

Between knowledge and conservation: An ethnozoological study in the Serra da Capivara National Park, Piauí, Brazil

Entre saberes e conservação: um estudo etnozoológico no Parque Nacional Serra da Capivara, Piauí, Brasil

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Abstract: The relationship between local communities and Conservation Units (UC) involves multiple ecological, cultural and economic dimensions that must be considered when formulating participatory management and biodiversity conservation strategies. In this context, our objectives were to evaluate the perceptions of local residents, tourist guides and ICMBio agents about the importance of Serra da Capivara National Park (PNSC), as well as to identify the ethnozoological knowledge of these three groups. were interviewed 43 people, including: (1) residents of the village of Sítio do Mocó in Coronel José Dias, Piauí State, Brazil, a community located on the edge of the PNSC; and (2) employees of ICMBio and the PNSC, in São Raimundo Nonato, Piauí State. Our results demonstrated that participants recognize the importance of UC for generating income, especially through activities linked to tourism and crafts. On the other hand, approximately 42% reported that the local population rarely visits the PNSC, citing the cost of services and lack of interest as barriers. In terms of knowledge of fauna, 92 species were cited. Of these, 38 spp. were associated with hunting, with emphasis on *Subulo gouazoubira*, *Dicotyles tajacu* and *Dasypus novemcinctus*. Both groups interviewed acknowledged the increase in hunting over the last five years, although they pointed out that social programs such as Bolsa Família contributed to the reduction in the prospect of hunting for immediate subsistence. These results reinforce the importance of integrating local/traditional knowledge and expanding knowledge of local wildlife exploitation scenarios, as well as the need to rethink local conservation strategies towards a more participatory and inclusive model.

Keywords: environmental perception; ethnozoology; national parks; fauna use.

Resumo: A relação entre comunidades locais e Unidades de Conservação (UC) envolve múltiplas dimensões ecológicas, culturais e econômicas que devem ser consideradas na formulação de estratégias de gestão participativa e conservação da biodiversidade. Nesse contexto, nossos objetivos foram avaliar a percepção de moradores locais, guias turísticos e agentes do ICMBio sobre a importância do Parque Nacional Serra da Capivara (PNSC), assim como identificar os conhecimentos etnozoológicos desses grupos estudados. Foram entrevistadas 43 pessoas, compreendendo: (1) 30 moradores do povoado Sítio do Mocó em Coronel José Dias, na borda do PNSC; (2) seis agentes do ICMBio e sete guias do PNSC, em São Raimundo Nonato. Nossos resultados demonstraram que os participantes reconhecem a importância da UC para a geração de renda, especialmente por meio de atividades ligadas ao turismo e ao artesanato. Por outro lado, aproximadamente 42% relataram que a população local raramente visita o PNSC, apontando como barreiras o custo de serviços e o desinteresse. Em termos de conhecimentos da fauna, foram citadas 92 espécies. Dessas, 38 spp. foram associadas à caça, com destaque para *Subulo gouazoubira*, *Dicotyles tajacu* e *Dasypus novemcinctus*. Ambos os grupos entrevistados reconheceram o aumento da caça nos últimos cinco anos, mas apontaram que programas sociais como o Bolsa Família contribuíram

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para a redução da perspectiva da caça por subsistência imediata. Esses resultados reforçam a importância de integrar saberes locais/tradicionais e ampliar os conhecimentos dos cenários locais de exploração da fauna, bem como a necessidade de repensar as estratégias de conservação local para um modelo mais participativo e inclusivo.

Palavras-chave: etnozoologia; parques nacionais; percepção ambiental; usos da fauna.

1. Introduction

In the face of intense environmental change, particularly habitat loss and fragmentation, a range of strategies has been adopted to safeguard the biodiversity that remains (Jones et al., 2018). Within this context, protected areas have become central instruments for biodiversity conservation (Zeng et al., 2022), serving as refuges for threatened species and as barriers to the expansion of environmentally destructive human activities. Since the 1960s, the International Union for Conservation of Nature (IUCN) has established guidelines and targets for the designation and management of these areas (Wenceslau et al., 2020), reinforcing their role as pillars of global conservation policies.

Currently, more than 260,000 protected areas exist worldwide, covering approximately 16% of the Earth's terrestrial surface (UNEP World Conservation Monitoring Centre [UNEP-WCMC] & IUCN, 2024). Although this represents substantial progress, many of these areas remain vulnerable to anthropogenic pressure (Marques & Peres, 2015; Tilman et al., 2017). Some protected areas are located near socioeconomically vulnerable populations (Molotoks et al., 2017), which broadens their role in promoting human well-being and ensuring access to natural resources (Naughton-Treves et al., 2005; Zorondo-Rodríguez et al., 2024).

In megadiverse countries such as Brazil, protected areas play a strategic role. Brazil has the largest extent of protected areas in Latin America, totaling approximately 2,509,321 km² – equivalent to 27% of the national territory and approximately 7.5% of the planet's protected areas (Ministério do Meio Ambiente, 2025; Vieira et al., 2019). Among Brazil's protected areas, Serra da Capivara National Park (SCNP), located in the state of Piauí, stands out, encompassing approximately 100,000 hectares across four municipalities. The SCNP is a key strategic Conservation Unit in Caatinga biome and it is managed by the Chico Mendes Institute for Biodiversity Conservation (ICMBio).

SCNP harbors 349 vertebrate species, some species endemic to the region, such as *Tolypeutes tricinctus*, *Kerodon rupestris*, *Icterus jamacaii*, and *Penelope jacucaca* (Olmos & Albano, 2012; Cavalcanti et al., 2014). In addition to its ecological importance, this protected area is notable for its cultural and historical significance, encompassing 172 archaeological and paleontological sites open to visitors (Chaves et al., 2017; ICMBio, 2019; Barros et al., 2023). Despite its ecological and cultural heritage value, SCNP has experienced conflicts with local communities, particularly during the

early stages of its implementation in 1988, when residents were forcibly removed from the area where the park is now located (Bastos, 2010).

The removal of entire communities from areas where protected areas are established is generally associated with insufficient information sharing and a lack of dialogue with surrounding populations (Canto et al., 2020). Nevertheless, when properly managed, these areas can safeguard biodiversity while contributing to the well-being of local communities (Olmos-Martínez et al., 2022). In the case of SCNP, to mitigate the social impacts arising from the establishment of the Park, the Museum of the American Man Foundation (FUMDHAM), in partnership with the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), promoted income-generating initiatives, including handicrafts, pottery, and sustainable tourism, as well as educational activities addressing the importance of the protected area (Rodrigues, 2011).

