



# Use and traditional management of *Galea spixii* (Wagler 1831) and *Kerodon rupestris* (Wied-Neuwied 1820) in the municipalities of Pau dos Ferros, Encanto, and Francisco Dantas (northeastern Brazil)

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## Abstract

This study aimed to identify the forms of use (knowledge and current use) and traditional management of two rodent species reared as pets: *Galea spixii* (Wagler 1831) and *Kerodon rupestris* (Wied-Neuwied 1820), popularly known as “preá” and “mocó,” respectively. This case study was carried out in the Caatinga biome, in the state of Rio Grande do Norte (northeastern, Brazil). Residents of rural communities were interviewed regarding their knowledge of these species, as well as the purposes for which they use these animals. The data were obtained through semi-structured questionnaires addressing questions on the purposes of use, current use, and issues on biological and ecological knowledge of these species. Four purposes of use (food, rearing, zootherapeutic, and artisanal) were recorded for both species, which are currently used for food and rearing purposes. Their management is performed outside their natural environment, according to their peculiarities. This type of analysis is essential to understanding the sociocultural importance of these animals, in addition to providing data that can be used in wild species conservation plans if their populations in natural habitats decline due to environmental or exploitation factors.

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**Keywords** Rodent use · Rearing · Protection management · Maintenance management

## 1 Introduction

The use of mammal species in human communities is practiced all over the world (Gonzalez and Vallejo 2014; Altaf et al. 2017; Francesconi et al. 2018; Nieman et al. 2019; Santos et al. 2019a, b, c; Zarazúa-Carbajal et al. 2020). Many species, including those of the family Caviidae, are hunted and used for food, and reared as pets, for example.

*Galea spixii* (Wagler 1831) and *Kerodon rupestris* (Wied-Neuwied 1820), belonging to the family Caviidae, are among the most appreciated species in the semi-arid region of Brazil. Commonly known as “preá,” *G. spixii* is a small-sized animal, weighing between 140 and 560 g. Meanwhile, *K. rupestris*, popularly known as “mocó,” weighs between 700 and 900 g (Paglia et al. 2012).

Despite their small body sizes, these rodents have been used as a resource for food (Lima et al. 2018), artisanal (Santos et al. 2019a), and zootherapeutic (Santos et al. 2019b) purposes, as well as reared as pets (Santos et al. 2019b) in the semi-arid regions of Brazil, especially during the drought periods that are a characteristic of these areas. Such regions are characterized by annual rainfall ranging from 240 to 900 mm and a dry season of 7–11 months (Santos et al. 2011).

The usage of *G. spixii* and *K. rupestris* involves both ecological and cultural factors, as they both have numerous desirable biological characteristics, including high relative reproduction rates, reproduction in captivity, gregarious habit, practice of polygamy, prolificness, society, and docility, as well as providing tasty meat that is much appreciated by the sertanejos (Roberts et al. 1984; Pinheiro et al. 1989). These criteria encourage people to rear and manage these animals.

Moreover, captive rearing of wild species is a common practice among populations in tropical and subtropical regions (Richter 1979), representing one of the oldest interactions between humans and animals (Alves et al. 2010; Alves 2012).

Wild species are collected from their natural habitat (in situ) through specific hunting and capture strategies. In the case of rodents in semi-arid regions, it is common to use the “fojo,” which is a wooden trap that captures the animal for manual collection (Alves et al. 2009) and later management in controlled environments (ex situ) (Zarazúa-Carbajal et al. 2020).

It is noteworthy that according to the National Report on Wild Animals Trafficking (RENTAS 2017), many citizens who rear wild species have no intention of commercializing them; instead, the person-animal bond is related to a passion for having a pet as a family member. In this sense, animals reared ex situ are subjected to maintenance care, such as feeding control and restricted movement capacity (Zarazúa-Carbajal et al. 2020).

According to the RENTAS (2017), captive rearing of animals has accumulated a deep knowledge of food, sanitary, and reproductive management of intensively reared species. However, the sociocultural practice related to the rearing of wild animals is illegitimate in Brazil because, legally, pets must be born in a commercial rearing place authorized for such purpose (IBAMA 2015).

It is worth mentioning that several breeders (illegal) are skilled in the techniques of maintenance and the captive rearing of many species, with knowledge of animal management that has accumulated over many generations. This mastery of the management of several species continues to be of high importance for the conservation and existence of

genetic wealth (RENTAS 2017), for both the management of natural environments and those areas modified by human activities.

Interventions during species management, when performed continuously, potentially cause changes in the morphological (e.g., color and size), behavioral (the animal becomes docile), and genetic (e.g., molecular biology and cytogenetics) characteristics of an animal, resulting in their domestication. Thus, studies are necessary to understand the dynamics of the captive rearing of wild species.

