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People socialize ecological information about the environment but may forget their own experiences: a case study of local ecological knowledge about seed-dispersing animals

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ABSTRACT

Local ecological knowledge (LEK) has been increasingly used in the search for efficient strategies to maintain biological diversity. However, considering the rapid environmental changes in ecosystems, such knowledge may have been lost between generations, affecting its potential application. In this study, we adopted the LEK of the potential dispersers of *Caryocar coriaceum* Wittm. (Caryocaraceae), an endangered plant species of socioeconomic and cultural importance from northeast Brazil, as a model. We evaluated whether there is intergenerational variation in the LEK about the abundance of *Dasyprocta prymnolopha* (the principal disperser of *C. coriaceum*) associated with the local practice of hunting. We collected LEK data from 39 hunter-gatherers aged 31 to 84 years, and camera traps were used during two annual *C. coriaceum* harvests to record its potential dispersers. Our results indicate that the LEK of the potential animal dispersers of *C. coriaceum* does not vary between generations; it is disseminated and shared between different generations. The strong interactions among people during the *C. coriaceum* harvest period facilitate the sharing of information about the potential dispersers of this species. Our results show that hunting *D. prymnolopha* does not depend on perceptions regarding the availability of this resource in the forest, which may be causing overexploitation. Therefore, local knowledge may need to be updated and connected to the recent and rapid environmental changes because people may believe that current environmental conditions are like those of the past. If this is the case, people may be less cooperative with conservation strategies because they are not aware of environmental changes, so measures to update knowledge about environmental conditions may be necessary to encourage effective participation in management and conservation plans.

Keywords: Biodiversity conservation, Seed dispersal, Environmental change, Hunting, Shifting baseline syndrome.

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SIGNIFICANCE STATEMENT

This study significantly advances our understanding of Local Ecological Knowledge (LEK) and its relationship with environmental perception and behavior, particularly in biodiversity conservation and sustainable resource management. By focusing on the LEK of communities in northeastern Brazil about the seed-dispersing animals of *Caryocar coriaceum*, an endangered plant species, the research highlights the complexities of knowledge transmission across generations and its implications for hunting practices and species conservation. The findings challenge assumptions about generational differences in LEK, revealing that knowledge and perceptions about the environment and its resources are shared and consistent across different age groups. This consistency underscores the resilience of LEK systems but also points to the potential risks of outdated knowledge in rapidly changing environments. The study's novel approach in linking LEK with direct ecological observations, like camera trap data, provides a model for other researchers and underscores the importance of integrating LEK into conservation and management strategies, particularly in regions facing intense environmental changes.

INTRODUCTION

Local ecological knowledge (LEK) is considered an important tool for monitoring and managing species of ecological importance. The use of such knowledge to assess ecological information has increased and generated greater participation by local communities in the development and application of conservation strategies (Berkes et al. 2000; Huntington 2000; Danielsen et al. 2010; Parry and Peres 2015; Carvalho et al. 2024; Galvão et al. 2024; Grimald et al. 2024). These records from the LEK can also bring new information not yet tested that can be used as hypotheses for future work and increase the knowledge of the biological characteristics of the species (Silva et al. 2014), areas of animal occurrence (Parry and Peres 2015), beyond to provide the causes of possible decreases in their stocks, local preferences among other important aspects (Turvey et al. 2010; Bender et al. 2014; Silva Neto et al. 2017; Carmo Loch et al. 2023; Nkengbeza et al. 2024).

LEK is dynamic and continuously modified, being naturally influenced by environmental, social, and economic factors. This trend is well illustrated by the "Shifting baseline syndrome (SBS)", a concept proposed by Pauly (1995) that refers to the phenomenon affecting people's abilities to recognize long-term environmental trends; as one generation replaces another, there is a risk of failing to perceive long-term environmental changes. In the face of rapid environmental change, people from older generations may not update their perceptions, believing that the environmental conditions of the past, which tend to be forgotten (personal amnesia), are the same as those of the present (Simons and Rensink 2005; Papworth et al. 2009; Santos et al. 2022). Alternatively, the lack of communication between generations may lead to a loss of LEK, especially among younger people who are unaware of past biological conditions (generational amnesia) and are incapable of noticing environmental changes, even recent ones (Papworth et al. 2009; Turvey et al. 2010; Bender et al. 2014). Consequently, there is a greater tolerance for progressive environmental degradation due to a change in people's expectations of what is acceptable (Soga and Gaston 2018).

SBS is increasingly recognized as an obstacle in understanding today's global environmental issues; therefore, it needs to be further studied (Soga and Gaston 2018). SBS may be associated with a range of environmental problems related to resource misuse, such as overexploitation of plant products (Hanazaki et al. 2013) and defaunation (Turvey et al. 2010; Corlett 2013; Bender et al. 2014). In this regard, LEK reveals people's perceptions of the environment and its changes, whether they correspond to the actual state or if their baselines are changing. For this, it is necessary to analyze biological data relevant to environmental changes and based on the perception of the people who observe or follow these changes (Papworth et al. 2009).

