Research Article

Wild vertebrates kept as pets in the semiarid region of Brazil

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Abstract

The keeping and commercialization of the native wild fauna of Brazil as pets threatens many animal species. These practices are traditional and common, and have persisted until the present day in the semiarid region of Brazil in spite of their illegality. We used an ethnozoological approach to investigate keeping native vertebrates as pets in a city of the semiarid region of Brazil, as well as the conservationist implications of this practice. We found that most of the interviewees raised pets, predominately domesticated animals (cats and dogs). Keeping wild animals as pets, however, persists in the region, and 31 wild native species were identified, including 28 bird species. Other groups included mammals (n= 2 species) and reptiles (n=1). Among the wild birds, the families with the most species were Thraupidae (39%), Columbidae (19%), and Icteridae (10%). Keeping wild animals as pets is a clandestine practice that involves people from all socioeconomic levels – indicating its strong cultural character and the inefficiency of environmental enforcement actions. Future strategies for the conservation of native wild animals must include educational activities in the schools, the substitution of these wild species for domestic cats and dogs, and/or stimulating legal breeding programs for wild animals. Additionally, steps must be taken to strengthen enforcement of laws against illegal trafficking of wild animals.

Key words: Ethnozoology, conservation, commercialization of wild animals

Resumo

A criação e comércio da fauna silvestre como animais de estimação tem sido apontada como uma ameaça para muitas espécies de animais. Particularmente, no semiárido brasileiro, essas práticas são comuns e vem persistindo historicamente na região, apesar de serem legalmente proibidas. No presente estudo, através de uma abordagem etnozoológica, investigamos a criação de vertebrados de estimação entre moradores de um município do semiárido brasileiro e suas implicações conservacionistas. Nossos resultados revelaram que a maior parte dos entrevistados cria animais de estimação, com predominância de espécies domésticas. No entanto, a criação de animais silvestres persiste na região, onde foram registradas 31 espécies usadas como pets, das quais 28 são aves. Outros grupos representados foram a mastofauna (n= 2 espécies) e herpetofauna (n=1). Dentre as aves silvestres criadas, as famílias que se sobressaíram em número de espécies registradas foram Thraupidae (39%), Columbidae (19%) e Icteridae (10%) . A perpetuação da criação de animais silvestres na região vem ocorrendo de forma clandestina, sendo praticada por pessoas de diferentes níveis sócio econômicos, evidenciando seu forte caráter cultural e a ineficiência das ações de fiscalização ambiental. Potenciais estratégias de conservação da fauna silvestre local devem incluir a adoção de ações educacionais nas escolas, além do estímulo à criação legalizada das espécies silvestres, ou mesmo a substituição destas por cães e gatos domésticos. Adicionalmente, medidas de combate ao tráfico ilegal de animais silvestres devem ser intensificadas.

Palavras-chave: Etnozoologia, Conservação, comércio de animais silvestres

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Introduction

There are many forms of interaction between humans and animals, including their uses for entertainment purposes (contemplation in zoos, aquariums, and safaris); for transport; generation of energy (traction animals); combating drug trafficking; for sports and warfare activities; and, most frequently, as pets [1]. Millions of people keep many varieties of both domestic and wild animals in their homes [2-5]. Although predominantly birds and mammals (principally dogs and cats) are kept as pets, other groups, including reptiles, fish, amphibians, and even some invertebrates, are becoming common [6-8]. The sociocultural, economic, and environmental implications of these practices are numerous.

In Brazil, wild animals have been kept for companionship for centuries, a very traditional and very widely disseminated practice that involves hundreds of species [2]. This tradition has stimulated the trapping and illegal commerce of many native animals, as most are captured in the wild [2, 9-11], with important implications for animal conservation in the country [9, 12-14]. The custom of keeping pets is as old as human occupation of the semiarid region of northeastern Brazil, and has been identified as an important factor in strong declines in many local species of wild animals. Most research has focused only on wild birds kept as pets [9, 15-17] – indicating the importance of this group in that region – but many other types of animals are involved, especially reptiles and mammals.

We sought new information on the use of wild animals as pets in a semiarid area of Northeast Brazil, where this practice is widespread. Using an ethnozoological approach, we examined the following hypotheses: a) most people who keep pets choose to have traditional domesticated cats and dogs and are inhibited by legal implications from keeping wild animals; b) among those who keep wild vertebrates, birds are the principal species; and c) the local practice of keeping wild animals is independent of the socioeconomic status (income, age, sex) of their owners. We hope the results of our

research will be useful in devising conservation strategies for protecting wild animals in the semiarid region of Brazil.

Methods

Study area

The present study was carried out in the municipality of Santa Luzia, which is situated in the Seridó Ocidental microregion of Paraíba State, Brazil (Fig. 1) (06º 52' 20" S x 36º 55' 07" W). The local population is approximately 14,700 (ca. 7,100 men and 7,600 women) in an area of 456 Km², yielding a population density of ca. 32 inhabitants/Km² [18].

The regional climate is hot semiarid, with average monthly temperatures oscillating between 25 and 28 ºC. Rainfall averages approximately 550 mm per year, with precipitation concentrated between the months of January and April, although there have been periods of great irregularity in rainfall rates in recent decades throughout the entire region [19].