In this context, based on the relationship between human populations in the Brazilian semi-arid region and the rodent species popularly known as “preá” and “mocó,” this study aimed to investigate the forms of use (both knowledge and current use) and traditional management of these animals (reared as pets). The information obtained regarding the management of these species by the local population may indicate they have undergone an incipient domestication process, which would require future studies to be confirmed.

Furthermore, this study provides guidelines that can be used in wild species conservation plans, once their populations in natural habitats decline due to environmental and/or exploitation factors.

## 2 Methods

The data were collected in rural communities in the municipalities of Pau dos Ferros, Encanto, and Francisco Dantas (Rio Grande do Norte, northeastern Brazil) between February and November 2017 (Fig. 1). The family income in these communities is based on agricultural practices, animal rearing, and/or pension.

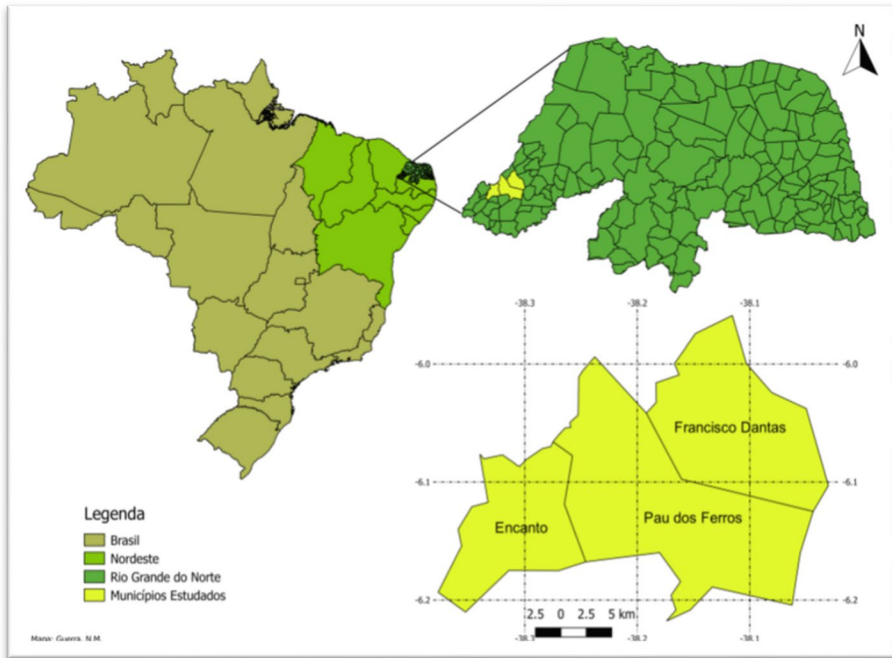
### 2.1 Study area

The communities of Extrema, Sorriso, Capa de Cima, and Capa de Baixo are located in Pau dos Ferros. According to the Brazilian Institute of Geography and Statistics, Pau dos Ferros (06°06'33" S and 38°12'16" W, at 193 m of altitude) has 27,745 inhabitants and a population density of 106.73 inhabitants per km<sup>2</sup>, of which 25,551 live in the urban area and 2194 live in the rural area (IBGE 2010).

The climate in the region is semi-arid hot (*Bsh*, according to the Koppen-Geiger climatic classification) with a mean annual temperature of approximately 27 °C. Pau dos Ferros is one of the hottest municipalities in Rio Grande do Norte, with temperatures that reach more than 38 °C in the hottest months, especially in the afternoons (IBGE 2010).

The communities of Várzea Velha and Cantinho belong to the municipality of Encanto (06°06'38" S and 38°18'19" W, at 212 m of altitude), which has an estimated population of 5231 and a population density of 41.6 inhabitants per km<sup>2</sup>, 3101 residing in the rural area and 2130 in the urban area (IBGE 2010). The climate in the region is classified as semi-arid hot (*Bsh*, according to the Koppen-Geiger climate classification), with a mean annual temperature of 26.7 °C. The highest precipitation occurs in March (IBGE 2010).

Urrada is a rural community belonging to the municipality of Francisco Dantas (06°04'42" S and 38°07'10" W, at 224 m of altitude) with a population of 2874 and a population density of 15.83 inhabitants per km<sup>2</sup>, of which 1647 live in the urban area and 1227 live in the rural area (IBGE 2010). The climate in the municipality is hot semi-arid (*Bsh*, according to the Koppen-Geiger climate classification), with a mean annual temperature of 26.5 °C (IBGE 2010).