In a context of socio-environmental vulnerability, strategies for the inclusion of local communities and participatory conservation are essential for reducing pressure on natural resources, particularly the hunting of wild animals for multiple purposes (e.g. Policarpo et al., 2018; Lemos et al., 2024). According to Rodrigues (2011), wildlife hunting and trade persist as two of the main threats to the fauna of SCNP. In many cases, hunting is traditionally conducted clandestinely and remains deeply intertwined with the livelihoods of surrounding communities, serving subsistence, cultural, and folk medicinal purposes (Miranda & Alencar, 2007). This context underscores the need for studies that integrate the social and ecological dimensions of conservation, particularly comprehensive investigations of community perceptions and local ethnozoological knowledge.

The literature shows that perceptions and knowledge of protected areas vary among groups with different territorial and professional ties, such as local residents, tour guides, and managers, reflecting their experiences and distinct relationships with the territory (Ruiz-Mallén et al., 2015a; 2015b). For instance, in local or traditional communities, ethnozoological knowledge may also be influenced by socioeconomic factors, including occupation, age group, and educational attainment, which shape the degree of involvement in daily activities, the nature of interactions with wildlife, and opportunities for learning (Souto & Ticktin, 2012; Souza et al., 2024a). Among these factors, age is particularly relevant because it is often positively correlated with ethnozoological knowledge, as older individuals tend to accumulate greater life experience and more direct contact with local fauna (Kai et al., 2014; Souza et al., 2024a). Assessing this correlation in SCNP is important because it may reveal whether knowledge is concentrated within particular age groups, thereby informing the development of more appropriate and intergenerational environmental education initiatives.

In light of the above, we tested the following hypotheses: (1) perceptions of the relevance of SCNP differ significantly among stakeholder groups;

(2) ethnozoological knowledge varies among social groups; and (3) among local residents, age influences the ability to recognize local wildlife species.

Our objectives were to assess the perceptions of local residents, tour guides, and ICMBio staff regarding the importance of Serra da Capivara National Park and to identify the ethnozoological knowledge held by the study's target groups. The data generated may inform educational initiatives, public policies, and inclusive sustainable development strategies focused both on local populations and on those directly involved in protecting biodiversity within protected areas.

2. Material and methods

2.1. Study area

Our study was conducted in the municipalities of São Raimundo Nonato (SRN) and Coronel José Dias (CJD), located in the southwestern region of the state of Piauí, northeastern Brazil. Both municipalities encompass portions of Serra da Capivara National Park (Figure 1). São Raimundo Nonato has 38,934 inhabitants, whereas Coronel José Dias has 4,250 inhabitants (Instituto Brasileiro de Geografia e Estatística [IBGE], 2025). The Human Development Index is classified as medium in both municipalities (SRN = 0.661; CJD = 0.546), and per capita income is low (SRN = R\$397.14; CJD = R\$206.51) (IBGE, 2025).

Serra da Capivara National Park was established by Federal Decree No. 83,548 of June 5, 1979, and classified as a strictly protected conservation unit under Law No. 9,985/2000 (Lei nº 9.985, 2000). It covers approximately 135,000 hectares across the municipalities of São Raimundo Nonato, Coronel José Dias, João Costa, and Brejo do Piauí (ICMBio, 2019). The region has a hot, dry tropical climate, with irregularly distributed mean annual precipitation of 650 mm and a mean temperature of 27°C (Alvares et al., 2013), which constrains agricultural activities and reinforces tourism as a viable economic alternative. SCNP is recognized not only for its ecological importance but also for its cultural heritage, encompassing 1,223 archaeological and paleontological sites, of which 172 are open to visitors (ICMBio, 2019; Chaves et al., 2017).

SCNP encompasses a vegetation mosaic typical of the Caatinga, including tree, shrub, cactus, and herbaceous species adapted to semiarid conditions (Freire et al., 2020; ICMBio, 2019). Its fauna is also diverse, with at least 57 mammal species, 238 bird species, 39 reptile species, and 15 amphibian species recorded (Olmos & Albano, 2012; Cavalcanti et al., 2014; ICMBio, 2019; Oliveira, 2021). Notable among them are threatened species such as the Brazilian three-banded armadillo (*Tolypeutes tricinctus*), the collared peccary (*Dicotyles tajacu*), and the white-browed guan (*Penelope*

jacucaca), all of which are subject to intense hunting pressure (ICMBio, 2019). (ICMBio, 2019).

A regional ICMBio office, the agency responsible for the administration and protection of SCNP, is located in SRN. In CJD, one of the largest communities bordering SCNP is the village of Sítio do Mocó ($8^{\circ}50'48.09''$ S; $42^{\circ}33'30.71''$ W) (Figure 1), located 9.5 km from the municipality's urban center.