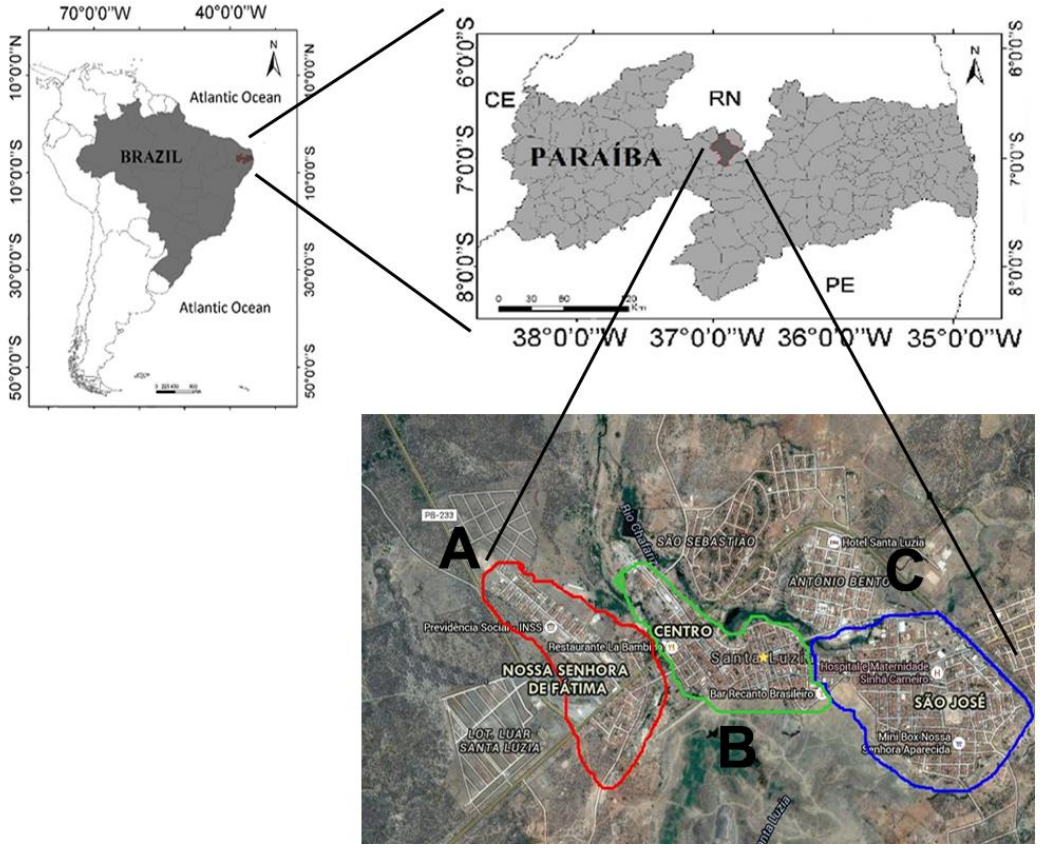

Fig. 1. Location of the municipality of Santa Luzia in Paraíba State, Brazil, showing neighborhoods surveyed (A- Nossa senhora de Fátima, B- Centro, C - São José).

Data collection

We gathered information in residences of three urban neighborhoods of Santa Luzia municipality: 1) Nossa senhora de Fátima, 2) São José, and 3) Centro (Fig. 1). These areas were chosen based on their high numbers of occupied homes. According to the Brazilian Institute of Geography and Statistics – IBGE [18] - the total population of these neighborhoods is 8,454 citizens (57.5% of the municipality). In the first area we visited 553 (96%) of occupied residences, in the second area, 458 (40%), and in the third, 184 (30%). It is noteworthy that only one member of each family (mainly householders) was interviewed in each residence through a semi-structured questionnaire [20, 21]. The questionnaire included socioeconomic aspects such as age, sex, marriage status, civil status, education, and family income, as well as questions about the animal species kept in the homes and practices related to their maintenance. In residences without pets, only the socioeconomic section of the questionnaire was used. Information about the number of animals kept and conditions for maintenance and feeding of the pets was obtained through direct observations in the homes.

Domestic pets such as cats and dogs were identified during the visits. Wild pets encountered in the residences during the interviews were photographed for later identification to the species level. For birds, which had the most species encountered in the residences visited, the scientific nomenclature follows the protocols established by the Brazilian Committee for Ornithological Registration [22]. In addition to birds, three species from two other groups were encountered: two mammals and one reptile. Species identifications for these animals were based on the scientific literature and comparative photographs.

The present work was approved by the CEP - UEPB ethics committee (Comitê de Ética em Pesquisa envolvendo Seres Humanos da Universidade Estadual da Paraíba - Protocol: 38156214.1.0000.5187).

Before conducting the interviews, we outlined the objectives of the research project to the homeowners and sought formal permission to record their responses, asking them to sign a free-consent agreement, according to Resolution 466/12 of the National Health Council/Ministry of Health. In this way, the inhabitants could choose whether or not to participate in the research. In some cases (12 residences) the inhabitants refused to participate in the project, possibly because they were illegally keeping wild animals without authorization (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais), which is an environmental crime.

Data analyses

Basic quantitative analyses were performed with Microsoft Excel to prepare data matrices and graphs. Binary data (presence/absence) were used to measure the species richness encountered during the interviews. The socioeconomic data of the interviewees were categorized into three groups: 1) those keeping only domestic species, 2) those keeping only wild animals, and 3) those keeping both wild and domestic animals simultaneously.