**Fig. 1** Distribution map of the study municipalities in the state of Rio Grande do Norte (Northeast Brazil) (Natan Guerra 2017)

## 2.2 Ethnozoological inventory

The ethnozoological information was obtained by interviewing people who used and managed *G. spixii* and *K. rupestris*.

The informants were selected through the snowball sampling technique, which consists of interviewing local experts (Bailey 1994). These social actors are those people who recognize themselves as specialists and/or are recognized for their specialized knowledge regarding a specific theme (Hays 1976); in the case of the present research, this theme was the study of rodent species.

The semi-structured questionnaire used to interview these experts addressed questions about purpose(s) of use(s) for each species and their respective used parts, current use(s), forms of management (rearing difficulties and preferences, the possibility of large-scale rearing, manner of preparing the environment and/or enclosure where the animals are reared, provided diet, forms of protection, management time, and influences in the reproduction process), and morphological (e.g., size and color) and ecological (e.g., behavior and habitat) descriptions, complemented by free interviews and informal conversations (Albuquerque et al. 2010). The participants' socioeconomic data were also recorded during the interviews (Table 1).

Before the interview, the objective of the research was explained to each informant, who gave the researches permission to record and later use the information provided by them. Subsequently, they were invited to sign the Informed Consent Term, required by the National Health Council through the Research Ethics Committee (CNS/MS Resolution

**Table 1** Socioeconomic profile of the respondents

Gender	
Men	8
Women	1
Age group	
30–50	2
51–70	5
> 70	2
Residency time	
> 60 years	1
31–60 years	3
15–30 years	2
< 15 years	3
Schooling level	
Incomplete primary education	4
Complete primary education	3
Complete secondary education	2

466/12). This research was approved by the Federal University of Paraíba (protocol No. 76987517.6.0000.5188).

### 2.3 Data analysis

The scientific identification was performed according to the following criteria: [1] vernacular names; [2] photographs of the animals analyzed from direct observations (Fig. 2); [3] guided by bibliographic references of ethnozoological studies previously performed in the study mesoregion; and [4] help from taxonomists who knew the fauna of the study areas (researchers from the Mammalogy Laboratory of the Federal University of Paraíba, Campus I).

The various forms of species usage were grouped into four categories: (1) food—indicating the animal is used as a protein source; (2) rearing—the animal is used as a companion, i.e., reared as a pet; (3) zootherapeutic—parts of the animals' body are used in the production of medicines for human health care; and (4) artisanal—biological parts of the animals are used in the manufacture of decorative items or for food production.

The knowledge of the uses attributed to each species was distinguished according to Lucena et al. (2012), who proposed separation of potential use from current use. Potential use refers to the forms of use people know about but do not personally perform, whereas current use refers to the uses people cited as effective (known and currently performed by them). Also, non-participant observation (Huntington 2000) was used to record the current use of the rodents and, when possible, the techniques used to capture them in their natural environment.

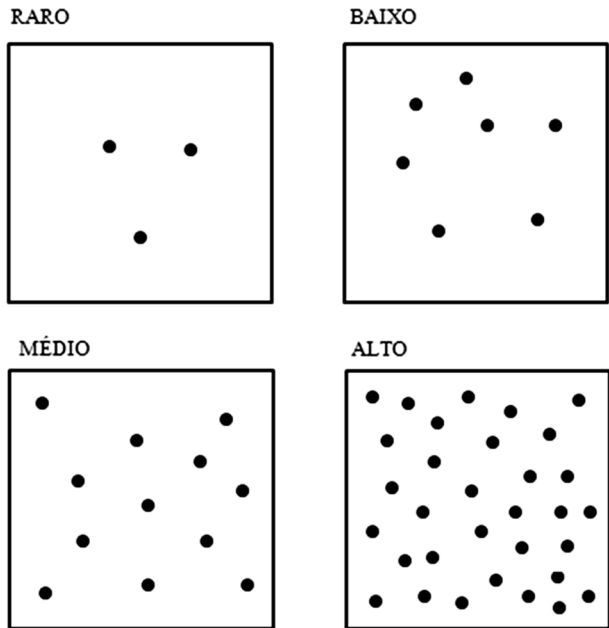
### 2.4 Perceived abundance

To verify the perceived abundance of the studied species, a figure was illustrated to show possible densities of the species populations in the region (Fig. 3). This figure



**Fig. 2** a—*Galea spixii* (Wagler 1831) (preá) and *Kerodon rupestris* (Wied-Neuwied 1820) (mocó); b and c—*G. spixii*; d, e and f—*K. rupestris*, recorded in rural communities in the municipalities of Pau dos Ferros, Encanto and Francisco Dantas, state of Rio Grande do Norte (Northeast Brazil)

**Fig. 3** Perceived abundance of *G. spixii* (preá) and *K. rupestris* (mocó) used in rural communities in the municipalities of Pau dos Ferros, Encanto and Francisco Dantas, state of Rio Grande do Norte (Northeast Brazil)



was used to minimize the subjectivity effect on the abundance of the animals. Besides, all informants were subjected to the same visual parameter and objective of abundance, determined by the authors of this study.

