According to the Köppen classification, the climate is AS', characteristically hot and humid, which presents rainfall events during autumn and winter²². Currently, the Lagoa Seca municipality covers an area of 109,342 km² and has 25,911 inhabitants, including 10,585 people living in urban areas and 15,226 in rural areas²³. The Human Development Index (HDI) of the municipality is 0.627 according to the Human Development Atlas of the United Nations Development Programme²⁴.

Procedures

The study was conducted from January 2011 to July 2013. Data on hunting and the general use of mammals

were obtained through semi-structured questionnaires complemented by individual free interviews and informal conversations^{25,26}. The respondents were inhabitants of the studied municipalities who hunted regularly. In addition to socioeconomic questions, the questionnaires included questions concerning each animal hunted (i.e., perceived abundance of local species, hunting area, and hunting gear) and the use of these animals. Some hunters were followed during their hunting activities. Thirty-nine persons were interviewed. All of the individuals were male with ages ranging from 13-64 yrs. The demographic data of the respondents are summarized in Table 1. The snowball sampling technique²⁷ was applied to select the respondents. Prior to each interview, the purpose and nature of the study were explained, and the respondents granted permission to record the data. The ethical approval for the study was obtained from the Ethics Committee of Paraíba University State (N° of protocol:0026.0.133.000-10). The common names of the animals mentioned were recorded. The animals were identified as follows: 1) analysis of the specimen or parts of the specimen donated by the respondents; 2) analysis of photographs of the animals made during the interviews and during monitoring of hunting events; and 3) analysis based on previous zoological and ethnological studies performed in the semi-arid regions of the Brazilian Northeast^{17,28,29}. The Catalogue of Life website (version 2016) (<http://www.catalogueoflife.org/>)³⁰ was consulted for

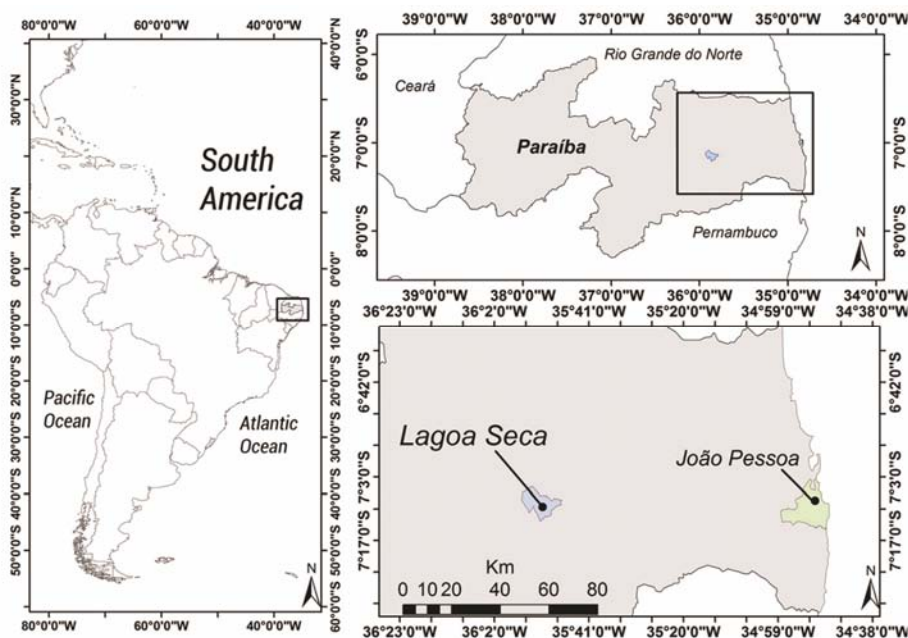


Fig.1—Location of the Lagoa Seca municipality (07° 10' 15" S 35° 51' 14" W) in the Agreste meso-region, Paraíba, Brazil.