To estimate the total number of species kept as pets we used the nonparametric Chao first-order estimator, which is capable of estimating total species richness from observed richness data, with 1,000 randomizations. This analysis was performed using EstimateS© version 8.2 software [23].

Results

Pets Keepers's profile

We visited a total of 1,195 homes, of which 463 (38.7%) did not keep any pets. In all other residences visited (n=732, 61.3%) pets were present. Considering only those residences which had pets, 641 (88%) kept only domesticated species; 51 (7%) kept only wild species; and 40 (5%) kept both wild and domesticated species simultaneously.

The profiles of the interviewees keeping pets are presented in detail in Table 1. It can be seen that the majority of the people raised only domesticated animals (cats and dogs), and most of them earned up to two minimum-wage salaries. The minimum-wage salary during the research period (2014) was R$ 724 (US$ 302 per month). The interviewees were distributed among many age categories, but were predominately between 20 and 40 years old. They had different levels of schooling, with most having completed high school (Table 1).

Species richness of kept animals

A total of 238 specimens were encountered in the residences of the interviewees who kept wild animals as pets (n=91). These specimens corresponded to 31 species distributed among 11 families (Appendix 1). Of all the species encountered, birds were the most representative group both in numbers of specimens (n=231, 97%) and numbers of species (n=28, 90%). Other groups represented were mammals (n= 2 species, 6%) and reptiles (n=1 species, 3%). Of the total of 31 wild species recorded, 25 (80%) were listed as threatened with extinction [24]. Most of these species (n=24), however, were listed in the Least Concern category according to the IUCN, with only one bird species (the Yellow-faced Siskin *Sporagra yarrellii*) classified as Vulnerable. This latter species is also listed in the Redbook of the Brazilian Fauna Threatened with Extinction under the category Vulnerable [25].

The total number of wild species recorded (n=31) was less than the estimated richness using Chao 1 (33 species). The rarification curve comparing the number of observed species with the estimated richness of wild species kept as domestic pets revealed that the observed richness approached the richness projected by the estimator (93.7%), demonstrating sufficient sampling and a large richness of wild species being kept as pets (Fig. 2).

The principal families in terms of the numbers of species recorded were Thraupidae (39%), Columbidae (19%), and Icteridae (10%). The most frequently encountered species in the homes of the interviewees were: Red-cowled Cardinal *Paroaria dominicana* (n= 36 specimens), White-throated Seedeater *Sporophila albogularis* (n=33), Cactus Parakeet *Eupsittula cactorum* (n=29), Capped Seedeater *Sporophila bouvreuil* (n=18), Ultramarine grosbeak *Cyanoloxia brissonii* (n=15), and Campo Troupial *Icterus jamacaii* (n=15).

Table 1. Socio-economic profiles of pet owners interviewed in the research project, categorized into groups that raised: 1) only domesticated animals, 2) only wild animals, and 3) both domesticated and wild species.

	Domesticated	**Wild**	**Domesticated + Wild**
Sex			
Female	N=348 (88%)	N=25 (6%)	N=22 (6%)
Male	N=293 (87%)	N=26 (8%)	N=18 (5%)
Civil state			
Single	N=124 (86%)	N=13 (9%)	N=7 (5%)
Married	N=473 (88%)	N=33 (6%)	N=31 (6%)
Divorced	N=24 (42%)	N=1 (4%)	N=1 (4%)
Widowed	N=20 (80%)	N=4 (16%)	N=1 (4%)
Income			
Up to R$788	N=310 (89%)	N=21 (6%)	N=19 (5%)
Between R$789 and 1576	N=247 (88%)	N=18 (7%)	N=14 (5%)
> R$1576	N=84 (81%)	N=12 (12%)	N=7 (7%)
Schooling			
Illiterate	N=18 (82%)	N=1 (4%)	N=3 (14%)
Grammar school in complete	N=57 (90.5%)	N=4 (6.3%)	N=2 (3%)
Grammar school complete	N=14 (63%)	N=42 (22%)	N= 30 (15%)
High school in complete	N=50 (96%)	N=1 (2%)	N=1 (2%)
High school complete	N=352 (99%)	N=1 (0.3%)	N=3 (0.8%)
College incomplete	N=7 (100%)	N=0 (0%)	N=0 (0%)
College complete	N=27 (90%)	N=2 (7%)	N=1 (3%)
Graduate school	N=9 (100%)	N=0 (0%)	N=0 (0%)
Age structure			
Up to 20 years old	N=47 (7%)	N=2 (4%)	N=6 (7%)
Between 20 and 40	N=299 (88%)	N=22 (6.5%)	N=19 (5.5%)
Between 41 and 60	N=247 (39%)	N=22 (43%)	N=11 (28%)
>60	N=48 (7%)	N=5 (10%)	N=4 (10%)

The pets being kept by the interviewees were obtained in a number of different manners, principally by directly capturing them (n=35 interviewees, 38.5%) or as gifts (n=35, 38.5%). The balance of the interviewees (n=21, 23%) had bought the wild specimens that they were keeping, indicating their encouragement of the illegal commerce of wild animals in the region. However they obtained the animals they kept, the majority of the interviewees indicated that they kept pets because they "liked them" (n=69, 76%) (as companion animals) and because they enjoyed their "singing" (n=11, 12%) (in the case of birds), while 12% raised animals to sell them.