In this context, to test whether there are changing baselines in the abundance of important dispersers in the Northeastern semi-arid region, we studied the sharing of information about the potential dispersers of pequi (*Caryocar coriaceum* Wittm. (Caryocaraceae)), focusing on its main disperser, the agouti (*Dasyprocta prymnolopha*) (Santos et al. 2016). *C. coriaceum* is endemic to Brazil and is distributed in the cerrados of central and northeastern Brazil, especially in the Chapada do Araripe (Prance and Pirani 2020). This species has large seeds and barochoric primary and zoochoric secondary dispersal. This species is a plant of socioeconomic and cultural importance for several local rural communities living in the surroundings of the Araripe Apodi National Forest (FLONA-Araripe) in northeastern Brazil due to the nutritional, medicinal, and commercial value of its fruits and seeds. Historically, entire families would gather in camps built at the edges of the FLONA-Araripe during the harvest period to facilitate the collection, transport and processing of *C. coriaceum* (Braga 1976; Sousa Júnior et al. 2013; Cavalcanti et al. 2015; Silva et al. 2015). However, this important species is currently endangered (IUCN 2024).

Evidence shows that *D. prymnolopha* is one of the main dispersers of *C. coriaceum* in the Araripe region (Santos et al. 2016) but also one of the most hunted animals in the semi-arid regions of Brazil, as reported in several ethnozoological studies (Alves et al. 2016; Barboza et al. 2016; Silva Neto et al. 2017). A study conducted in a community located near the FLONA-Araripe revealed that *D. prymnolopha* was a mammal of the greatest hunting importance in the region, compared to other possible dispersers of *C. coriaceum* such as gray brocket (*Mazama gouazoubira*) and white-eared opossum (*Didelphis albiventris*) (Silva Neto et al. 2017). The low percentages of seed removal recorded for *C. coriaceum* (between 6.4 and 11%) suggest that the population of *D. prymnolopha* in FLONA-Araripe has declined (Santos et al. 2016), likely due to intense hunting in the region (IBAMA 2004; Melo et al. 2014; Nascimento et al. 2015, 2016; Bonifácio et al 2016; Silva Neto et al., 2017). This decline is concerning, both in terms of the maintenance of the agouti populations and the influence of this decline on the regeneration of plants dependent on these dispersers (Galetti et al. 2006; Forget and Janse 2007; Stoner et al. 2007; Donatti et al. 2009).

Therefore, our model allows us to make inferences related to both the phenomenon of intergenerational information sharing as well as the implications for management and conservation because such LEK is related to seed dispersal, a fundamental ecological process for the regeneration of plant populations and the maintenance of biodiversity (Harms et al. 2000; Wang and Smith 2002). This study was guided by the following question: does the LEK about the potential dispersers of *C. coriaceum* vary between generations? Therefore, we tested the following questions:

i. Does knowledge of the richness of potential *C. coriaceum* dispersers vary between generations?

ii. Does the local perception of the abundance of *D. prymnolopha* vary between generations?

iii. Does the number of *D. prymnolopha* hunted each year vary by generation?

iv. Is the number of *D. prymnolopha* hunted each year related to the perceived abundance of these animals?

MATERIAL AND METHODS

Study site

The FLONA-Araripe encompasses an area of approximately 39,000 ha and is located in the Chapada do Araripe (Araripe Plateau) in the south of the state of Ceará in northeastern Brazil between 07°11'42" and 07°28'38" S latitude and 39°13'28" and 39°36'33" W longitude (IBAMA 2004; Ribeiro-Silva et al. 2012). This forest is influenced by a hot and wet tropical climate with higher rainfall from January to May. The mean annual temperature varies from 24 to 26 °C, and the mean annual rainfall is 1,090.90 mm (IPECE 2014). The vegetation structure is composed of different vegetation types, including Cerrado *sensu stricto* (savanna), Cerradão (woodland), Carrasco (dense and dry savanna), and Semi-Deciduous Forest (IBAMA 2004; Ribeiro-Silva et al. 2012).

The FLONA-Araripe was created on May 2, 1946, by Legal Decree 9,226/46 and was the first conservation unit in Brazil established for sustainable use, in which the extraction of Non-Timber Forest Products (NTFPs) is allowed. However, the hunting activities in this forest generate problems and conflicts and violate current environmental laws (IBAMA, 2004). *M. gouazoubira* (gray brocket), *D. prymnolopha* (agouti) and *Dasypus novemcinctus* (nine-banded armadillo) are the mammals most targeted for hunting in the region (IBAMA 2004; Melo et al. 2014; Nascimento et al. 2015; Bonifácio et al 2016; Silva Neto et al. 2017).