### 3 Results

#### 3.1 Local knowledge of the forms of use of wild rodents: *G. spixii* (preá) and *K. rupestris* (mocó)

Nine residents were interviewed (8 men and 1 woman), corresponding to 100% of local breeders. The informants were selected through the snowball method, in which a participant indicates other participants, in an attempt to find as many informants as possible that have reared or managed rodents. All of the areas indicated, as well as all of the participants, were visited.

Further information on this subject may be obtained by conducting studies in different areas, promoting reliable results on the forms of interaction between humans and animal resources. It is worth mentioning that it is difficult to access information on rearing and management of wild species because breeders resist admitting that they use or rear animals.

The number of informants varies between *G. spixii* and *K. rupestris* as two respondents reported having no specific knowledge of *K. rupestris*, explaining that they have never used and, consequently, never managed this species.

Regarding local knowledge of the forms of use, *G. spixii* was cited for several purposes, such as food ( $n=43\%$ ), rearing ( $n=43\%$ ), zootherapeutic ( $n=9\%$ ) (Table 2), and artisanal ( $n=5\%$ ). The uses of *K. rupestris* were also organized into four categories accounting for distinct citations: food ( $n=35\%$ ), rearing ( $n=35\%$ ), zootherapeutic ( $n=20\%$ ) (Table 2), and artisanal ( $n=10\%$ ).

#### 3.2 Hunting techniques involved in the capture of wild rodents

The species are collected from their natural environment through hunting techniques developed by the informants themselves, as well as by other people in the community.

The method of capturing the animal depends on the purpose for which it will be used. For example, if the animal is to be used for food purposes, the techniques used may kill the specimen(s) during capture; however, if the animal is to be used for rearing purposes, it must be captured by non-lethal traps (Fig. 4). Eight and seven techniques were recorded for *G. spixii* and *K. rupestris*, respectively (Fig. 5).

#### 3.3 Current use of rodents

*Galea spixii* and *K. rupestris*, according to the informants, are currently used for both food and rearing purposes. The preference for food purposes is not widespread due to the notorious emotional attachments between humans and these animals. This factor reduces such practice but does not exclude them, as some respondents reported using these species as food sometimes when relatives or friends visited.

The pleasant taste of the meat of these species is appreciated not only by people in the studied community, but also by visitors from several localities, who come in search of these animals for purchase as a protein source.

#### 3.4 Rearing aspects: species management

The rearing of wild rodents involves care considering their biological (e.g., behavior, diet) and ecological (e.g., habitat, habit) characteristics.



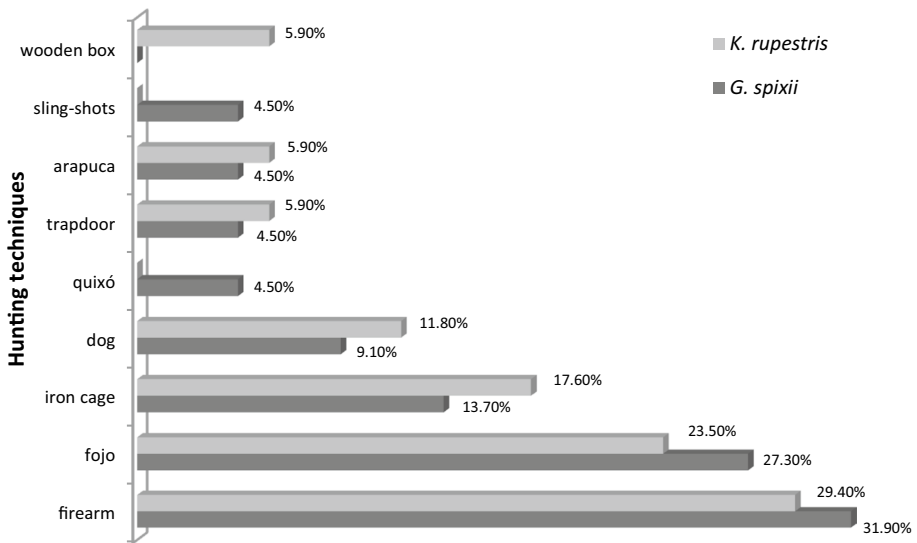
**Table 2** Used part, form of use and therapeutic purposes of *G. spixii* (preá) and *K. rupestris* (mocó), described by informants from rural communities in the municipalities of Pau dos Ferros, Encanto, and Francisco Dantas, state of Rio Grande do Norte (Northeast Brazil)