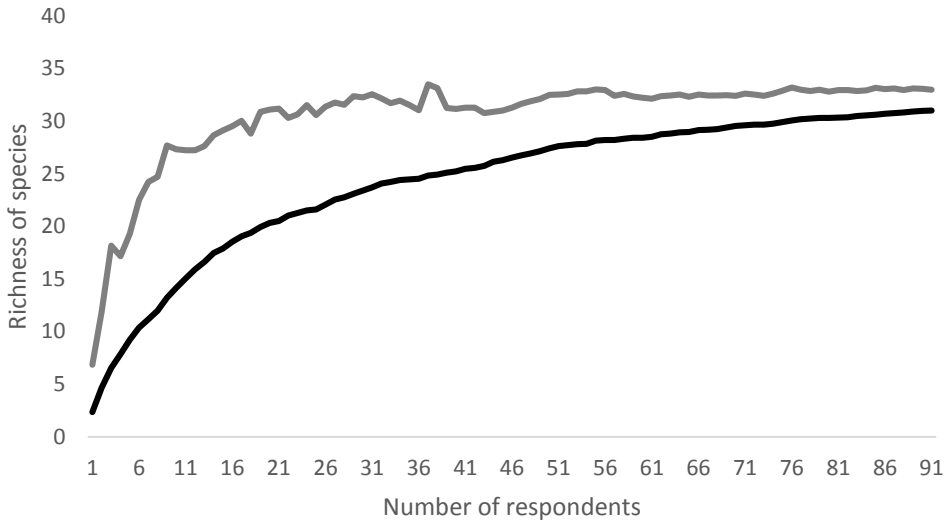

Fig. 2. Rarefaction curve of species (Chao 2), comparing the number of observed species (Sobs) and the estimated richness of wild species being kept as pets in the municipality of Santa Luzia-PB.

Maintenance and care of wild species

All of the interviewees who kept wild animals affirmed that it was not difficult to maintain them at home, and that the foods offered to the animals was not particularly expensive. The owners fed the animals (in the case of birds) seeds (sunflower and paico) (n=33, 36.3%), balanced rations (n=32, 35%), fruits and vegetables (n=13, 14.3%), food from their own table (n=9, 10%), or meat (n=4, 4.4%). Some owners (n=38) stated that they added small stones or sand to the bird's rations to aid digestion.

When questioned about the "well-being" of their pets, half of the interviewees (n= 45, 50%) expressed their conviction that the specimens in captivity lived better than did free animals, and possibly longer, as they had regular and continuous supplies of food, water, and basic care. Many pet owners (45%) stated that they understood that the animals could live better when free, but would continue to keep them in captivity. Five interviewees (5%) were not able to comment on the well-being of their captive wild animals.

We also investigated the possibility that some of the wild species being kept as pets could be consumed as food by their owners. Only two interviewees (2%) responded that

they would have no objection to eating the animals they were keeping if it became necessary, with specific references to Yellow Armadillo *Euphractus sexcinctus* (Dasypodidae) and eared dove *Zenaida auriculata* (Columbidae). The large majority of the interviewees (n=89, 98%), however, expressed attachment to the animals they kept and stated that they would never think of consuming them as food.

Discussion

Our results demonstrated that the option to keep domestic pets (cats, dogs and domesticated birds) instead of wild species is a positive tendency from a conservationist perspective, as fewer wild animals would be removed from the natural environment. This result supports our hypothesis that the presence of a domestic pet has a positive conservationist implication in mitigating the desire to keep a native wild animal. Obviously, the predominant presence of domestic animals among pet owners is influenced by current legislation (Federal Law N° 5.197 of January 3, 1967), which prohibits capturing, raising, or commercializing the native wild fauna of Brazil. Within this construct, active controls by environmental agencies, and publicity about the penalties for keeping these animals, have significantly contributed to the safer choice of domesticated animals as pets.

Keeping wild animals in captivity is nonetheless a deeply rooted cultural practice throughout Brazil [2, 9, 10, 26, 27], which persists in spite of many legal implications – as was observed in the present research, with numerous citizens keeping wild animals as pets, independent of numerous socioeconomic variables among their owners (income, age, civil standing, sex, and education level). There was, however, little variation in the socioeconomic profiles of those owners, which impedes a more refined discussion of this point.

As expected, our results confirmed that birds were the most representative group of wild vertebrates kept as pets in the research area. The number of species of wild birds recorded here (n=28) is similar to the findings of other ethno-ornithological research projects undertaken in other localities in the semiarid region of Paraíba State, such as the municipalities of Catolé do Rocha [17] and Santana dos Garrotes [15], where 38 and 41 species of native birds were kept as pets respectively. Similar situations have been reported from other states in the semiarid region of northeastern Brazil, such as in the municipality of Serra Negra do Norte in Rio Grande do Norte State [28] and in four different municipalities in Ceará State [9] where 20 and 44 wild native bird species were kept as pets respectively. Our research also corroborated observations by Albuquerque *et al.* [29] that the market for pets appears to be the principal stimulus for capturing wild native birds in the semiarid region of northeastern Brazil.

It is well-established that, in addition to birds, other vertebrates are commonly kept as pets, including fish, mammals, amphibians, and reptiles [8]. Our results suggested, however, that the residents of the semiarid region of Brazil demonstrated a significant and widely disseminated preference for birds as vertebrate pets. The popularity of birds is not restricted to the semiarid region, however, but can be seen throughout the country, stimulating an enormous illegal trade that involves at least 295 species of native Brazilian birds [2].