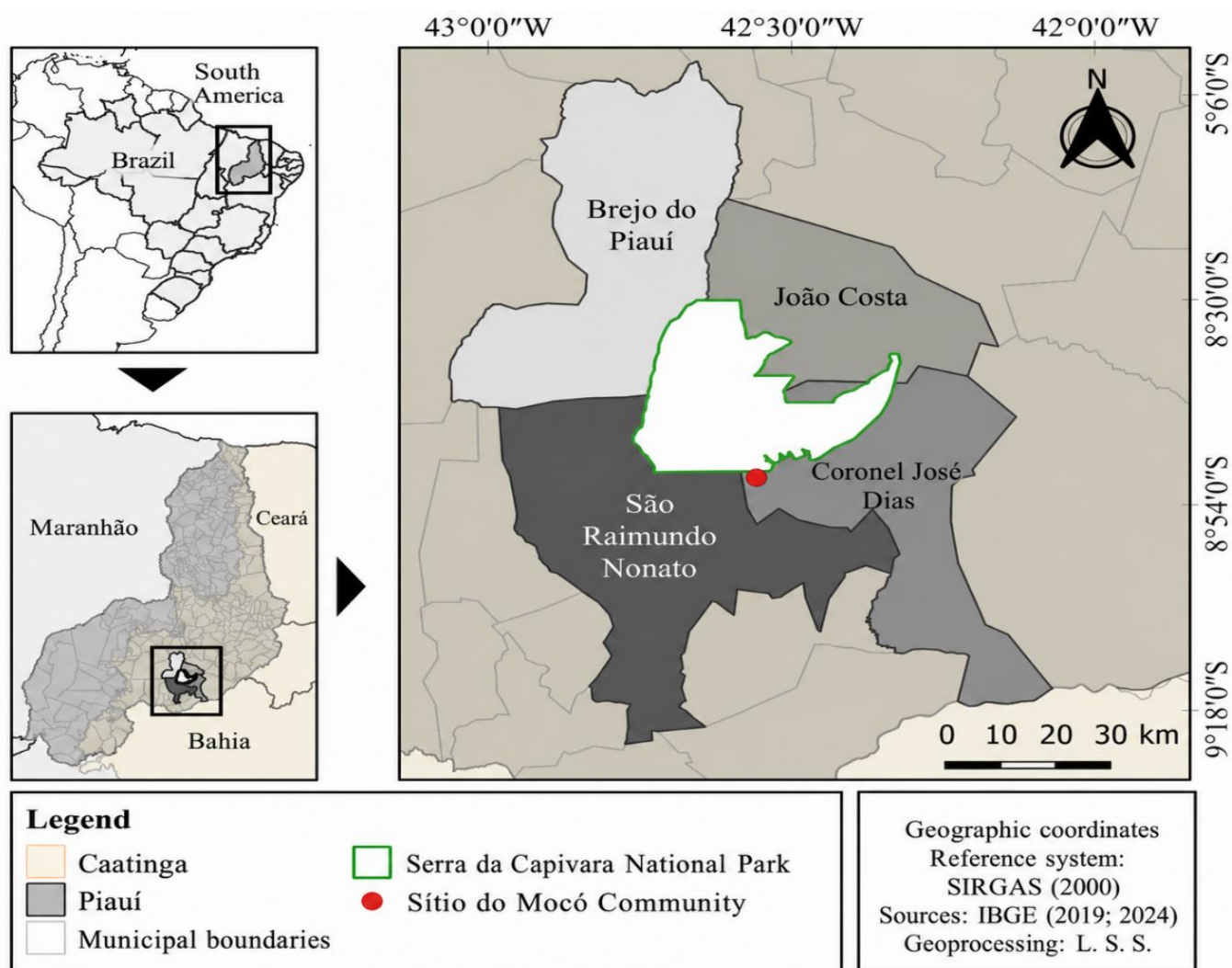
2.2. Data collection and ethical aspects

Data were collected in November 2019. Following an approach similar to that of Souto et al. (2017), participants were recruited through snowball sampling and opportunistic encounters. Data was obtained through semi-structured interviews conducted with the following target groups:

Figure 1

Location of the Sítio do Mocó community in the surroundings of Serra da Capivara National Park, Piauí, Brazil.

SOURCE: prepared by the authors based on data from the Brazilian Institute of Geography and Statistics (IBGE, 2024; 2025).



- (1) 30 residents of the rural community of *Sítio do Mocó*, in Coronel José Dias (15 men and 15 women);
- (2) seven SCNP tour guides (six men and one woman); and
- (3) six ICMBio staff members, equally divided between men and women, selected from the employee list provided by the local ICMBio administration.

The interviews were recorded with the participants' oral consent. In accordance with CNS Resolution No. 510/2016, the requirement for a printed Informed Consent Form was waived because some questionnaire topics involved sensitive issues, including illegal practices related to the use of wild animals, which could have generated mistrust, reduced participation, and exposed the researchers to potential risks. The study was submitted through *Plataforma Brasil* and approved by the Research Ethics Committee of the Federal University of Piauí (CAAE No. 47887015.9.0000.5214).

The questionnaires included items related to socioeconomic profile, residential history, educational attainment, relationship with SCNP, perceptions of its importance to the local community, visitation frequency, and sources of income associated with the protected area (Supplementary Material 1). We also collected data on ethnozoological knowledge, allowing participants to identify known species through free listing (Bernard, 2017).

2.3. Species Identification

Taxonomic identification was conducted using specialized literature (Sigrist, 2009; Reis et al., 2011), reliable digital sources (WikiAves, 2019), and researchers familiar with the species occurring in the region. Scientific names were updated based on the following sources: the Brazilian Ornithological Records Committee for birds (de Piacentini et al., 2015), the Brazilian Society of Herpetology for reptiles (Costa et al., 2022) and amphibians (Segalla et al., 2021), and the Catalogue of Life for mammals (2024). Species conservation status was obtained from the IUCN Red List (IUCN, 2025).

2.4. Data analysis

For data analysis, interviewees were organized into two main groups:

- (A) residents of the *Sítio do Mocó* community; and
- (B) tour guides from Serra da Capivara National Park and ICMBio staff members.

The decision to combine tour guides and ICMBio staff into a single group was based on the fact that, although they have different types of employment relationships, both perform paid activities directly associated with the management, public use, and operation of the Park and, consequently, share responsibilities, expectations, and perspectives regarding

the maintenance of the protected area and its biodiversity. Socioeconomic profiles and other information were analyzed using descriptive statistics, including means, standard deviations, and percentages. Perceptions of the importance of SCNP were assessed using a four-point Likert scale without a neutral category, with the aim of reducing response bias (Mutanga et al., 2015). The categories were (as seen on Supplementary Material 1):

- (1) “disagree”,
- (2) “strongly disagree”,
- (3) “agree”, and
- (4) “strongly agree”

Comparisons between the two groups regarding perceptions of the importance of SCNP were performed using Student’s *t*-test. To assess variation in species knowledge among age groups, we applied a one-way ANOVA. Differences in mean species richness were analyzed using a paired *t*-test and the Mann–Whitney *U* test after verifying normality with the Shapiro–Wilk test and homogeneity of variances with Levene’s test. Total species richness cited by each group was estimated using the first-order Jackknife estimator (Legendre & Legendre, 2012), with 999 randomizations, in EstimateS software (v. 9.1.0; Colwell, 2013). All other statistical analyses were conducted in PAST (v. 3.26.0; Hammer et al., 2001), adopting a significance level of 5% ($p \leq 0.05$).

3. Results

3.1. Sampling’s socioeconomic profile and perceptions about of Serra da Capivara National Park

We interviewed 30 residents of the *Sítio do Mocó* community and 13 participants engaged in paid activities associated with the Park (nine men and four women). Participants ranged in age from 18 to 77 years, with a mean age of 40.27 ± 14.94 years. Length of residence among community residents ranged from 16 to 77 years (mean = 37.17 ± 16.28), whereas participants engaged in paid activities directly associated with the Park and residing in the municipalities of CJD and SRN had lived there for three to 45 years (mean = 25.7 ± 14.83). Among interviewees who reported having lived outside these municipalities, the duration ranged from one to 20 years (mean = 2.7 ± 4.49). Regarding educational attainment, 41.86% had completed high school (Table 1).