In addition to the FLONA-Araripe, the study was conducted in the adjacent rural community of Horizonte (07°29'36.9" S and 39°22'06.02" W), which is located 13 km from the municipality of Jardim in the state of Ceará (Figure 1). The community is composed of 210 families, and the main sustenance activities performed are agriculture and extractivism of NTFPs. Horizonte is an excellent study site because of all the rural communities surrounding the FLONA-Araripe (approximately 20), it is the one with the closest relationship to the forest due to its strong dependence on the NTFPs for necessities (IBAMA 2004; Sousa Júnior et al. 2013; Feitosa et al. 2014, 2018; Lozano et al. 2014; Campos et al. 2015; Cavalcanti et al. 2015; Nascimento et al. 2015, 2016; Silva et al. 2015).

Legal procedures and selection of informants

We conducted our study following the rules and guidelines of the National Health Council (Resolution

466/12) through the Research Ethics Committee of the University of Pernambuco. The Biodiversity Authorization and Information System (SISBio), which granted permission to develop the research at FLONA-Araripe (Nº. 38234), also reviewed our study. Initial contacts with the Horizonte community were made through the Association of Pequi Pickers and the local health center, where the research objectives were explained to the leaders.

The local specialists were identified using the snowball technique (see Albuquerque et al., 2014a) to encompass all specialists in the community. Hence, the data collection included 39 informants, all males aged between 31 and 84. The specialists were hunter-gatherers who, besides hunting, knew dispersers of *C. coriaceum*. We are aware that some of the specialists may not have been included because some informants might not have felt comfortable identifying other specialists for several reasons such as vanity, i.e., considering oneself the most knowledgeable, or even due to personal reasons, such as relationship problems (Albuquerque et al. 2014a).

The informants who agreed to participate in the study signed a free and informed consent form according to the legal requirements (Resolution no. 466/12 of the Research Ethics Committee of the National Health Council).