In addition to birds, at least three species of wild vertebrates belonging to other taxa were encountered during our research: Red-footed tortoise *Chelonoidis carbonarius*, *E. sexcinctus*, and Common marmoset *Callithrix jacchus*. The presence of the Red-footed tortoise was not unexpected, as various species of the genus *Chelonoidis* are widely raised and sold as pets in Brazil [30-32]. Alves *et al.* [33] pointed out that Red-footed tortoise is one of the most popular native reptiles kept as pets in the semiarid region of northeastern Brazil, as they are relatively docile, easily captured, and easy to maintain in captivity. The popular belief that their presence in a home helps prevent respiratory diseases such as bronchitis and asthma also favors their maintenance in captivity [30, 33, 34].

Similarly, the presence of marmoset monkeys, *C. jacchus,* being kept as pets was not surprising, as these animals are widely domesticated over their entire area of natural occurrence [35]. These authors noted that these monkeys, frequently captured by contraband agents to be sold as pets [36, 37], are usually kept chained, in cages, or even free in their owner's houses, depending on the dietary resources offered to them. The other mammal encountered during our research was the yellow armadillo *E. sexcinctus*, an important species in the semiarid region widely used for food [12, 13]. This animal is often kept in captivity to be fattened and to "clean" its meat for eventual human consumption, as it is a generalist species and is known to consume the remains of other animals in various stages of decomposition. In our survey, however, the yellow armadillo we encountered was being kept as a pet, and its owner affirmed that he had no intention of eating it.

All of the wild native bird species recorded during our survey are also kept as pets in other parts of Brazil [2, 10, 17, 38], confirming that the capture and keeping of these species are quite widespread and that they suffer intense pressure from continuous and widespread persecution. Songbirds are frequently kept specifically for their singing abilities. According to Pagano et al. [38], their songs make them quite valuable on the illicit wild animal market. Alves et al. [12,15,17] noted that the practice of keeping wild native animals as pets has driven many species to high levels of vulnerability, as this human custom transcends generations, and continual capture removes many individuals from the breeding pool. It is important to stress that the inappropriate conditions to which many wild birds are subjected after capture often cause their deaths [15, 39-41], intensifying impacts on their natural populations.

In the specific case of birds, the high numbers of specimens of the genus *Sporophila* encountered in the domiciles visited (n=60) corroborates observations made during similar studies in Paraíba State [15, 17, 42, 43] and affirms that the preference given to the birds of this genus is associated with their low monetary costs and easy maintenance [40]. Of all of the species identified in the present survey, *S. yarrelli* merits special attention as it is known to be threatened with extinction, with the status of "vulnerable" on the red lists of both the Brazil [25] and IUCN [24].

Implications for conservation

Brazil has a rich faunal diversity, with many species valued as pets. The practice of capturing and sequestering wild animals as pets has, however, negative consequences on the animals themselves and the ecosystems from which they were subtracted [17].

In the specific case of keeping wild native animals, the ecological impacts on their populations are obvious, especially when holding them as pets stimulates an illegal commerce to meet that demand – often threatening their very existence. The illegal traffic in wild animals, including their use as pets, has direct impacts on the populations of those species, which generates consequent impacts on the ecosystem as a whole – resulting in risks of extinction and restrictions of their ecological functions.

Although cats and dogs predominated as pets in the study area, the residual culture trait of keeping wild native animals is still widely disseminated. A large percentage of the wild species kept as pets are captured in their natural habitat, sustaining their clandestine commercialization in the region. The illegal keeping and commercialization of wild animals have cascading effects on the species themselves and their ecosystems of origin. In the case of the semiarid region of Brazil, the impacts of animal capture for the pet market are principally directed toward the avifauna – making it necessary to consider this factor when designing conservation plans for birds inhabiting the Caatinga (dryland) ecosystem. Although other vertebrates are caught and used as pets, this activity does not have as large an impact on mammals and reptiles as they are less frequently sought after for that purpose.

It should be emphasized that in the surveyed area we found exotic birds kept legally as pets (n=4 species) (Appendix 1), which may lead to conservation concerns when such birds escape to the wild and interfere with local ecosystems. Introduced species are one of the principal threats to global biodiversity, due to competition for food resources and territory, and the introduction of previously unknown diseases and parasites [44, 45]. In Brazil, this problem is intensified by poorly planned releases of birds that have been confiscated by the authorities [9]. Even wild species captured illegally can be introduced in inappropriate places (outside of their natural geographical distribution) without proper assessment of their health status, which results in unknown side effects [46]. According to Marini and Garcia [46), a large proportion of the specimens captured illegally are liberated in localities far from their natural geographic distribution and without appropriate evaluations of their state of health. Kuhnena and Kanaanb [39] highlighted that released animals may not be fit to live in the wild on their own, or may impact the natural local populations by introducing diseases or becoming nuisance animals.

The need to incorporate human dimensions in conservation and management of natural resources has been increasingly recognized in the literature [8, 47-51]. It will be important to take into consideration the social, economic, and cultural aspects of the local human populations when designing conservation plans to preserve the native wild fauna of the semiarid region of Brazil, as the uses of wild animals and their products are common and widely disseminated in the region. The clandestine perpetuation of these practices, even after many decades of legal prohibition, points to the inefficiency of environmental enforcement actions. To help remedy this situation, educational activities should be promoted in schools, together with the production of informative pamphlets. Stricter and more rigorous measures for combating the illegal traffic in wild animals must be implemented, and in a much wider context, the conservation of the Caatinga biome must be promoted, as it has suffered considerably due to intense anthropogenic impacts in recent decades.