Using the Likert scale (Supplementary Material 1) to assess perceptions of the importance of the protected area to the community studied, all residents ($n = 30$) expressed some degree of agreement, with 28 indicating that they “strongly agreed” with the statement. No significant difference was

Table 1 Socioeconomic profile of *Sítio do Mocó* residents, ICMBio staff members, and tour guides from Serra da Capivara National Park, Piauí, Brazil.

SOCIOECONOMIC CHARACTERISTICS	N	(%)
Gender		
Male	24	55.81%
Female	19	44.19%
Age		
18–25 years	9	20.94%
26–33 years	10	23.25%
34–41 years	6	13.96%
42–49 years	10	23.25%
50 years or older	8	18.60%
Educational attainment		
Very low (no formal education)	6	13.95%
Low (elementary education)	5	11.63%
Intermediate (high school education)	18	41.86%
High (higher education)	14	32.56%
Length of residence in the community		
Less than 1 year	3	6.98%
3–16 years	5	11.63%
21–30 years	14	32.56%
35–51 years	14	32.56%
52–77 years	7	16.28%
Time lived outside the community		
Never lived outside the community	16	37.21%
1–5 years	21	48.84%
6–20 years	6	13.95%
TOTAL	43	100%

found between residents and the combined group of ICMBio staff members and tour guides regarding the importance of SCNP in supplementing local community income ($p > 0.05$). For this statement, 34 interviewees (79.07%) responded that they “strongly agreed”. Reported income sources included handicraft-related activities (26 citations, 60.47%), work as tour guides and gate attendants (21 citations, 48.84%), and tourism (12 citations, 27.91%).

We found no significant differences among the surveyed groups regarding perceptions of how frequently surrounding residents visit the Park ($p > 0.05$). Of all interviewees, 18 (41.86%) disagreed with the statement that residents living near the protected area regularly visit it, whereas 16 (37.21%) agreed, reporting an average frequency of only one visit per year. Among those who stated that such visits did not occur, eight respondents (18.60%) identified the cost of hiring a tour guide (R\$150.00 per day) and a lack of interest in visiting the protected area as the main reasons.

Interviewees cited a total of 92 species, with community residents mentioning a greater number ($n = 80$) than participants engaged in paid activities directly associated with the Park ($n = 63$). Total species richness estimated using the Jackknife 1 method was 114.47 ± 4.49 species for the two groups combined. When analyzed separately, the estimates were 103.2 ± 4.24 species for ICMBio staff members and tour guides and 81.54 ± 2.99 species for community residents. The sampling effort recorded 80.70% of the total estimated richness (Sobs/Jackknife 1). Specifically, 79.10% (Sobs/Jackknife 1) of the estimated species were recorded for ICMBio staff members and tour guides, and 77.60% (Sobs/Jackknife 1) for community residents (Figure 2).

The results revealed significant differences in reported species richness between the groups ($t = -5.03$; $p < 0.001$). Community residents provided a significantly greater number of citations ($U = 3148.5$; mean rank = 52.12) than ICMBio staff members and tour guides (mean rank = 40.36; $p < 0.001$). However, among community residents, the number of citations did not vary significantly with age ($F = 0.53$; $df = 9.9$; $p > 0.5$) (Figure 3).

The species most frequently cited by residents of Sítio do Mocó, occurring in $\geq 50\%$ of reports, were *S. gouazoubira* (26 citations, 86.67%), *D. tajacu* (25 citations, 83.33%), *Sapajus libidinosus* (20 citations, 66.67%), *Dasybus septemcinctus* (20 citations, 66.67%), *Kerodon rupestris* and *Panthera onca* (17 citations, 56.67%), *Dasyprocta prymnolopha* (16 citations, 53.32%), and *Euphractus sexcinctus* and *Penelope superciliaris* (15 citations, 50.00%). Similarly, among ICMBio staff members and tour guides, the most frequently cited species were *K. rupestris* (10 citations, 76.92%), *S. gouazoubira* and *Panthera onca* (nine citations, 69.23%), *D. tajacu* and *Dasybus novemcinctus* (eight citations, 61.54%), *Penelope jacucaca* (seven citations, 53.85%), and *Tolypeutes tricinctus* (six citations, 46.15%).

3.2. Wildlife Hunting and Perceptions about SCNP

A total of 38 species associated with hunting were reported by the interviewees, comprising 19 mammals, 18 birds, and one reptile (Figure 4; and Table 1 in Supplementary Material). Residents of Sítio do Mocó mentioned 22 species (13 birds and nine mammals), with *Dasybus novemcinctus* (86.7%), *D. tajacu* (43.32%), *S. gouazoubira* (36.67%), *Amazona aestiva* (26.67%), and *Amazona amazonica* (23.32%) being the most frequently cited. In turn, ICMBio staff members and SCNP tour guides identified 35 species (19 mammals, 15 birds, and one reptile) as known targets of hunters. The most frequently mentioned were *Dasybus septemcinctus* (22.8%) and *S. gouazoubira* (15.15%), followed by *P. jacucaca*, *E. sexcinctus*, *Dasybus novemcinctus*, and *D. tajacu*, each accounting for 12.3% of citations.

Our data show that 14 residents (46.67%) “agreed” or “strongly agreed” with the statement that the protected area represents an important source of animals for consumption or as a means of supplementing household