Scientific name	Used part	Form of use	Treated disease
Rodentia			
Caviidae			
<i>Kerodon rupestris</i> (Wied-Neuwied 1820)	Meat Broth Broth Stomach (rennet)	Ingestion of cooked portion Ingestion of broth from cooked meat Ingestion of broth from cooked meat Tea	Energy repository for women after pregnancy surgery Strengthening and accelerating dental growth in children Bone strengthening Digestive system disorder—tummy ache
<i>Galea spixii</i> (Wagler 1831)	Meat Fat	Ingestion of cooked portion with no salt and seasoning Melt and put on the affected area	Respiratory system disorder—cough Hair alopecia





**Fig. 4** **a**—“arapuca,” **b**—wooden box, and **c**—iron cage. Techniques used to capture *G. spixii* (preá) and *K. rupestris* (mocó) in rural communities in the municipalities of Pau dos Ferros, Encanto, and Francisco Dantas, state of Rio Grande do Norte (Northeast Brazil)



**Fig. 5** Percentage of citation referring to hunting techniques used to capture *G. spixii* and *K. rupestris* developed in rural communities belonging to the municipalities of Pau dos Ferros, Encanto and Francisco Dantas, state of Rio Grande do Norte (Northeast Brazil)

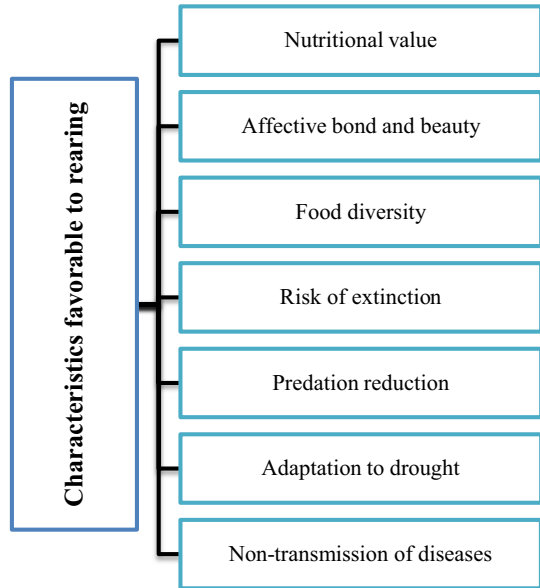
The informants pointed out that rearing of *K. rupestris* by confining the animal in an enclosure results in fights among the animals and, consequently, the death of the males, either due to the females, who are aggressive toward them and kill them when trapped together, or due to fights with other males over disputes between territory.

These problems are probably related to the breeders' lack of interest in rearing these species on a large scale ( $n_{\text{mocó}} = 5$ ;  $n_{\text{preá}} = 6$ ).

Regarding the preferences for rearing both species, several reasons can be considered (Fig. 6).

Managed specimens are often reared in open areas (yards and/or porches), places named as “coivaras” (stacks of dry branches), and/or rocks, which shelter them (Fig. 7). It is noteworthy that this type of rearing allows the animals to move between their natural environment and the rearing area.

**Fig. 6** Characteristics related to the preference for rearing *G. spixii* (“preá”) and *K. rupestris* (“mocó”) in descending scale, according to the number of citations by informants living in rural communities in the municipalities of Pau dos Ferros, Encanto and, Francisco Dantas, state of Rio Grande do Norte (Northeast Brazil)



Many specimens stay in the rearing structure built for them; however, some move away and return to their natural habitat. One informant reported that when a male returns to its natural habitat, it emits a sound for a long time, presumably in an attempt to attract the females.

A variety of food resources are made available, such as fruit, vegetables, corn bran, bread, and even cooked food prepared for the family, such as rice, beans, pasta, and cuscuz (a dish consisting of steamed corn): *The animals sing for food at the yard door* (T. B. Q., 65 years old).

Additionally, breeders protect their specimens from possible attacks, killing predators that threaten the rodents, such as domestic cats, foxes, wild cats, snakes, teju lizards, and hawks.