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References

[1] Alves, R. R. N. 2014. Recursos animais. In: *Introdução à Etnobiologia*. Albuquerque, U. P. (Ed.), pp.115-119. NUPEEA, Recife.

[2] Alves, R. R. N., Lima, J. R. F. and Araújo, H. F. 2013. The live bird trade in Brazil and its conservation implications: an overview. *Bird Conservation International* 23:53-65.

[3] Roldán-Clarà, B., Lopez-Medellín, X., Espejel, I. and Arellano, E. 2014. Literature review of the use of birds as pets in Latin-America, with a detailed perspective on Mexico. *Ethnobiology and Conservation* 3:1-18.

[4] Franke, J. and Telecky, T. M. 2001. *Reptiles as pets: an examination of the trade in live reptiles in the United States*. Humane Society of the United States, Washington (DC).

[5] Jepson, P. and Ladle, R. J. 2005. Bird-keeping in Indonesia: conservation impacts and the potential for substitution-based conservation responses. *Oryx* 39:442-448.

[6] Drews, C. 2001. Wild animals and other pets kept in Costa Rican households: incidence, species and numbers. *Society and Animals* 9:107-126.

[7] Beck, A. M. and Katcher, A. H. 1996. *Between pets and people: The importance of animal companionship*. Purdue Univ Pr.

[8] Alves, R. R. N. 2012. Relationships between fauna and people and the role of ethnozoology in animal conservation. *Ethnobiology and Conservation* 1:1-69.

[9] Fernandes-Ferreira, H., Mendonça, S. V., Albano, C., Ferreira, F. S. and Alves, R. R. N. 2012. Hunting, use and conservation of birds in Northeast Brazil. *Biodiversity and Conservation*, 21 (1): 221-244.

[10] Licarião, M. R., Bezerra, D. M. M. and Alves, R. R. N. 2013. Wild birds as pets in Campina Grande, Paraíba State, Brazil: An Ethnozoological Approach. *Anais da Academia Brasileira de Ciências* 85 (1): 201-213.

[11] Bezerra, D. M. M., Araújo, H. F. P., Alves, A. G. C. and Alves, R. R. N. 2013. Birds and people in semiarid northeastern Brazil: symbolic and medicinal relationships. *Journal of Ethnobiology and Ethnomedicine* 9 (3): 1-11.

[12] Alves, R. R. N., Mendonça, L. E. T., Confessor, M. V. A., Vieira, W. L. S. and Lopez, L. C. S. 2009. Hunting strategies used in the semi-arid region of northeastern Brazil. *Journal of Ethnobiology and Ethnomedicine* 5:1-50.

[13] Alves, R. R. N., Gonçalves, M. B. R. and Vieira, W. L. S. 2012. Caça, uso e conservação de vertebrados no semiárido Brasileiro. *Tropical Conservation Science* 5:394-416.

[14] Regueira, R. F. S. and Bernard, E. 2012. Wildlife sinks: Quantifying the impact of illegal bird trade in street markets in Brazil. *Biological Conservation* 149:16-22.

[15] Alves, R. R. N., Leite, R. C., Souto, W. M. S., Bezerra, D. M. M. and Loures-Ribeiro, A. 2013. Ethno-ornithology and conservation of wild birds in the semi-arid Caatinga of northeastern Brazil. *Journal of Ethnobiology and Ethnomedicine* 9 (14): 1-12.

[16] Bezerra, D. M. M., Araujo, H. F. P. and Alves, R. R. N. 2012. Captura de aves silvestres no semiárido brasileiro: técnicas cinegéticas e implicações para conservação. *Tropical Conservation Science* 5:50-66.

[17] Alves, R. R. N., Nogueira, E., Araujo, H. and Brooks, S. 2010. Bird-keeping in the Caatinga, NE Brazil. *Human Ecology* 38:147-156.

[18] IBGE (Instituto Brasileiro de Geografia e Estatística). 2010. *Censo Populacional 2010*. http://censo2010.ibge.gov.br/

[19] Prefeitura de Santa Luzia. 2015. *Município de Santa Luzia*. http://www.santaluzia.pb.gov.br/cidade/historia

[20] Huntington, H. P. 2000. Using Traditional Ecological Knowledge in Science: Methods and Applications. Ecological Applications 10:1270-1274.

[21] Albuquerque, U. P., Cunha, L. V. F. C., Lucena, R. F. P. and Alves, R. R. N. 2014. Methods and Techniques in Ethnobiology and Ethnoecology. Springer, New York.

[22] CBRO (Comitê Brasileiro de Registros Ornitológicos). 2014. *Listas das aves do Brasil. 11ª edição*. http://www.cbro.org.br

[23] Colwell, R. K. 2009. *EstimateS: Statistical estimation of species richness and shared species from samples. Version 8.2. User's Guide and application published at: http://purl.oclc.org/estimates.* Storrs, USA.