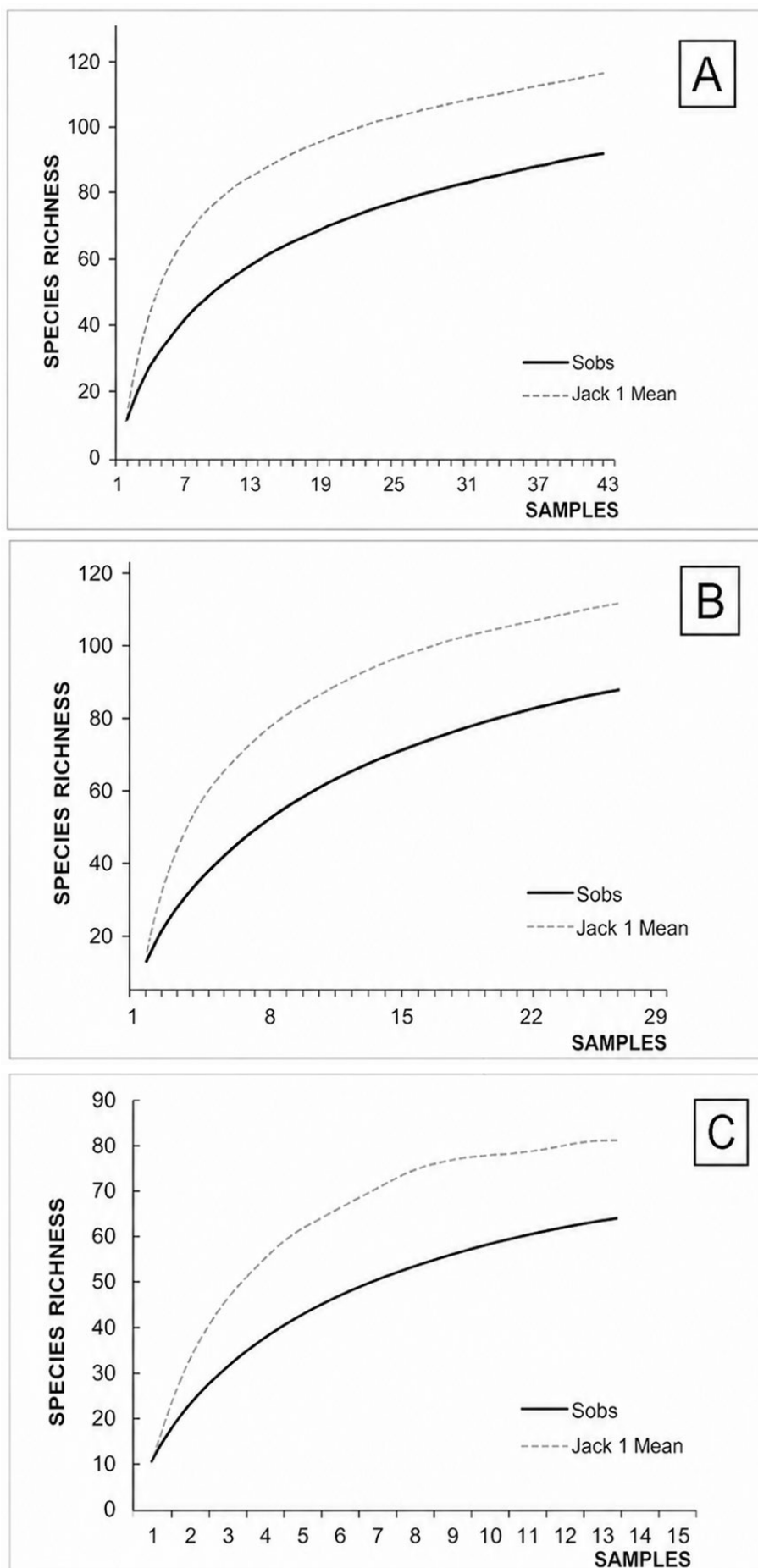


Figure 2

Species accumulation curves based on species cited by the interviewees.

LEGEND: (A) Estimated total richness of species cited by both groups of interviewees: residents of the *Sítio do Mocó* community and professionals engaged in paid activities directly associated with Serra da Capivara National Park, including ICMBio staff members and tour guides. (B) Estimated richness of species cited exclusively by residents of the *Sítio do Mocó* community in the municipality of Coronel José Dias, Piauí, Brazil. (C) Estimated richness of species cited exclusively by ICMBio staff members and tour guides from Serra da Capivara National Park, Piauí, Brazil.