Table 1—Socioeconomic aspects of the respondents (n=39) in the studied areas (the Paraíba semi-arid region, Brazil)

Parameters	Total	(%)	
Age	13 - 20 yrs	12	30.76%
	21 - 30 yrs	09	23.07%
	31 - 40 yrs old	04	10.25%
	41 - 60 yrs	07	17.94%
	61 - 80 yrs	03	7.69%
	Illiterate	01	2.56%
Education level	Incomplete Primary Education	30	76.92%
	Complete Primary Education	01	2.56%
	Incomplete Secondary Education	02	5.12%
	Complete Secondary Education	02	5.12%
	Complete Higher Education	0	0.0%
Marital status	Incomplete Higher Education	01	2.56%
	Single	12	30.76%
	Cohabiting	07	17.94%
	Married	12	30.76%
	Separated	03	7.69%
Monthly family income	Divorced	01	2.56%
	Widowed	0	0.0%
	No stable income	03	7.69%
	Up to 1 minimum wage (retirement)	0	0.0%
	Less than 1 minimum wage	16	41.02%
	Up to 1 minimum wage	03	7.69%
	Up to 2 minimum wages	11	28.20%
Family size	3 minimum wages or over	01	2.56%
	Declined to answer	06	15.38%
	1 Couple	06	15.38%
	3 Persons	08	20.51%
	4 Persons	07	17.94%
	5 Persons	08	20.51%
	6 Persons	06	15.38%
Time residing in the studied area	7 Persons	01	2.56%
	Declined to answer	01	2.56%
	Up to 15 yrs	06	15.38%
	16 to 25 yrs	16	41.02%
	26 to 40 yrs	09	23.07%
Time residing in the studied area	41 to 60 yrs	03	7.69%
	61 to 80 yrs	0	0.0%
	Declined to answer	05	12.82%

the classification and nomenclature used. Additionally, the Brazilian List of Endangered Fauna species (<http://www.icmbio.gov.br/portal/biodiversidade/faunabrasileira/listadeespecies.html>)³¹ and the International Union for Conservation of Nature Red List of Threatened Species (IUCN)³² were used to verify the conservation status of the species recorded in the present study.

Data analysis

The respective use value (UV) was calculated for each animal species mentioned (adapted³³). This

approach enabled the demonstration of the relative importance of the locally known species regardless of the investigator's opinion. The use value is calculated using the following formula:

$$UV = \sum U/n$$

Where U is the total number of mentions of a given species, and n is the total number of interviewees. The application of the UV of each species is objectively based on the importance of uses assigned by respondents and does not depend on the opinion of the investigator¹⁸.

Results

Overall, all respondents had low incomes and low education levels, suggesting the influence of socioeconomic factors on the use of local faunal resources. The respondents mentioned 15 mammal species distributed among 6 orders, 14 genera and 11 families (Table 2). The mentioned animals fell into the following types of use: food (9 species), artisanal (for handicrafts) (2), medicinal (2), pets (2), and trade (1). According to the respondents, some species were hunted because they represented a threat to both local inhabitants and their livestock and crops. This type of situation was termed 'conflict' or 'control hunting' in the present study and included seven species in the studied area. Overall, food was the major use and was associated with the highest number of species

(n=9, 64 %), with meat the main product of this activity. Among the mammals used as food, two species stood out: *Galea spixii* (Spix's yellow-toothed cavy) and *Euphractus sexcinctus* (six-banded armadillo). The meat of the latter is appreciated in the region; some of the respondents keep the animal in captivity and feed it for fattening to prevent the animal from feeding on other animals' carcasses, which it does in the natural environment. There is a demand for mammals in the studied region because they have a greater biomass compared to other local vertebrates; they are consumed in both daily meals and during social meetings on weekends. Some species experience greater hunting pressure because they have more than one use. Two mammalian species that were hunted for food and used for

Table 2—Uses and human vs. animal relationships in the studied communities. Legend: LC – Least concern, VU- Vulnerable