The animals reared by the respondents have morphological characteristics similar to those of specimens found in their natural habitat. On the other hand, they do have a slightly different diet and display different behavioral patterns. The following

**Fig. 7** Structure (“coivaras”) built to shelter the animals and provide food resources—Pau dos Ferros, Rio Grande do Norte (Northeast Brazil)

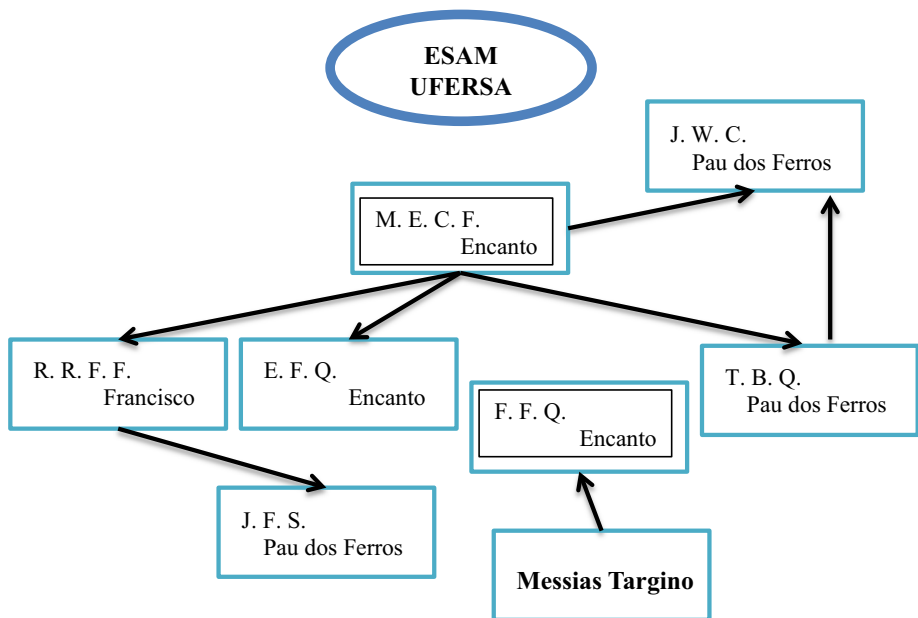


morphological and behavioral description was reported by the breeders during interviews and informal conversations: *They are tame, and get closer to people; in the brush-wood, if they sense the presence of someone, they hide and certainly don't come out.* (J.F.S., 56 years old).

*K. rupestris* has been reared by two informants in the region since 1998. One of them lives in the rural community of Cantinho, in the municipality of Encanto, and acquired the specimens from the neighboring municipality (Messias Targino). The other informant lives in the Várzea Velha farm (municipality of Encanto) and acquired the specimens by a donation from the ESAM (Agriculture Higher School of Mossoró), currently, named UFERSA (Semi-arid Federal Rural University), located in Rio Grande do Norte State; this breeder rears the animals with the purpose of increasing their populations.

Over time, other people became interested in rearing *K. rupestris*, sharing the principle of increasing its population. Thus, some of the informants, both from the community itself and from other municipalities, asked the first breeder, from Várzea Velha, for some specimens. Additionally, breeders from neighboring states acquired specimens through donations from people who had obtained descendant animals from those donated by the Education Institute, creating a chain of distribution of this species (Fig. 8).

Regarding *G. spixii*, informants explained that rearing occurred after the establishment of *K. rupestris*, when specimens of *G. spixii* moved closer to the areas near the residences. The perceived abundance of this species in the region was high at that time, which possibly contributed to its rearing. It is noteworthy that some people rear only *G. spixii*, in this case, there is no spontaneous approach, and the animals are captured in the region and later released in the rearing area.



**Fig. 8** Distribution chain of *K. rupestris* (mocó) reared by residents of rural communities in the municipalities of Pau dos Ferros, Encanto, and Francisco Dantas, state of Rio Grande do Norte (Northeast Brazil)

### 3.5 Trading aspects

Regarding the commercial value of these species, it was observed that due to body pattern and meat taste, *K. rupestris* is more expensive than *G. spixii*, reaching prices of approximately US\$ 20 and US\$ 2 per couple slaughtered, respectively.

According to the informants, although these prices have been established by people years ago, these animals are no longer sold. Only one informant claimed to be interested in commercializing them because, at a time not too long ago, it was an important means of complementing his income (he had already commercialized *G. spixii*). The other informants knew of yet had no interest in this practice; they prefer to donate live animals for future rearing by other people. The purpose of this process is the donation of a couple of animals for future mating and reproduction, increasing their population size. Some informants, however, prefer to donate male specimens in order to minimize the fights that occur when populations are mostly composed of males.

### 3.6 Perception of local species availability

With regard to the perceived abundance, the respondents stated that there is a high number of specimens of both studied species in nature (only one informant indicated *K. rupestris* as a rare species), and pointed out that this is probably due to the care provided by them.