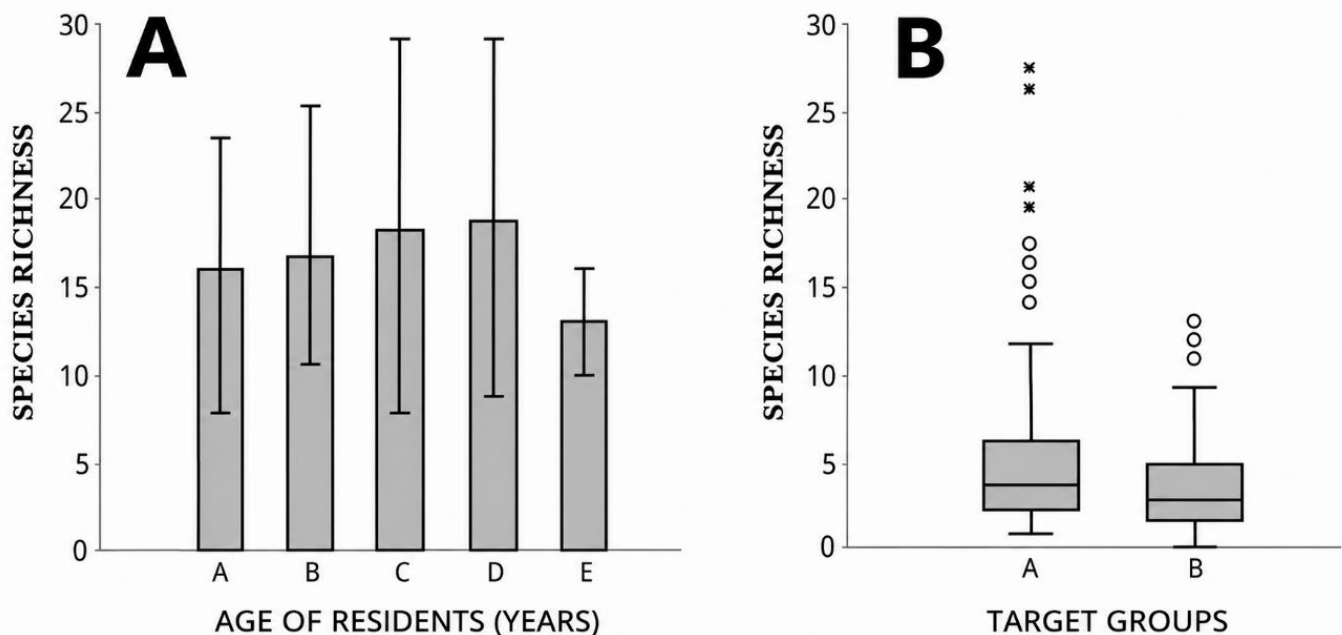


Figure 3

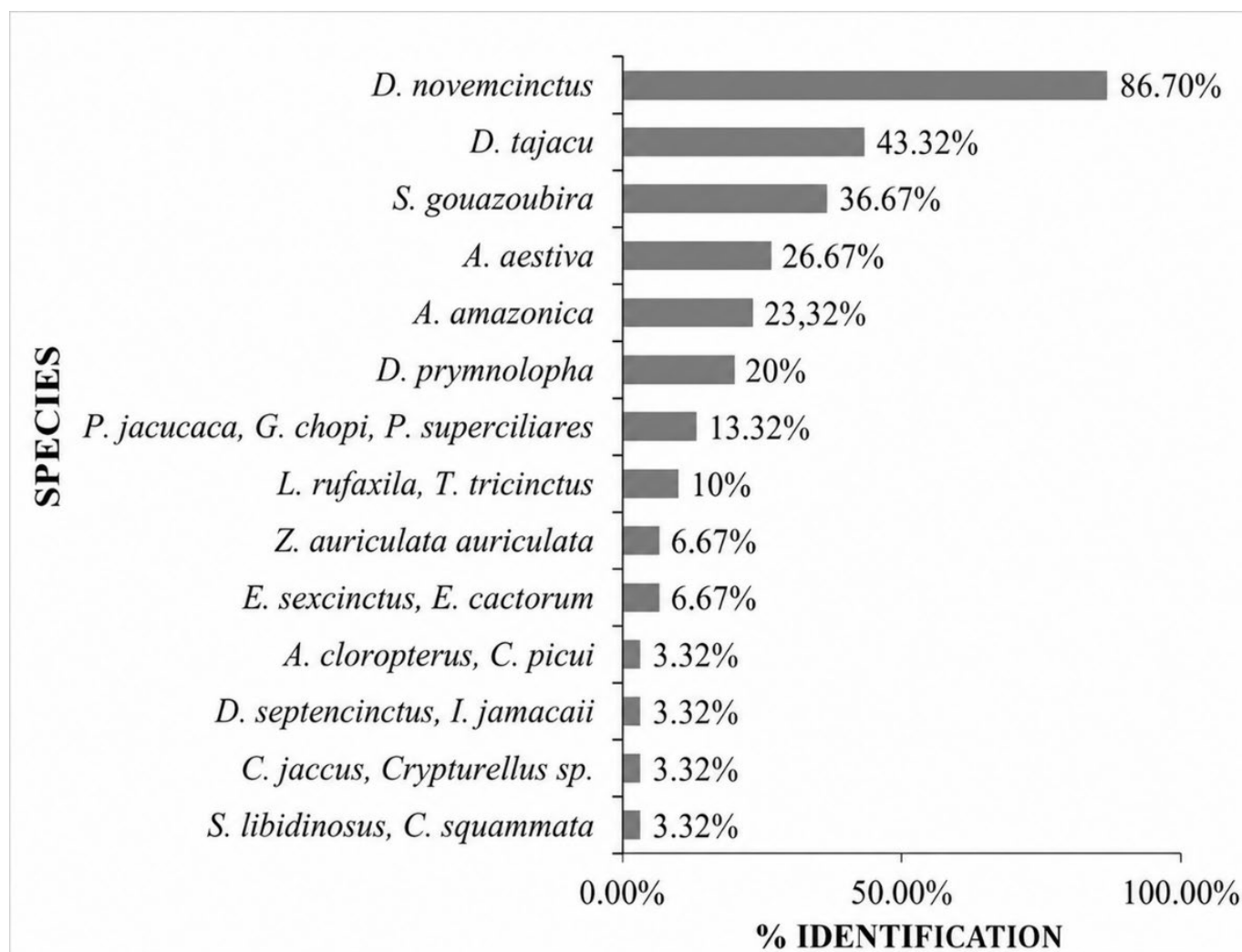
Estimated species richness reported by interviewees.

LEGEND: (3A) Species richness according to the age group of Sítio do Mocó residents: (A) 18–25 years; (B) 26–33 years; (C) 34–41 years; (D) 42–49 years; and (E) 50 years or older. (3B) Comparison of species richness reported by the target groups: (A) residents of the Sítio do Mocó community in the municipality of Coronel José Dias, Piauí, Brazil; and (B) ICMBio staff members and tour guides from Serra da Capivara National Park, Piauí, Brazil.

income. Regarding the perceived taste of meat from domestic and wild animals, four interviewees (9.30%) did not know or preferred not to express an opinion. Among those who responded, 20 (46.51%) considered wild meat to be more palatable, identifying the nine-banded armadillo *D. novemcinctus*, the collared peccary *D. tajacu*, and the birds *P. jacucaca* (white-browed guan) and *P. superciliaris* (rusty-margined guan) as the preferred species.

Among ICMBio staff members and SCNP tour guides, 10 respondents (76.92%) expressed some degree of agreement with the statement that the protected area is frequently used by surrounding residents to hunt or capture wild animals. Regarding wildlife hunting and trade, seven respondents (53.85%) expressed some degree of disagreement with the statement that hunting or capture is directed more toward consumption than trade. Of the animals cited, 17 species were reported as being exploited primarily for the illegal wildlife trade. The most frequently mentioned were *S. gouazoubira*, *D. novemcinctus*, *E. sexcinctus*, and *T. tricinatus*, with four citations each, followed by *D. prymnolopha*, with three citations.

Both community residents ($n = 21$; 70%) and ICMBio staff members and tour guides ($n = 11$; 84.62%) expressed some degree of agreement that access to the protected area by hunters and wildlife trappers had increased during the five years preceding the study (2015 – 2019). Nevertheless, 18 residents of Sítio do Mocó (60.00%) and eight ICMBio staff members and tour guides (61.54%) agreed to some extent that social programs such as *Bolsa Família* had helped reduce subsistence hunting within Serra da Capivara National Park compared with previous decades.



4. Discussion

The socioeconomic data revealed distinct profiles among the groups studied. Residents of *Sítio do Mocó* had lived in the area for longer periods, indicating a deeper relationship with the territory and a greater accumulation of local ecological knowledge, a pattern also observed in other rural contexts (see Buta et al., 2014). By contrast, interviewees engaged in paid activities directly associated with SCNP had resided in the area for shorter periods, suggesting a more technical and institutional perception of the protected area. Differences in length of residence and territorial attachment may influence how each group interacts with and perceives the environment, as discussed by Cebrián-Piqueras (2020), particularly regarding the valuation, use, and conservation of local natural resources.