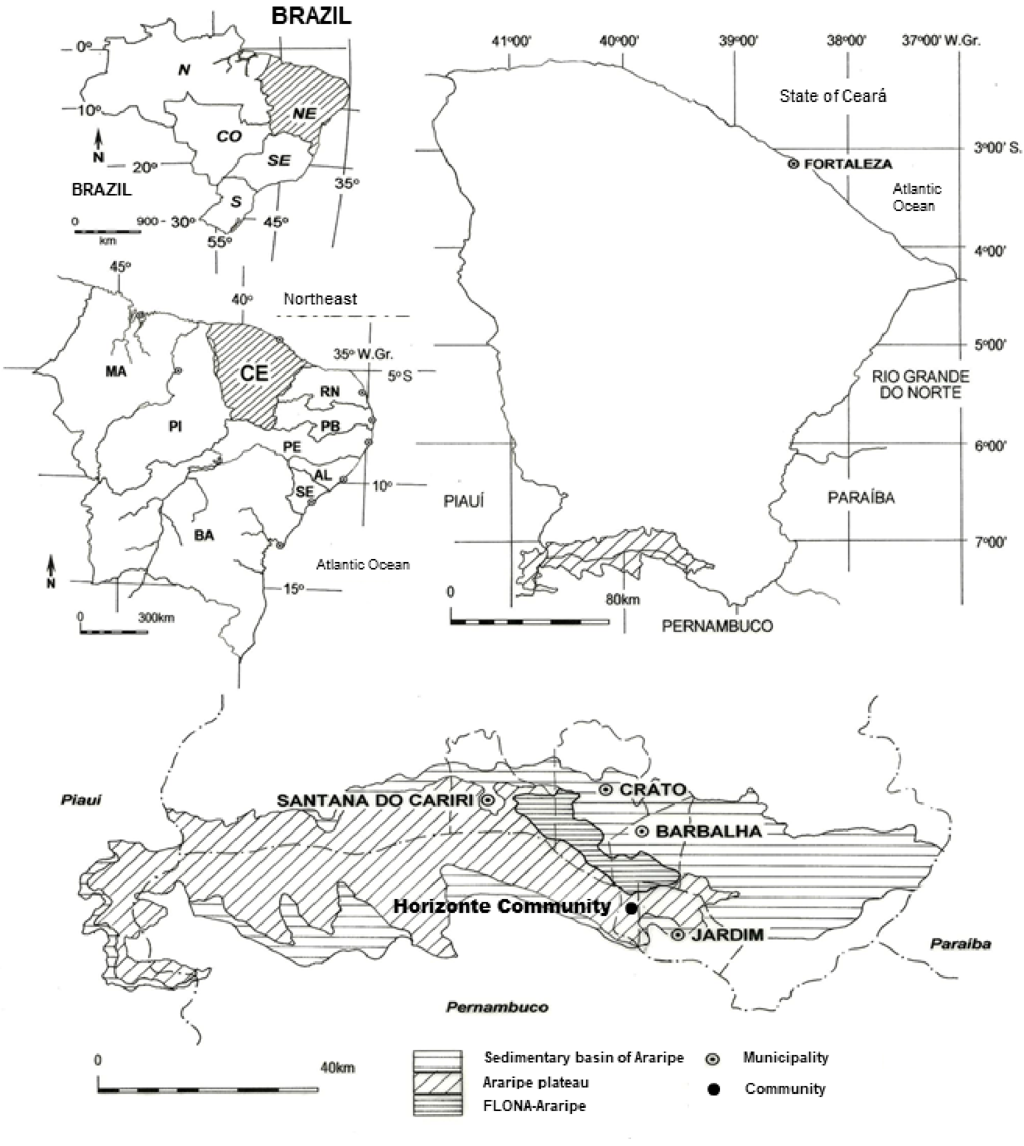

Figure 1. Map of the study area, including the Horizonte community, located adjacent to the Araripe Apodi National Forest, Ceará, northeastern Brazil.

Access to intergenerational LEK

Information about the potential dispersers of *C. coriaceum*, the abundance of *D. prymnolopha,* and its annual hunting frequency was obtained from October 2014 to March 2015. To obtain information about the potential dispersers of *C. coriaceum*, informants were encouraged to answer questions about the animals that eat (prey), move (remove from one place and transport to another), or bury *C. coriaceum* fruits. Each informant produced a free list of animals. This technique consists of each informant listing a known repertoire of a given cultural domain (see Albuquerque et al. 2014b), which in this case were the potential dispersing animals of *C. coriaceum,* and from this list the other questions were elicited.

To estimate the perceived abundance of agoutis and other native mammals in the forest recognized as potential dispersers of *C. coriaceum*, a visual aid was presented so that each informant could indicate the representation of the number of animals occurring in the region (Figure 2). This technique allows for comparisons between groups of people or individuals.

To obtain information about the annual hunting frequency of agoutis, each informant was asked to reveal the number of animals he hunts per year. At all stages of the LEK assessment, each informant was approached individually to avoid interference from the others and to minimize possible biases. Although the community may have demonstrated a degree of kinship, this was not a target of investigation in our research since our sampling unit consisted of one hunter-gatherer per family.

Recording of potential mammal dispersers of *C. coriaceum*

To record the potential mammal dispersers of *C. coriaceum* in FLONA-Araripe, especially *D. prymnolopha*, and to support our interpretation of the LEK, we used five automatic digital camera traps with infrared heat and movement sensors (Moultrie® A-5), which were set up from January to April 2014 and during the same period in 2015. Sampling was performed during the rainy season because of the natural availability of *C. coriaceum* fruits.

Sampling was conducted for 180 days (90 days in 2014 and 90 days in 2015), for a total sampling effort of 900 camera days, in six randomly chosen Cerrado *sensu stricto (*savanna) areas with naturally occurring *C. coriaceum* (three areas in 2014 and three areas in 2015). Cerrado *sensu stricto (savanna)* areas were chosen because of the higher natural occurrence of *C. coriaceum* in this vegetation type (absolute density of 38.9 Ind./ha), at the expense of Cerradão (33.8), Semi-Deciduous Forest (5.9) and Carrasco (5) areas (IBAMA 2004). In each month of each year, camera traps were distributed along trails for five sampling points per area, and they remained active 24 hours a day for the entire period. The cameras were rotated among areas, and a new area was sampled every 30 days. In each area, sampling points were set up with a minimum distance of 300 m between points to ensure independent records of *D. prymnolopha* better, as the movement radius of the animals of this genus is generally 100 m (Dubost 1988; Aliaga-Rosel et al. 2008).

Each sampling point consisted of a *C. coriaceum* tree to which a camera trap was attached approximately 30 cm above the ground. Ten *C. coriaceum* fruits, collected on the same day and from the same area as the camera traps, were placed directly on the ground at a distance of approximately 3 m from the camera trap. The fruits were replaced every 15 days to increase the chances of attracting mammalian seed dispersers.

The camera traps were operated in video mode to increase the probability of detecting the mammal species that visited the fruits with an activation interval of 30 seconds. To increase the robustness of the data, we determined which mammals might feed on the fruits by consulting specialized literature on the subject. To distinguish between individual dispersal events, the date and time were automatically recorded in all of the videos, and each video obtained per species per sampling point was considered an independent record. Because the same individual may have visited the fruits more than once, the videos were watched carefully several times to minimize this possible bias and reinforce the records' independence. Throughout the experiment, we assumed there was a risk that people might collect the fruits, but this did not occur, as the camera traps recorded no humans.

