




# Hunting pressure on primates in the southern portion of the Brazilian Northeast: historical threats and current perspectives

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## ABSTRACT

Hunting is an ancient human behavior, which likely became complex and efficient gradually through time. We present data from a bibliographic survey (qualitative) and field sampling (quantitative) of primate hunting in Northeastern Brazil. We evaluated hunting threats faced by 14 primate species native to the States of Bahia and Sergipe (three Critically Endangered, three Endangered, three Vulnerable, two Near Threatened, and three Least Concern). Qualitatively, since 2005, we identified 21 academic studies that contained 47 mentions of all six studied genera known to occur in the study area (*Alouatta*=4, *Brachyteles*=2, *Callicebus*=16, *Callithrix*=8, *Leontopithecus*=3, *Sapajus*=14). Approximately half of the citations were for hunting (55.3%; 88.4% of this for bushmeat) and the other half for trapping (44.7%; 90.4% for pet). Quantitatively, we obtained 834 local experts' citations of primate hunting and capturing at 348 sites. All experts cited *Callithrix*, 818 cited *Sapajus*, and 738 cited *Callicebus*. We argued 539 about hunting for bushmeat (164 positive; 30.4%) and 636 about trapping for pet (189 positive; 30.9%). *Callicebus* presented 95 citations as bushmeat (30.1% of 326 queries) and *Sapajus* presented 80 citations as pet (35.7% of 224). Four informants reported hunting *Sapajus* for pest control because of crop damage. There was a significant difference ( $\chi^2=33.982$ ;  $df=2$ ;  $p<0.0001$ ) comparing hunting for bushmeat and pets, with *Callicebus* (higher bushmeat) and *Sapajus* (higher pet) presenting significant differences (both  $p<0.01$ ). The impact of hunting is associated with biological contexts, besides socioeconomic and political, requiring complex-specific attention and efforts in conservation and management strategies, perhaps innovative, even non-prohibitive hunting.

**Keywords:** Threatened species, *Alouatta*, *Brachyteles*, *Callicebus*, *Callithrix*, *Leontopithecus*, *Sapajus*.

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## SIGNIFICANCE STATEMENT

We reviewed the academic literature since 2005, which mentions the hunting of primates from the states of Bahia and Sergipe, and their respective uses. In addition, we investigated the hunting and trapping patterns of primates from these states through field data sampling. The analysis of the field data agreed with the academic literature on primate hunting patterns in northeastern Brazil. Moreover, we found an unexpected hunting pattern in some species. The results highlighted the impact of hunting to the reduction of primate populations and the local extinction of some species. Any strategy for the conservation of primates throughout the study region must consider the regional, biological, socioeconomic, and political contexts of local impacts of game hunting.

## INTRODUCTION

Hunting is an ancient human behavior of unknown origin (Hill 1982), which likely became more complex and efficient quite gradually through time over the course of the evolution of *Homo sapiens* (Klein 1987). Hunting was important precursor of agricultural practices, contributing to the advancement of human societies (Nitecki 1987), and is still an important component of the subsistence strategies of some human societies (Sponsel 1997; Peres 2001; Nunes *et al.* 2017). In the present day, however, hunting is second only to habitat loss and fragmentation as a major threat to the planet's terrestrial fauna (Cowlshaw and Dunbar 2000; Benítez-Lopez *et al.* 2017; ICMBio 2018).

In addition to its impact on populations, which includes local extinction, in some cases, hunting may lead to other processes, such as the loss of genetic variability, key ecological processes, and certain plant species, as well as the homogenization of landscapes (see Redford 1992; Cowlshaw and Dunbar 2000; Tabarelli *et al.* 2004; Terborgh *et al.* 2008; Wilkie *et al.* 2011; Bagchi *et al.* 2018). Hunting, combined with habitat loss and fragmentation, imposes severe limitations on a local fauna (Novaro *et al.* 2000), in particular animals, such as Neotropical primates, that are dependent on forest habitats (Gouveia *et al.* 2014).

In addition to subsistence, hunting has a number of alternative objectives, including the trade in bushmeat and medicinal substances (Stanford 1999; Alvard *et al.* 1997; Cowlshaw and Dunbar 2000), pest control (King and Lee 1987; Lee and Priston 2005), and sport (Bekoff and Jamieson 1991; Loveridge *et al.* 2007). Here, we differentiate trapping as the non-lethal harvesting of animals, for the capture of pets or trade, legal or otherwise, although, in the specific case of primates, this may often include the death of certain individuals (Ceballos-Mago *et al.* 2010). Hunting tends to result in a drastic reduction in population size, as observed in some Neotropical mammals (Robinson and Redford 1991), including many Brazilian primates (Costa *et al.* 2005; Chiarello *et al.* 2008; ICMBio 2018). Under certain conditions, hunting may even lead to the local extinction of a primate species (Aguirre 1971; Lane 1990; Cowlshaw and Dunbar 2000).