The high level of agreement among residents regarding the importance of SCNP to the community indicates a positive perception of the benefits provided by the protected area. The overwhelming majority (93.3%) who “strongly agreed” suggests that the Park is regarded as a central component

Figure 4

Frequency of citations of hunted species by residents interviewed in the *Sítio do Mocó* community, municipality of Coronel José Dias, Piauí, Brazil.

of the local economy, reinforcing the view that protected areas can contribute to income generation in resource-limited contexts (Heagney et al., 2015; Campos-Silva et al., 2021; Li et al., 2024). These findings are consistent with studies conducted in communities surrounding protected areas in countries such as Ghana and Tanzania, where interviewees likewise reported positive impacts of protected areas on their livelihoods and economic development (Abukari & Mwalyosi, 2020).

The absence of statistically significant differences between residents and ICMBio staff members and tour guides in their perceptions of SCNP's economic contribution suggests a shared understanding of the socioeconomic role of the protected area. This convergence may support more integrated and participatory management strategies (He et al., 2020; Nobi et al., 2021). The activities mentioned by interviewees, such as handicraft production, tourism, and visitor guiding, represent income-generating opportunities linked to the appreciation of local natural and cultural heritage. These practices reflect dynamics observed in other protected areas in Brazil's semiarid region (Santana et al., 2019) and in various parts of the world, where expanding economic opportunities associated with conservation has become a strategic component of the sustainability of local communities (Dang et al., 2020; Allendorf, 2022).

However, the local community's engagement with Serra da Capivara National Park appears limited, particularly regarding visitation by residents of the surrounding area. Economic activities associated with SCNP were largely restricted to occasional work as tour guides, without any guarantee of regular employment or stable income. As observed in other contexts (e.g., Guo et al., 2023), although the potential economic benefits generated by the protected area are recognized, the data indicate a practical disconnect between residents and the protected space. The limited engagement of residents with SCNP can likely be attributed to several factors, including economic barriers, such as the high cost of hiring accredited guides, as reported by Liu et al. (2012), and sociocultural factors, including the limited availability of community-engagement and environmental-education initiatives promoted by public authorities. The absence of such strategies hinders the strengthening of identity-based and emotional ties to the protected area, thereby compromising the development of a sense of belonging to the conserved territory (Andrade et al., 2022).

The lack of interest reported by residents may be related to the perception that Serra da Capivara National Park is not intended for the local community, but primarily for tourists and researchers. This view contributes to the persistence of inequalities in access to and appropriation of protected natural and cultural assets, limiting residents' direct involvement in the dynamics of the protected area (Muñoz et al., 2019; Gidebo, 2023). Beyond economic barriers, these findings underscore the urgent need for more inclusive public policies that expand local residents

access to SCNP activities and spaces. Such measures are essential for strengthening their sense of belonging to the protected territory and for promoting conservation practices grounded in community engagement and the mutual recognition of different knowledge systems.

Our findings corroborate studies arguing that geographic proximity alone is insufficient to ensure the effective participation of local communities in the protection of protected areas (Andrade & Rhodes, 2012; Méndez-López et al., 2014). More recent research further emphasizes that strengthening the relationship between local populations and protected areas requires specific strategies aimed at inclusion and the recognition of residents' value and contributions (Htay et al., 2022). Initiatives such as free or subsidized access for surrounding communities and the promotion of context-specific educational activities have proven essential for fostering a culture of biodiversity appreciation and engagement in its protection (Digun-Aweto et al., 2019; Ayivor et al., 2020). In addition to encouraging visitation, such actions contribute to the development of more critical environmental awareness and to the active involvement of local communities in the management of protected areas.

Regarding knowledge of the local fauna, residents cited more local wildlife species per interviewee than ICMBio staff members and SCNP tour guides, reflecting broader traditional ecological knowledge associated with direct and sustained interaction with the environment. Nevertheless, both groups demonstrated considerable knowledge, as indicated by the high sampling completeness, which exceeded 77% for both groups. The higher estimated species richness among staff members may be related to the smaller number of species cited, resulting in a greater difference between observed and estimated richness. These findings reinforce the potential of local and traditional knowledge to contribute to conservation strategies and environmental education.

It is important to emphasize that the significantly greater number of citations provided by residents may reflect their direct and daily contact with the territory, which facilitates observation of and familiarity with different species. The absence of an effect of age on the number of species mentioned by residents indicates that this knowledge is relatively evenly distributed across generations, possibly sustained through oral transmission and cultural practices shared within the region. Similar findings were reported by Piña-Covarrubias et al. (2022). This pattern further highlights the value of local and traditional knowledge in complementing scientific biodiversity data and underscores the importance of involving residents in wildlife management and monitoring initiatives within protected areas.

Analysis of the species most frequently cited by both groups revealed convergences and divergences in their knowledge of the local fauna, indicating different forms of interaction with the environment. Residents of the Sítio do Mocó community, for example, showed greater familiarity

with commonly occurring species of potential dietary importance, such as *Dasypus novemcinctus*, *Subulo gouazoubira*, *Dicotyles tajacu*, and *Penelope jacucaca*, which ranked among the most frequently mentioned animals. This predominance may be related to the degree of interaction with these species, including their utilitarian importance, as well as to their abundance or body size (Alves & Souto, 2015; Souza et al., 2024b). The presence of parrots such as *Amazona aestiva* and *Amazona amazonica* among the most frequently mentioned taxa reinforces the view that not all hunted species are used for food; many are captured for sale or as pets, reflecting an overlap between the economic and affective uses of wildlife (Oliveira et al., 2020; Silva et al., 2023).

In contrast, ICMBio staff members and SCNP tour guides more frequently cited species of greater conservation concern or those classified within a threatened category, such as *P. onca*, *Tolypeutes tricinctus*, and *Penelope jacucaca*, possibly reflecting their professional training and institutional involvement in environmental protection. This suggests that the nature of people's relationship with the territory influences not only the number of species known but also the characteristics of local ecological knowledge, as demonstrated by Takasaki et al. (2025). The differences observed reinforce the importance of integrating multiple knowledge systems, both technical-scientific and traditional, to ensure effective wildlife management in protected areas, particularly those located in culturally diverse settings such as the Caatinga (Dawson et al., 2023).