Order/Family/Scientific name/ Local common name/	IUCN category	Type of use	No. of citations per species	Use value (UV)
Rodentia – Caviidae – <i>Hydrochaeris hydrochaeris</i> (Linnaeus, 1766) – Capivara (English name: Capybara)	LC	Food	1	0.02
Carnivora – Mustelidae – <i>Galictis cuja</i> (Molina, 1782) – Furão (English name: Lesser Grison)	LC	Conflict	4	0.10
Didelphimorphia – Didelphidae – <i>Didelphis albiventris</i> (Lund, 1840) – Timbu (English name: White-eared opossum)	LC	Food	6	0.16
Carnivora – Felidae – <i>Leopardus pardalis</i> (Linnaeus, 1758) – Gato do mato maracajá (English name: Ocelot)	LC	Food, conflict	3	0.07
Carnivora – Felidae – <i>Puma yagouaroundi</i> (É. Geoffroy Saint-Hilaire, 1803) – Gato do mato vermelho (English name: Jaguarundi)	VU	Food, conflict	2	0.05
Carnivora – Felidae – <i>Leopardus tigrinus</i> (Schreber, 1775) – Gato do mato mirim (English name: Oncilla)	VU	Conflict, decoration	1	0.02
Carnivora – Procyonidae – <i>Procyon cancrivorus</i> (Cuvier, 1798) – Guaxite (English name: Crab-eating Raccoon)	LC	Conflict	1	0.02
Cingulata – Dasypodidae – <i>Euphractus sexcinctus</i> (Linnaeus, 1758) – Tatu peba (English name: Six-banded armadillo)	LC	Food, breeding, trade, medicinal (fat)	19	0.46
Rodentia – Caviidae – <i>Galea spixii</i> (Wagler, 1831) – Preá (English name: Spix's yellow-toothed cavy)	LC	Food	20	0.51
Rodentia – Echimyidae – <i>Thrichomys apereoides</i> (Lund, 1839) – Punaré (English name: Common punare)	LC	Food	6	0.15
Carnivora – Canidae – <i>Cerdocyon thous</i> (Linnaeus, 1766) – Raposa (English name: Crab-eating fox)	LC	Conflict, game	7	0.17
Primates – Callitrichidae – <i>Callithrix jacchus</i> (Linnaeus, 1758) – Sagui (English name: Common marmoset)	LC	Breeding	1	0.02
Carnivora – Mephitidae – <i>Conepatus semistriatus</i> (Boddaert, 1785) – Ticaca (English name: Striped hog-nosed skunk)	LC	Food	3	0.08
Cingulata – Dasypodidae – <i>Dasypus novemcinctus</i> (Linnaeus, 1758) – Tatu verdadeiro (English name: Nine-banded armadillo)	LC	Food, medicinal (fat), decoration	4	0.11
Chiroptera – Phyllostomidae – <i>Artibeus</i> sp. (English name: Fruit bat)	LC	Conflict	5	0.12