[24] IUCN (International Union for Conservation of Nature). 2014. *IUCN Red List of Threatened Species. Version 2014.3.* . www.iucnredlist.org

[25] Ministério do Meio Ambiente 2014. Lista das Espécies da Fauna Brasileira Ameaçadas de Extinção. Ministério do Meio Ambiente. http://www.icmbio.gov.br/portal/biodiversidade/fauna-brasileira/lista-de-especies.html

[26] Sick, H. 1997. *Ornitologia Brasileira*. Nova Fronteira, Rio de Janeiro.

[27] Bezerra, D. M. M., Araujo, H. F. P. and Alves, R. R. N. 2012. Wild birds as source of food in the semi-arid region of Rio Grande do Norte State, Brazil. *Sitientibus Série Ciências Biológicas* 11:177-183.

[28] Bezerra, D. M. M. S. Q., Araujo, H. F. P. and Alves, R. R. N. 2011. The use of wild birds by rural communities in the semi-arid region of Rio Grande do Norte State, Brazil. *Bioremediation, Biodiversity and Bioavailability* 5: 117–120

[29] Albuquerque, Araújo, E., Lima, A., Souto, A., Bezerra, B., Freire, E. M. X., Sampaio, E., Casas, F. L., Moura, G., Pereira, G., Melo, J. G., Alves, M., Rodal, M., Schiel, M., Neves, R. L., Alves, R. R. N., Azevedo-Júnior, S. and Telino Júnior, W. 2012. Caatinga revisited: ecology and conservation of an important seasonal dry forest. *Scientific World Journal* 2012, 1–18.

[30] Alves, R. R. N., Vieira, K. S., Santana, G. G., Vieira, W. L. S., Almeida, W. O., Souto, W. M. S., Montenegro, P. F. G. P. and Pezzuti, J. C. B. 2012. A review on human attitudes towards reptiles in Brazil. *Environmental Monitoring and Assessment* 184:6877-6901.

[31] Fitzgerald, S. 1989. *International wildlife trade: whose business is it?* World Wildlife Fund.

[32] Lopes, P. R. D. 1991. Comércio de animais silvestres. *Bioikos* 5:49-56.

[33] Alves, R. R. N., Pereira Filho, G. A., Silva Vieira, K., Souto, W. M. S., Mendonças, L. E. T., Montenegro, P. F. G. P., Almeida, W. O. and Vieira, W. L. S. 2012. A zoological catalogue of hunted reptiles in the semiarid region of Brazil. *Journal of Ethnobiology and Ethnomedicine* 8 (27): 1-29

[34] Alves, R. R. N., Vieira, W. L. S. and Santana, G. G. 2008. Reptiles used in traditional folk medicine: conservation implications. *Biodiversity and Conservation* 17:2037–2049

[35] Fernandes-Ferreira, H. 2011. *Atividades cinegéticas em um brejo de Altitude no Nordeste do Brasil: Etnozoologia e conservação*. Thesis. Universidade Federal da Paraíba.

[36] Moura, S. G., Pessoa, F. B., Oliveira, F. F., Lustosa, A. H. M. and Soares, C. B. 2012. Animais silvestres recebidos pelo centro de triagem do ibama no Piauí no ano de 2011. *Enciclopédia Biosfera* 8:1-15.

[37] Renctas 2001. *1º relatório nacional sobre o tráfico de fauna silvestre.* Report. Brasília.

[38] Pagano, I. S. A., Sousa, A. E. B. A., Wagner, P. G. C. and Ramos, R. T. C. 2010. Aves depositadas no Centro de Triagem de Animais Silvestres do IBAMA na Paraíba: uma amostra do tráfico de aves silvestres no estado. *Ornithologia* 3:132-144.

[39] Kuhnen, V. V. and Kanaan, V. T. 2014. Wildlife trade in Brazil: A closer look at wild pets welfare issues. *Brazilian Journal of Biology* 74:124-127.

[40] Rocha, M. S. P., Cavalcanti, P. C. M., Sousa, R. L. and Alves, R. R. N. 2006. Aspectos da comercialização ilegal de aves nas feiras livres de Campina Grande, Paraíba, Brasil. *Revista de Biologia e Ciências da Terra* 6:204-221.

[41] Gama, T. F. and Sassi, R. 2008. Aspectos do comércio Ilegal de Pássaros Silvestres na Cidade de João Pessoa, Paraíba, Brasil. *Gaia Scientia* 2:1-20.

[42] Souza, J. B. and Alves, R. R. N. 2014. Hunting and wildlife use in an Atlantic Forest remnant of northeastern Brazil. *Tropical Conservation Science* 7:145-160.

[43] Barbosa, J. A. A., Nobrega, V. A. and Alves, R. R. N. 2010. Aspectos da caça e comércio ilegal da avifauna silvestre por populações tradicionais do semi-árido paraibano. *Revista de Biologia e Ciências da Terra* 10:39-49.

[44] Begon, M., C. R. T. Send and J. L. Harper. 2006. ECOLOGY: From Individuals to Ecosystems. Blackwell Publishing, Garsington Road, UK.

[45] García-Moreno, J., R. P. Clay and C. A. Ríos-Muñoz. 2007. The importance of birds for conservation in the Neotropical region. Journal of Ornithology 148:321-326.

[46] Marini, M. A. and F. I. Garcia. 2005. Bird conservation in Brazil. Conservation Biology 19(3):665-671.