Data analysis

A Kruskal-Wallis test was applied to test for intergenerational differences about the perceived richness of the species that are recognized potential dispersers of *C. coriaceum.* The informants were divided into three distinct generations (Generation A, born in the 1930s and 1940s; Generation B, born in the 1950s and 1960s; Generation C, born in the 1970s and 1980s), and the number of potential disperser species cited by each informant in each generation was used as a variable. The same analysis was employed to test whether the annual agouti hunting frequency cited by the informants and the relative perceived abundance of this animal varied between generations.

We calculated the agouti relative perceived abundance (ARPA) as APA/(PAM1+PAM2+.../100), where APA is the agouti perceived abundance; PAM1

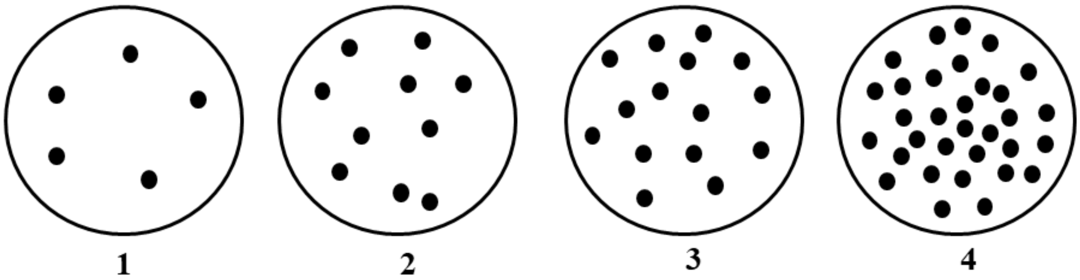

Figure 2. Visual aid presented to informants to indicate the perceived abundance of mammal seed dispersers of *Caryocar coriaceum* Wittm. (Caryocaraceae). 1 - Low abundance; 2 - Intermediate abundance; 3 - Abundance; 4 - High abundance (reproduced from Silva Neto et al. 2017).

is the perceived abundance of mammal 1 as a potential disperser of *C. coriaceum*; PAM2 is the perceived abundance of mammal 2 as a potential disperser of *C. coriaceum*, etc. until the perceived abundance of mammals as potential dispersers of *C. coriaceum* per informant was exhausted.

Lastly, we tested whether there was a relationship between the ARPA and the annual hunting frequency with a Spearman correlation test because the data were not normally distributed.

All tests were performed with the statistics software R version 3.2.2, and $p < 0.05$ was considered significant.

RESULTS

There was no variation in the knowledge about the potential dispersers of *C. coriaceum* ($H = 0.6062$; $p > 0.05$), the annual agouti hunting frequency ($H = 0.7759$; $p > 0.05$) or the abundance ($H = 2.36$; $p > 0.05$) (Table 1). These data indicate no generational amnesia related to the LEK of the dispersers of *C. coriaceum*.

The following animals were cited as potential dispersers and their interactions with *C. coriaceum* fruits are *D. prymnolopha* (agouti), Coleoptera-Scarabaeidae (dung beetle), *Bos taurus* (cow), *M. gouazoubira* (gray brocket), *Euphractus sexcinctus* (six-banded armadillo), *Galea spixii* (cavy), *Thrichomys apereoides* (punaré), *Cyanocorax cyanopogon* (white-naped jay), *Didelphis albiventris* (white-eared opossum) and *D. novemcinctus* (nine-banded armadillo) (Table 2). According to the informants, the main disperser of *C. coriaceum* is the agouti because it gnaws on the pulp and moves and buries the seeds. They also reported that dung beetles played a fundamental role in the dispersal of *C. coriaceum* because they buried the seeds contained in cattle feces, which no longer occurs. After all, cattle were prohibited in the forest approximately 20 years ago. The informants also reported that the burrowing beetles started burying the rotting fruits of *C. coriaceum* after cattle were prohibited.

There were a total of 199 camera trap records of mammals attracted to the *C. coriaceum* fruits (Table 3), and only *Conepatus semistriatus* (skunk), which was only recorded once and did not directly interact with *C. coriaceum* fruits, was not cited as a potential disperser of C. *coriaceum.* Of all potential dispersers cited, only *D. prymnolopha* (in the eight records of this species) and *D. albiventris* (in three of the 183 records) directly interacted with the *C. coriaceum* fruits. In all records of *D. prymnolopha*, the animal carried a *C. coriaceum* fruit. In the three records where *D. albiventris* was caught interacting directly with the fruits, the animal did not act as a disperser, consuming the shell and breaking the seed, without removing the fruits from the site.