medicinal purposes were *Dasybus novemcinctus* (nine-banded armadillo) and *E. sexcinctus* (six-banded armadillo). The fat of these animals is extracted to treat earaches, muscle pain and nasal congestion, among other uses. The shell of *D. novemcinctus* (nine-banded armadillo) is also used for household ornaments. Another mammalian species used for the same purpose is *Leopardus tigrinus* (oncilla); its skin is used to make artisanal rugs. According to the testimony of the respondents, some species are seen as charismatic animals and therefore are kept in captivity, such as the *Callithrix jacchus* (common marmoset). *E. sexcinctus* (six-banded armadillo) is kept in captivity for fattening to be consumed by the hunter and his family or is sold to individuals who previously ordered the animal for consumption. Fruit bats of the genus *Artibeus* sp. are considered vermin that transmit diseases and feed on fruits and animal blood. Thus, they are slaughtered whenever found and are included in the control hunting category in the present study. The calculated UV values ranged from 0.02 to 0.51 (Table 2). The species that had the highest UVs were *G. spixii* (Spix's yellow-toothed), *E. sexcinctus* (six-banded armadillo; UV=0.46) and *Cerdocyon thous* (crab-eating fox; UV=0.17). The species with the lowest UVs were *Hydrochaeris hydrochaeris* (capybara), *L. tigrinus* (oncilla), *Procyon cancrivorus* (crab-eating raccoon) and *C. jacchus* (common marmoset) with UV=0.02 and *Puma yagouaroundi* (jaguarundi) with UV=0.05. Among the wild mammals recorded in the present study, two species are classified in the IUCN Red List of Threatened species (IUCN)³² and the Brazilian List of Endangered Fauna Species (MMA)³¹ as vulnerable to extinction (VU) *Leopardus tigrinus* (oncilla) and *Puma yagouaroundi* (jaguarundi). The other species recorded are included in the least concern (LC) category. The respondents stated that several species were experiencing population decline and that hunting practices, deforestation and the construction of dams for agriculture were the major factors contributing to the decrease in many mammal species. An example is *E. sexcinctus* (six-banded armadillo), which was mentioned by 33 % of respondents (n=13) as the most difficult game mammal to find in the region at present.

Discussion

Our results indicate that the use of wild mammals as food resources predominates among the types of

uses recorded in the studied area. The hunting preference for wild mammals reflects a trend noted in different localities³⁴⁻³⁶. As suggested by Alves *et al.*¹⁷, the hunting pattern for game vertebrates used for food with a preference for mammals (higher biomass) indicates that the choice of species may be locally influenced by the availability, richness and size of the target species. Trinca & Ferrari³⁷ noted that hunters from the Amazon portion of the Brazilian state of Mato Grosso also related slaughtered animals to local abundance and body size. In the state of Amazonas, De Souza-Mazurek *et al.*³⁸ reported that mammals represented 91 % of the total weight of the most consumed species. In a study conducted in Pocinhos, Paraíba state, Mendonça *et al.*¹⁸ found that hunters reported that game meat tasted better than the meat of domestic animals; however, the consumption of game meat was occasional due to the difficulty in obtaining meat from game animals. In the Caatinga biome, the use of wild mammals for food is an ancient practice that persists to the present time and has become one of the main motivations for hunting such animals over the years. However, hunting and the use of wild animals in the region also represent major threats for some vertebrate species^{5,39,31}, indicating the importance of understanding hunting activities to determine the sustainability of such uses²⁸. In the studied region, meat is the main product used for food. The by-products from mammals (Fig. 2), such as fat and leather, are used for other purposes, thereby optimizing the use of wildlife resources¹⁷. The use of game species by-products for medicinal purposes recorded in the studied area has been reported in many ethnozoological studies. Alves & Rosa⁴⁰ studied the use of animals in zootherapy by fishing communities in North and North eastern Brazil and emphasized that their by-products were used as amulets and in "faith-healings" to prevent and treat diseases related to unnatural causes, in addition to the raw material provided by animals for the treatment of diseases using clinical methods. Carnivorous mammals are among the major animals involved in conflictual relationships with human populations in the Caatinga biome^{5,41}. This trend was also noted in the studied area, where carnivorous mammals were considered a risk for both livestock and local inhabitants. In the present study, we observed that bats were hunted for attacking fruit crops, transmitting diseases and feeding on the blood of domestic animals, especially cattle. The negative