[47] van Vliet N, Mesa MPQ, Cruz-Antia D, Aquino LJN, Moreno J, Nasi R (2014) The uncovered volumes of bushmeat commercialized in the Amazonian trifrontier between Colombia, Peru & Brazil. Ethnobiology and Conservation 3:1-11

[48] Premauer JM, Berkes F (2015) A Pluralistic Approach to Protected Area Governance: Indigenous Peoples and Makuira National Park, Colombia. Ethnobiology and Conservation 4:1-16

[49] Alves RRN, Souto WMS (2015) Ethnozoology: A Brief Introduction. Ethnobiology and Conservation 4:1-13

[50] van Vliet N, Quiceno-Mesa MP, Cruz-Antia D, Tellez L, Martins C, Haiden E, Oliveira MR, Adams C, Morsello C, Valencia L (2015) From fish and bushmeat to chicken nuggets: the nutrition transition in a continuum from rural to urban settings in the Tri frontier Amazon region. Ethnobiology and Conservation 4:1-12.

[51] Christoffel RA (2007) Using Human Dimensions Insights to Improve Conservation Efforts for the Eastern Massasauga Rattlesnake (*Sistrurus catenatus catenatus*) in Michigan and the Timber Rattlesnake (*Crotalus horridus horridus*) in Minnesota. Michigan State University, East Lansing.

Appendix 1**.** Animal species recorded in homes visited in the municipality of Santa Luzia, Paraíba, Brazil. Legend: *Exotic domesticated species. Red List Categories: NL – Not listed; LC – Least concern; VU – Vulnerable.

Taxon recorded	Number of specimens	Conservation Status	
		Brazilian Red List	IUCN Red List
BIRD			
Cardinalidae			
Cyanoloxia brissonii (Lichtenstein, 1823) - Ultramarine grosbeak	15	NL	N L
Columbidae			
Patagioenas picazuro (Temminck, 1813) - Picazuro Pigeon	4	NL	LC
Columbina minuta (Linnaeus, 1766)- Plain-breasted Ground-dove	2	NL	LC
Columbina passerina (Linnaeus, 1758) - Common Ground-dove	12	NL	LC
Columbina talpacoti (Temminck, 1811) - Ruddy Ground-dove	4	NL	LC
Columba livia (Gmelin, 1789) - Rock pigeon	2	NL	NL
Zenaida auriculata (Des Murs, 1847) - Eared dove	2	NL	LC
Corvidae			
Cyanocorax cyanopogon (Wied, 1821) - White-naped Jay	3	NL	LC
Fringillidae			
Euphonia cayennensis (Linnaeus, 1758) - Golden-sided Euphonia	4	NL	LC
Sporagra yarrellii (Audubon, 1839) - Yellow-faced siskin	4	VU	VU
* *Serinus canarius domesticus* - Domestic canary	10	NL	NL
Icteridae			
Icterus jamacaii (Gmelin, 1788) - Campo Troupial	15	NL	LC
Gnorimopsar chopi (Vieillot, 1819) - Chopi Blackbird	2	NL	LC
Chrysomus ruficapillus (Vieillot, 1819) - Chestnut-capped Blackbird	1	NL	LC
Passerelidae			
Zonotrichia capensis (Statius Muller, 1776) - Rufous-collared Sparrow	5	NL	LC
Psittacidae			
* *Agapornis roseicollis* (Vieillot, 1818) - Rosy-faced Lovebird	3	NL	NL
Eupsittula cactorum (Kuhl, 1820) - Cactus Parakeet	29	NL	LC
Amazona aestiva (Linnaeus, 1758) - Turquoise-fronted Amazon	5	NL	LC
* *Melopsittacus undulatus* (Shaw, 1805) – Budgerigar	14	NL	LC

**Nymphicus hollandicus* (Kerr, 1792) – Cockatiel	6	NL	LC
Thraupidae			
Paroaria dominicana (Linnaeus, 1758) - Red-cowled Cardinal	36	NL	LC
Tangara sayaca (Linnaeus, 1766) - Sayaca Tanager	4	NL	LC
Turdus leucomelas (Vieillot, 1818) - Pale-breasted Thrush	1	NL	LC
Sporophila bouvreuil (Statius Muller, 1776) - Capped Seedeater	18	NL	LC
Coereba flaveola (Linnaeus, 1758) – Bananaquit	9	NL	LC
Lanio pileatus (Wied, 1821) - Sooty-capped Bush-tanager	4	NL	NL
Sporophila lineola (Linnaeus, 1758) - Lined Seedeater	3	NL	LC
Sicalis flaveola (Linnaeus, 1766) - Saffron Finch	3	NL	LC
Sporophila albogularis (Spix, 1825) - White-throated Seedeater	33	NL	LC
Sporophila nigricollis (Vieillot, 1823) - Yellow-bellied Seedeater	6	NL	LC
Volatina jacarina (Linnaeus, 1766) - Blue-black Grassquit	4	NL	NL
Saltator similis d`Orbigny & Lafresnaye, 1837 - Green-winged Saltator	1	NL	LC
MAMMALS			
Dasypodidae			
Euphractus sexcinctus (Linnaeus, 1758) - Yellow Armadillo	1	NL	NL
Callithrichidae			
Callithrix jacchus (Linnaeus, 1758) - Common marmoset	1	NL	LC
REPTILES			
Testudinidae			
Chelonoidis carbonarius (Spix, 1824) - Red-footed tortoise	5	NL	NL