Lastly, there was no relationship between the perceived abundance and the number of agoutis hunted by the informants each year ($rs = 0.0696$; $p > 0.05$). Hunters may base their activities on factors that are not directly related to the perceived abundance of the species. These factors may include economic necessity, accessibility of hunting areas, cultural traditions, availability of other prey, or even local wildlife management laws and policies. Furthermore, the absence of a significant correlation may indicate that the perception of abundance is not a good indicator of the true population of agoutis in the area, suggesting that hunters may not have an accurate assessment of the number of animals available.

Table 1. Mean ± standard deviation and median (Md) of the perceived richness of *Caryocar coriaceum* Wittm potential dispersers. (Caryocaraceae), The annual hunting frequency of *Dasyprocta prymnolopha* and the perceived relative abundance of this animal were cited by informants from the Horizonte community in Northeastern Brazil. Generation A was born in the 1930s and 1940s; Generation B was born in the 1950s and 1960s; Generation C was born in the 1970s and 1980s.

	Generation A (n=15)	Generation B (n=15)	Generation C (n=9)
Perceived richness of potential dispersers	3.80±1.65; Md=3	3.93±0.96; Md=4	3.55±1.42; Md=4
Annual agouti hunting frequency	44.06±127.06; Md=8	42.66±127.71; Md=0	24.88±65.80; Md=0
Perceived agouti relative abundance	9.21±4.66; Md=7.41	8.26±3.47; Md=8.33	6.40±3.68; Md=4.54

Table 2. Species richness indicated by informants as potential dispersers of *Caryocar coriaceum* Wittm. (Caryocaraceae) in the Horizonte community, Ceará, northeastern Brazil.

Order	Family	Scientific name	Common name	Number of citations		
				Eat	Move	Bury
Artiodactyla	Cervidae	*Mazama gouazoubira*	gray brocket	11	-	-
	Bovidae	*Bos taurus*	Cow	19	2	-
Pilosa	Dasypodidae	*Euphractus sexcinctus*	six-banded armadillo	12	1	2
		Dasypus novemcinctus	nine-banded armadillo	2	-	-
Marsupialia	Didelphidae	*Didelphis albiventris*	white-eared opossum	-	1	-
Rodentia	Dasyproctidae	*Dasyprocta prymnolopha*	Agouti	39	37	11
	Echimyidae	*Trichomys apereoides*	Punaré	4	1	-
	Caviidae	*Galea spixii*	Cavy	5	-	-
Passerines	Corvidae	*Cyanocorax cyanopogon*	white-naped jay	4	1	-
Coleoptera	Sacarabaeidae	*Coleoptera-Scarabaeidae*	dung beetle	4	1	35

Table 3. Camera trap records of mammals attracted to *Caryocar coriaceum* Wittm's fruits. (Caryocaraceae) in the Araripe Apodi National Forest, Ceará, northeastern Brazil.

Scientific name	Common name	Number of records	Number of direct interactions
Dasyprocta prymnolopha	agouti	8	8
Didelphis albiventris	white-eared opossum	183	3
Mazama gouazoubira	gray brocket	5	0
Dasypus novemcinctus	nine-banded armadillo	2	0
Conepatus semistriatus	skunk	1	0

DISCUSSION

Intergenerational LEK on the richness of potential *C. coriaceum* dispersers

Our results suggest that LEK on the richness of potential *C. coriaceum* dispersers is shared intergenerationally. Although the transmission of knowledge between generations is not straightforward, intergenerational sharing of information on ecosystem elements may be closely associated with the environmental, social, and cultural importance that natural resources represent to local human populations (Reyes-García et al. 2009; Gómez-Baggethun and Reyes-García 2013; Hanazaki et al. 2013; Soldati et al. 2015; Aguiar et al. 2023). In this regard, the interaction between individuals extracting or using *C. coriaceum* (Sousa Júnior et al. 2013; Cavalcanti et al. 2015; Silva et al. 2015) is crucial for the socialization of information regarding the potential dispersers of this species. These settlements allow direct contact between people and the forest, which may further facilitate the perception and sharing of information on the potential dispersers of *C. coriaceum*. Additionally, the extraction of *C. coriaceum* involves people of different ages (Campos et al. 2015) and may enable the encounter or sighting of animals interacting with this resource.

We highlight here that people of different generations could cite 80% of the mammals recorded on the camera traps. One of the mammals mentioned as a potential disperser of *C. coriaceum* was *D. albiventris*. This predominantly omnivorous mammal may be an effective plant disperser but only for small-seeded pioneer species (Cáceres 2002; Alves-Costa and Eterovick 2007) and not for large-seeded species such as *C. coriaceum*. Accordingly, only one interviewee mentioned *D. albiventris* as a potential disperser of *C. coriaceum*.