The set of 38 species associated with hunting highlights the sociocultural and economic importance of this practice to local populations. Conversely, the greater diversity of species cited by protected-area staff members ($n = 35$), compared with residents of the community ($n = 22$), may reflect broader access to technical information and accumulated field experience, thereby expanding their awareness of wildlife species subject to hunting pressure, even in the absence of direct involvement in this activity. In turn, the greater number of species citations per interviewee among local residents reinforces the value and quality of local knowledge and the transgenerational nature of this knowledge system, generating clusters of information on species that are useful or potentially useful to residents of a given region (Hassan et al., 2022; Silva et al., 2022).

Studies conducted in northeastern Brazil have documented most of the game species recorded in our study (Fernandes-Ferreira et al., 2012; Almeida et al., 2023; Santos et al., 2022; Costa et al., 2024), indicating convergence in wildlife use among local communities across the region. As in other parts of Brazil, the most frequently cited mammals – *D. novemcinctus*, *D. tajacu*, and *S. gouazoubira* – are widely recognized as targets of subsistence hunting (Bonifácio et al., 2016; Chaves et al., 2017), highlighting their importance as sources of animal protein for semiarid populations. In the case of *D. tajacu* and *S. gouazoubira*, hunting interest is

further enhanced by the high energetic return associated with their larger body mass, reinforcing their socioeconomic and cultural importance in the context of local subsistence.

Cultural, environmental, and economic factors also shape species use (Policarpo et al., 2018). In the present study, it is plausible that supplemental income generation is also associated with wildlife hunting in SCNP, since 14 of the 30 residents stated that the protected area is an important source of game animals. These same participants expressed a preference for wild meat over meat from domesticated species, such as cattle and goats, suggesting that hunting is motivated both by household consumption and by potential commercial purposes. This pattern is reinforced by the species most frequently described as “tasty” – *D. novemcinctus*, *D. tajacu*, *P. jacucaca*, and *P. superciliares* – which correspond to those most often reported as being subject to hunting pressure. These species are widely used as food resources in several regions of Brazil (Bezerra et al., 2020; Santos et al., 2022), highlighting their cultural and nutritional value to traditional and rural communities. In other parts of Piauí, the hunting of wild animals for the commercial sale of meat or live specimens has become increasingly common (Souto et al., 2017; Souto et al., 2019).

Among the mammals cited, members of the family Dasypodidae were particularly associated with trade, indicating the existence of a local wildlife market. *Dasypus novemcinctus* stood out as the primary target of hunting and trade in the region, corroborating Alves et al. (2016), who identified the species as a preferred prey item among hunters in the Caatinga. A similar pattern was observed among birds: columbids, cracids, and tinamids are commonly hunted for food by residents living around SCNP, whereas psittacids and icterids (*Icterus jamacaii* and *Gnorimopsar chopi*) are more frequently kept as pets. Other studies have confirmed the use of these birds across Brazil (Alves et al., 2013; Nunes et al., 2019; Bezerra et al., 2020).

Pets, in turn, are part of a complex commercial chain in which many birds are transported to regions far from their native habitats (Oliveira et al., 2020). Souto et al. (2017) reported that *Sete Cidades* National Park and *Serra das Confusões* National Park may act as source areas for wild birds destined for the city of Floriano, an important regional hub connected by highways linking northern and northeastern Brazil. This flow suggests that the region not only supplies the local wildlife trade but may also play a relevant role in the interstate trafficking of birds, reinforcing the need for enforcement and environmental education initiatives aimed at wildlife conservation.

Another factor supporting the assumption that hunting around SCNP is associated with both consumption and trade is the perception of ICMBio staff members and tour guides working in the protected area. Ten of the 13 interviewees agreed that the protected area is frequently used by local residents to hunt or capture wild animals and believed that this practice

is more strongly oriented toward trade than consumption. However, despite this perception, studies such as Barboza et al. (2016) have shown that mammal meat – the group identified by ICMBio staff members and tour guides as the main target of trade – represents one of the principal sources of protein for populations in Brazil's semiarid region. These findings suggest that hunting practices in the region are driven by multiple motivations, including subsistence and income generation, and highlight the complexity of the relationships between local communities and wildlife in protected areas.

We found that, although the interviewed groups agreed that hunter access to SCNP had increased over the previous five years, their perceptions differed regarding the causes and potential solutions. Residents attributed this increase to reduced enforcement, whereas ICMBio staff members and tour guides emphasized the need for more effective enforcement, environmental education, and improved public policies to reduce hunting. Indeed, these strategies have proven effective in other protected areas worldwide (Bragagnolo et al., 2019; Ardoin et al., 2023; Meier et al., 2024). Nevertheless, it is important to recognize that hunting in SCNP occurs within a complex sociocultural context in which the practice is closely linked to subsistence and local culture.

In this context, Reyes-García e Gallois (2014) emphasize that natural resource use varies according to the social group and its relationship with the environment, highlighting the importance of understanding local dynamics for sustainable management. Applying this perspective to SCNP makes it clear that management plans cannot disregard hunting as a cultural practice deeply rooted in the lives of local communities, nor the limitations of social programs such as Bolsa Família, which do not always reach all vulnerable groups. Therefore, for conservation to be both effective and equitable, strategies must integrate environmental protection with recognition of the needs and knowledge of local populations, thereby promoting a balance between biodiversity conservation and social justice.

5. Conclusions

Our findings highlight the complexity of the relationships between local communities and protected areas, demonstrating how local and traditional knowledge, sociocultural practices, and socioeconomic factors shape both wildlife use and perceptions of *Serra da Capivara* National Park. Differences among residents, environmental staff members, and tour guides – particularly in how they recognize wildlife and attribute functions to the protected area – reveal that each group holds distinct information that, when systematically integrated, can enhance management effectiveness.

The persistence of hunting and wildlife trade, together with the low level of visitation to SCNP by local residents, indicates challenges in

strengthening community engagement with the protected area. These aspects reinforce the need for strategies that incorporate traditional knowledge as a tool for interpreting local needs, guiding educational initiatives, and supporting decision-making related to wildlife management and land use.

In this context, this study contributes empirical evidence that can support improvements in protected-area management. By identifying differences in knowledge among social groups and highlighting the role of age among residents, the findings can help guide more targeted and intergenerational environmental education programs, communication strategies, and social participation initiatives. In addition, the study reinforces the potential of local and traditional knowledge as an important ally in the development of public policies that are more legitimate, equitable, and responsive to the sociocultural context of the semiarid region.

Thus, integrating different knowledge systems and recognizing the central role of local communities in environmental protection emerges as a promising pathway for strengthening participatory management and enhancing the effectiveness of protected areas in socially diverse and environmentally fragile regions such as SCNP.

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