Partly due to the care involved in the rearing these animals in open environments, which makes possible their future displacement to natural environments, as well as their use as food produced exclusively by the breeders themselves and that sometimes, breeders reprimand the hunters/gatherers who wish to obtain this type of game in the region, specimens are no longer captured/hunted by locals in their natural habitat.

## 4 Discussion

Mammalian species are of great importance to traditional populations in several parts of the world, where they are used as food (Carpaneto et al. 2007; Hanazaki et al. 2009), for zootherapeutic (Gonzalez and Vallejo 2014; Altaf et al. 2017; Nieman et al. 2019) and artisanal purposes (García-Flores et al. 2014; Santos et al. 2019a), and reared as pets (Santos et al. 2019b; Solís and Casas 2019).

Large-sized species are the usual primary target of wild animal hunters; however, small-sized animals are also sometimes involved (Macdonald et al. 2011; Ripple 2015). The group of mammals in the semi-arid region of Brazil comprises species of high utilitarian value, including small-sized mammals such as the rodents *G. spixii* and *K. rupestris* (Santos et al. 2019a, b, c). In our study, the informants cited four utilitarian purposes for the studied species: food, rearing, zootherapeutic, and artisanal. The former was the most prominent and, in all categories except for captive rearing, the animals are slaughtered prior to use after being acquired from their natural environment.

For food purposes, the animals are prepared (cooked or roasted) according to the consumer's preference. In folk medicine, the species have been cited for a combined six therapeutic purposes: four for *K. rupestris* and two for *G. spixii* (Table 2). Regarding artisanal use, the stomachs of both species are used in the preparation of cheese. All

the practices described here corroborate the results of other studies conducted in the Caatinga (Fernandes-Ferreira and Alves 2017; Oliveira et al. 2017; Santos et al. 2019b).

The capture of wild animals is carried out through predatory hunting, which has been improved over the years, using techniques specific to each species (Alves et al. 2009). Eight capture techniques for *G. spixii* and seven for *K. rupestris* were recorded in the study communities.

Considering their current use, *G. spixii* and *K. rupestris* both play relevant roles in the life of those who participated in the study, as these species are used as pets and appreciated by the “sertanejos” as food. Both of these uses have been recorded in other regions of the world, especially the food category, which accounts for a significant number of useful mammal species (Carpaneto and Fusari 2000; Francesconi et al. 2018; Solís and Casas 2019; Santos et al. 2019a, b, c). In general, wild animals are reared at smaller scale and this practice may be related to their beauty and the affective bond between them and the breeders, or to their use as a food resource (Santos et al. 2019b).

Regarding *G. spixii* and *K. rupestris*, the informants stated difficulties in rearing these species, such as keeping *K. rupestris* enclosed. However, breeders demonstrated a strong understanding of the animals’ biological and ecological aspects, which allows them to punctually manage these species (e.g., feeding and preparing an appropriate rearing environment).

The females’ aggressiveness when confined with males, as described by the breeders, is a behavioral characteristic observed in *Cavia* rodents. This wild species has a linear hierarchy between females (Sachser 1986; Künzl and Sachser 1999), and agonistic behavior toward other females’ offspring and young rodents has already been recorded (Rood 1972). To solve these conflicts, the breeders interviewed in our research raise the species in open areas.

Despite the difficulties faced in rearing these animals, the breeders described seven characteristics favorable to the development of this activity, highlighting the species’ nutritional value and their beauty, as well as the affective bond. Concerning the first characteristics of these animals, the informants explained their rearing helps to reduce their capture in a natural environment for consumption, consisting of another reason (reduction of predation) for performing such an activity. Meanwhile, the latter characteristic evidences people’s attachment to animals reared ex situ.

The risk of extinction is another important aspect described by the breeders as a factor driving the rearing of *G. spixii* and, especially, *K. rupestris* because, according to the breeders, they became interested in rearing this species due to decreased numbers of the specimens in situ. One of the first breeders of *K. rupestris* received specimens from researchers (Semi-arid Federal Rural University—UFERSA) who informed them about the species’ population decrease.

Regarding rearing preference, the non-transmission of diseases from *G. spixii* and *K. rupestris* is another factor worth mentioning. In an informal conversation with the wife of one of the breeders, an existential risk of catching diseases from *K. rupestris* was recorded. She reported having been diagnosed with an illness caused by the constant presence of the animal inside her residence.

In this regard, experimental studies on locally reared specimens are needed to analyze the susceptibility of the species as being possible vectors of parasites able to transmit diseases to other individuals; or as agents that may transmit diseases through, for example, feces, urine, or saliva that affects humans.