The several records of *D. albiventris* caught our attention. It deserves further concerns about the local conservation status, since this mammal is considered an opportunistic frugivore closely related to disturbed environments (Adler et al. 2012). Thus, increased occurrence of *D. albiventris* or small rodents in tropical forests may indicate environmental imbalance caused by population reduction or the loss of large seed-dispersing animals. This trend leads to relaxed food competition and, consequently, elevation of seed predation rates, which may be up to two and a half times higher than in conserved environments (Smythe 1986; Adler et al. 2012; Galetti et al. 2015a; 2015b). On the occasions when *D. albiventris* was recorded by our camera trap interacting directly with *C. coriaceum* fruits, the animal behaved as a seed predator by consuming the shell and breaking the seeds.

Our data suggest *M. gouazoubira* as a potential disperser of *C. coriaceum*. Although our camera traps did not record any direct interaction between *M. gouazoubira* and the fruits of the studied species, research shows that this large frugivore can consume fruits of several species (Serbent et al. 2011) and is important in seed dispersal interaction networks (Vidal et al. 2013). The relationship of deer with different plant species was also shown in an ethnobiological study on the diet of ungulate mammals of the Brazilian Atlantic Forest, in which informants cited fruits as the most consumed food type by this animal (Prado et al. 2013). The authors also revealed that, in terms of diet variety in deer and other ungulates, the LEK was much higher than the knowledge documented in several scientific records on the foraging of the investigated species (Prado et al. 2013). Thus, it is evident that LEK can contribute new information or complement scientific knowledge and empirical observations, and expert LEK can provide important and detailed, and even unpublished, information leading to greater understanding of natural systems (Mackinson and Nottestad 1998; Gagnon and Berteaux 2009; Prado et al. 2013; Beaudreau and Levin 2014; Oliveira et al. 2022).

Camera trap records indicate the agouti as a disperser of *C. coriaceum*, reinforcing the information obtained locally. In 100% of the camera trap records, this animal appeared carrying *C. coriaceum* fruits. In fact, besides *C. coricaeum* (Santos et al. 2016), the agouti is considered the main disperser of several other plant species with large seeds, such as *Caryocar brasiliense* Camb. (Guimarães et al. 2008), *Carapa procera* DC. (Forget 1996; Forget and Jansen 2007), *Bertholletia excelsa* Bonpl. (Peres et al. 2003; Tuck Haugaasen et al. 2010), and several palm species (Galetti et al. 2006; Donatti et al. 2009). Besides the agouti, all informants also mentioned the dung beetle (Coleoptera: Scarabaeidae) as one of the main potential dispersers of *C. coriaceum*; the beetle buries the seeds contained in cattle feces or decaying fruits. Andresen (2001) revealed that seeds of *Micropholis guyanensis* subsp. *guyanensis* (A.DC.) were only buried by these beetles when enveloped by at least 5 g of primate feces. Further corroborating the LEK described in this study, previous studies have shown that beetles of this insect family bury fruits or seeds of *Quercus* spp. (Pérez-Ramos et al. 2007, 2013), *Ceratocaryum argenteum* Nees ex Kunth (Midgley et al. 2015), *C. brasiliense* (Vaz-de-Mello et al. 1998), and *C. coricaceum* (Santos et al. 2016).

Accessing LEK to obtain information about animals and their roles in ecosystems becomes attractive because, in addition to being up to 100 times cheaper than usual ecological methods such as establishing linear transects, it can also provide new directions for future field research, especially in places lacking scientific data (Anadón et al. 2009; Gagnon and Berteaux 2009; Beaudreau and Levin 2014; Service et al. 2014; Parry and Peres 2015; Alves and Lopes 2018; Braga-Pereira et al 2022).

Intergenerational perception of relative abundance and hunting frequency of agouti