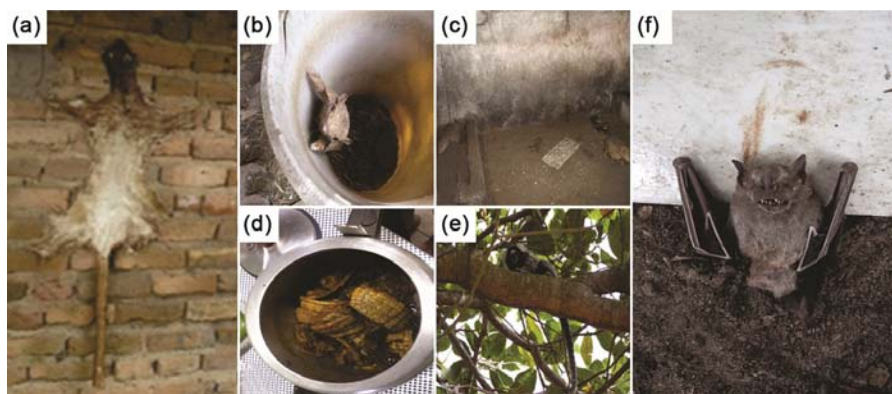


Fig. 2—Examples of some mammals and their by-products mentioned by the respondents in the present study: *Leopardus tigrinus* – oncilla (A), *Euphractus sexcinctus* – six-banded armadillo (B, C and D), *Callithrix jacchus*- common marmoset (E), *Artibeus* sp. – fruit bat (F).

perception of bats has been recorded in other localities in Paraíba state. For example, a study on the interactions between humans and bats in the surroundings of a protected area in Northeastern Brazil found that 11.2 % of the respondents mentioned that bats attacked domestic animals to feed on their blood and 7.5 % mentioned that bats attacked fruit crops⁴². Fernandes-Ferreira⁴³ studied hunting activities in the Serra de Baturité Protected Area (APA da Serra de Baturité), Ceará state, and found that carnivores were often slaughtered as a form of control in response to attacks on humans and domestic animals. According to Mendonça *et al.*²⁸, conflict interactions between wildlife and human communities are extremely important from the perspective of conservation and represent a significant challenge for conservation managers. Species used in folk medicine in the studied area were also reported to be used for the same purpose in other studies that investigated the use of wildlife resources for the treatment of different types of human diseases^{17,44}. In a study with indigenous hunters of the “Tupinambá de Olivença” people (Bahia state, Brazil) concerning the knowledge and use of game fauna, Pereira & Schiavetti⁴⁵ found that the fat of animals was the main medicinal product used by the “Tupinambá de Olivença” hunters. In agreement with the present study, others authors⁴⁶⁻⁴⁸ also noted that fat was the most used raw material in the treatment and cure of many diseases. Hunting practices related to other factors, such as deforestation and habitat fragmentation, exert variable effects on the densities of animal species and may lead to population decline, which has been perceived by local hunters. This situation represents a challenge to seek new forms of exploitation

that minimize the impact on game species. For this purpose, it is necessary to understand the multidimensional context involving hunting practices^{47,17}. Leal *et al.*²⁵ suggested that non-sustainable human activities, such as burn-and-slash agriculture and the continuous removal of plant cover for cattle and sheep farming, caused large-scale environmental impoverishment. Therefore, the hunting of wildlife should be considered a type of anthropogenic pressure^{17,11}. In this context, knowing the chosen species and the amount of and reason for extraction are essential aspects to understand the type of use and the degree of the hunting threat for each wild species⁴⁹. Therefore, ethnozoological studies are crucial for the development of effective strategies to regulate hunting and the sustainable management of wildlife resources^{17,3}. In the Brazilian semiarid region, the use of wildlife resources through hunting practices is strongly consolidated in the cultural sphere and plays a crucial socioeconomic role for the people of the Caatinga involved in this activity. Our results suggest the need for effective public policies aimed at the creation of educational programs target in the sustainable management and conservation of wildlife, including the socioeconomic and cultural context of the users of the Caatinga fauna resources. As suggested by Alves *et al.*¹⁷, actions aimed at minimizing the impacts on animal populations are essential and must include the following factors: a) elaboration of educational programs for wildlife management with a strong component on environmental law and its effective enforcement and b) establishment of communication channels between academic and government institutions and the human populations engaged in hunting activities¹¹.

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