Bezerra et al. (2014), in an area of Caatinga in the state of Ceará, Brazil, investigated the occurrence of *Trypanosoma cruzi* in insect and mammal species and found that *Thrichomys*

*laurentius* (Thomas 1904) (74%; 83/112) and *K. rupestris* (10%; 11/112) were the most infected wild animals. Nevertheless, these authors showed no data evidencing transmission to humans. They also explained that the role played by different mammal species in the maintenance and reproductive cycle of *T. cruzi* is not constant and varies in time and place.

Regarding the management of these animals, the breeders seek to provide favorable conditions for their survival. This management involves the preparation of an environment with conditions similar to those in their natural environment, such as the provision of an appropriate diet and protection from predators, sometimes by killing the predator and allowing the rodents to stay in the area.

According to Zarazúa-Carbajal et al. (2020), the type and intensity of management practices depend on the motivations related to the use of the animal, as well as the traditional ecological knowledge involved in the interactions between humans and fauna.

Concerning the mating, the informants reported that they did not interfere with the animal's reproduction. However, because of the closeness between breeders and these rodents that results from the care provided for their maintenance, the breeders may potentially promote their genetic variability. Although the management strategies performed in the study areas are not directly related to artificial selection, as people do not interfere with the mating in order to select characteristics favorable to rearing them as pets (e.g., larger body size, less aggressive tendency), instead, they attenuate the natural selection of these species by eliminating various selective environmental factors, such as the search for resources (food, territory, and mates) and predation.

Regarding the differences between the specimens reared *ex situ* and those living *in situ*, the behavioral pattern is the most visible. According to the breeders, the animals reared *ex situ* are more docile than the wild ones. It should be noted that considering the distribution chain described here, *K. rupestris* has been managed for approximately 20 years. In contrast, *G. spixii* has begun to be managed more recently, after the establishment of the *K. rupestris* population.

The ethological factor and the management time of the animals reared in the study communities, together with other information on the management of species (maintenance care), may potentially indicate an incipient domestication process of the study species.

Taking another rodent species for example, *Cavia porcellus* (Linnaeus 1758) is classified as a domesticated animal in South America. The consumption of this species as food stands out in some countries such as Ecuador and Peru, as well as in the south of Colombia (Martínez-Polanco 2016), while it is also used as a pet and in laboratory practices (Valim et al. 2004).

Recently, in Peru, the rearing of *C. porcellus* in intensive production systems has been intensified. This is because the species is in high demand, being used as the main product in many typical dishes sold in patron and regional festivals and fairs throughout the country (Morales et al. 2011).

The commercialization of *K. rupestris* and *G. spixii* has been important in the study communities but is no longer so. A couple of *K. rupestris* used to cost US\$ 20 due to their larger size, while a couple of *G. spixii* used to be sold for US\$ 2. These values were significant for supplementing the sellers' income. However, this practice increased the collection pressure on these animals, as their capture was performed by any hunter who was interested and willing to search for this resource.

Most of the breeders showed no interest in selling the animals; they prefer to donate them to people who are interested in rearing the species. The new breeders serve as a means of increasing the number of specimens and can later provide some descendants as food.



Although the informants use *G. spixii* and *K. rupestris* for various purposes, these social actors recognize the need to reduce in situ collections of the species. From the conservationist point of view, it is inferred that these attitudes may be contributing to the increased spatial distribution of these animals in nature, considering that these species were perceived as scarce.

It is worth emphasizing that due to the low number of participants in this study, it was sought to understand the perception of species abundance in a qualitative way. Thus, it was concluded that the possible population increase reported by the breeders is influenced by the practice of raising these animals and that the higher availability of specimens in nature does not intensify their hunting. However, specific analyses are necessary to assess the relative abundance and population density of these species in the region.

Currently, these species are not on the lists of endangered animals of the *International Union for Conservation of Nature* (IUCN 2017). However, *K. rupestris* is classified as vulnerable on the national list of endangered species due to the frequency in which its specimens have been captured (MMA 2016). Therefore, it is important to record the forms of use of this species and understand the sociocultural factors, such as management, involved in the peoples' utilitarian preference for this animal.

## 5 Conclusions

*Galea spixii* and *K. rupestris* have remarkable sociocultural value in the studied communities result in their use for both food and rearing purposes. The rearing practices observed in this research involve maintenance care of the animals (preparation of rearing environments, food availability, and protection against predators). These mammals have been reared for approximately twenty years and are characterized by breeders as being more docile than those living in their natural environment. Management, when performed intensely and continuously, may promote an incipient domestication process of these animals. In this perspective, further studies need to be conducted in other areas to understand the dynamics involved in the management of these rodents and to verify (in the case of predisposition) if there is genetic variability between reared specimens and those living in their natural habitat.

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