Contrary to our hypothesis, we found that the perception of the relative abundance and annual hunting frequency of *D. prymnolopha* do not vary intergenerationally, suggesting that there are collective and socially shared hunting patterns, similar to wealth. People's direct contact with the natural environment may aid in the intergenerational sharing of information linked to hunting activity, which tends to be boosted when exploited resources are locally perceived as abundant (Sayles and Mulrenann 2010; Bender et al. 2014; Mesquita and Barreto 2015; Silva Neto et al. 2017). However, although decisions on the exploitation of wildlife resources are often associated with the local perception of the availability of these resources, several ethnozoological studies have shown that this perception can govern not only hunting behavior but also cultural, social, economic, and subsistence aspects, depending on local characteristics (Alves et al. 2009, 2012; Van Holt et al. 2010; Souza and Alves 2014; Alves et al. 2018). In addition, the attributes of the hunted species, such as meat flavor, biomass, and versatility of uses, may also account for the decisions made regarding the faunal resources preferentially exploited (Souza and Alves 2014; Alves et al. 2016; Bonifácio et al. 2016; Silva Neto et al. 2017). In the region of FLONA-Araripe, *D. prymnolopha* is widely exploited for food and zootherapic purposes (see Silva Neto et al. 2017). Hunter-gatherers of different generations of the community studied here perceive the most hunted animals in the FLONA-Araripe, such as *D. prymnolopha,* as more abundant than animals that suffer less or no hunting pressure. However, among younger and older hunters, no significant relationships were found between the perceived abundance of the most hunted animals and their hunting (Silva Neto et al. 2017). Specifically for *D. prymnolopha*, we found no relationship between the perceived abundance and the annual hunting frequency of this animal indicated by the interviewees. Our findings and those of Silva Neto et al. (2017) may indicate that the hunting activity practiced by hunters in the studied community is independent of the perceived availability of *D. prymnolopha* in the FLONA-Araripe. This finding may account for the overexploitation of this resource and result in a decline in the local population of this animal, whose population has already been categorized as stable in the region (Cruz and Campello 1998). Indirectly, this probable population decline of *D. prymnolopha* in FLONA-Araripe was evidenced by Santos et al. (2016), who, when studying the dispersal of *C. coricaceum* by this animal, found low percentages of seed removal of the species (maximum of 11%). Similar results to those found by Santos et al. (2016) were found by Donatti et al. (2009) in the Brazilian Atlantic Forest when studying the dispersal of *Astrocaryum aculeatissimum* (Schott) Burret by agouti (*Dasyprocta* spp.). The study showed that in areas where agoutis are not abundant, mainly due to hunting activity, the percentages of seed removal by these animals were low (up to 16%), and the dispersal and regeneration of *A. aculeatissimum* in these areas has reduced (Donatti et al. 2009).

The maintenance of hunting activity patterns does not indicate that people are keeping up with recent and rapid environmental changes, forgetting individual experiences, or not noticing these changes. In this context, our study participants' perception of the relative abundance of *D. prymnolopha* is not aligned with the actual abundance due to the probable overexploitation of this animal. Thus, our findings suggest that the hunting of *D. prymnolopha* is not primarily associated with sustenance needs, as the satisfaction of these needs is more susceptible to adjustments, even amid environmental changes (Berkes and Joly 2001; Sayles and Mulrenann 2010). Silva Neto et al. (2017) proposed that hunting may be performed for pleasure or opportunism. People hunt as they discover prey during other activities, such as collecting plant resources. In French Guyana and Suriname, it was revealed that the hunting of agoutis (*Dasyprocta leporina*) and acouchis (*Myoprocta acouchy*) had increased during the period of seed collection of *C. procera*, causing the decline in the population of these scatter-hoarding rodents, which act as dispersers for *C. procera* (Forget and Jansen 2007).

How people perceive changes in the environment influences their responses and ability to adapt to these changes (Davidson-Hunt and Berkes 2003; Byg and Salick 2009; Gómez-Baggethun and Reyes-García 2013). If environmental changes are not perceived, people may be less cooperative with management and conservation plans (Papworth et al. 2009; Kai et al. 2014). If past ecological conditions are not recalled, displaying the situation of natural resources in the past may help people understand the importance of conserving these resources and associated ecosystem services (Papworth et al. 2009; Bender et al. 2014). In addition, it is necessary to maintain intergenerational LEK sharing so that more accurate local narratives of environmental change can be established and preserved (Papworth et al. 2009; Fernández-Llamazares et al. 2015). Efforts to implement measures such as those mentioned are of paramount importance for conservation practice, as a lack of awareness of environmental change can influence data used on environmental conditions, such as for assessing ecosystem functioning, monitoring species, and defining management and conservation strategies (Anadón et al 2009; Daw 2010; Danielsen et al. 2014; Parry and Peres 2015). The growing interest in the use of LEK to document environmental changes has promoted a greater integration of this type of knowledge into scientific knowledge, favoring a better understanding of natural systems on spatial and temporal scales (Gagnon and Berteau 2009; Beaudreau and Levin 2014; Parry and Peres 2015).

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DATA AVAILABILITY

The data are available upon reasonable request.

CONFLICT OF INTEREST

Dr. Ulysses Albuquerque declares that he serves as co-editor in Chief for Ethnobiology and Conservation and has removed himself from the peer-review process for this paper.

CONTRIBUTION STATEMENT

Gilney Santos, Ulysses Albuquerque: Conceptualization, Methodology; Gilney Santos: Data curation; Gilney Santos: Writing- Original draft preparation. All authors: Visualization; Gilney Santos: Investigation. Ulysses Albuquerque, Nicola Schiel, Rômulo Alves: Supervision. Ulysses Albuquerque, Nicola Schiel, Rômulo Alves, Elcida Araújo: Validation.: All authors: Writing- Reviewing and Editing,

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