Under most circumstances, hunting is illegal in Brazil (Brasil 1998), which means that this activity tends to be under-reported in the extreme, although some insights into the illegal trade in wildlife are provided by the monitoring of government agencies. Between 1999 and 2006, for example, the wildlife screening centers (CETAS: *Centros de Triagem de Animais Silvestres*) of the Brazilian Environment Institute (IBAMA: *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis*) documented more than 4,500 primates, derived from actions against illegal trade, confiscations, and donations (Levacov *et al.* 2011). A total of approximately 1,300 legal trade transactions in Brazilian primates have also been registered since 1977 (Fialho *et al.* 2016). In fact, considering the trade only for zoos and scientific purposes (between 1977 and 2013), approximately 90,000 live Neotropical monkeys were exported from all South American habitat countries (except Ecuador). During a similar period (1975–2014), night monkeys (*Aotus* spp.) alone contributed more than 13,000 individuals (Svensson *et al.* 2016), which were exported from Brazil, Colombia, Ecuador, Panama, and Peru. While striking, it seems likely that these numbers under-report the real scenario considerably. In fact, Maldonado *et al.* (2009) reported that approximately 4,000 night monkeys (*Aotus* spp.) were captured or traded from the Brazil–Colombia–Peru border region in 2007 and 2008 alone.

A number of Brazilian primates are under some level of threat of extinction (see Costa *et al.* 2005; Chiarello *et al.* 2008; MMA 2014; ICMBio 2018), with the scenario being exacerbated, in many cases, by hunting pressure. This problem is especially intended in eastern Brazil, primarily in the Atlantic Forest and Caatinga domains, which have been subject to the most critical levels of habitat impact (see MapBiomias 2022). In the present study, we review both qualitative (literature search) and quantitative (field sampling) data on the hunting of primates in the southern portion of the Brazilian Northeast region, that is, the states of Bahia and Sergipe. We also applied a quantitative analysis to identify the principal threat faced by each primate genus, considering the focus of the hunting activity affecting each taxon.

## MATERIAL AND METHODS

### Study Area

We included all sites located within the southern portion of the Brazilian Northeast region, that is, the states of Bahia and Sergipe, including any research that refers to the primate species of this area. This area was inhabited originally by 14 primate species distributed in six genera: *Alouatta caraya*, *Alouatta guariba*, *Brachyteles hypoxanthus*, *Callicebus barbarabrownae*, *Callicebus coimbrai*, *Callicebus melanochir*, *Callithrix geoffroyi*, *Callithrix jacchus*, *Callithrix kuhlii*, *Callithrix penicillata*, *Leontopithecus chrysomelas*, *Sapajus libidinosus*, *S. robustus*, and *Sapajus xanthosternos* (see Rylands and Mittermeier 2009; Rylands *et al.* 2009; Marques *et al.* 2013a,b; Alonso *et al.* 2024). Three of these species – *B. hypoxanthus*, *C. barbarabrownae*, and *S. xanthosternos* – are listed as Critically Endangered (CR) by the IUCN (Canale *et al.* 2021; Melo *et al.* 2021b; Printes *et al.* 2021), and are the study region’s most prominent forms, in conservation terms. Three other species – *C. coimbrai*, *L. chrysomelas*, and *S. robustus* – are listed as Endangered (EN) by the IUCN (Jerusalinsky *et al.* 2020; Martins *et al.* 2021b; Oliveira *et al.* 2021). Three of the other eight species are listed as Vulnerable, VU (Jerusalinsky *et al.* 2021; Neves *et al.* 2021; Printes *et al.* 2020), two are Near Threatened, NT (Bicca-Marques *et al.* 2021; Martins *et al.* 2021a), and three as Least Concern, LC (Melo *et al.* 2021a; Valença-Montenegro *et al.* 2021; Valle *et al.* 2021).

### Qualitative Data Sampling

We surveyed and assessed the published academic literature and unpublished reports from research projects produced since 1997 up to 2023 that refer to the hunting and trapping of primates within the study area. We search the Web of Science catalogue and Google Scholar using the names (scientific and common names, former and current typos) of all primate species and genus occurring in the study area (see above), followed by the terms “hunt”, “hunting”, “pet”, “pet trade” together with the connectors “or” and “and”. We scrutinized the References of the articles and reports we find in order to identify additional documents. These documents were examined to determine the target species and the principal objective of the activity, i.e., hunting or trapping, and the specific subcategories. We also examined the studies to identify the number of citations or hunting events documented for each species, and any other information considered relevant to our goal.

### Quantitative Data Sampling

The assessment of the conservation status of a species based on a participative and integrative research depends on the adequate identification of the local residents that are considered to be local experts in their respective communities. In addition, since we knew about the absence of some species at specific sites, we did not argue all the informants comprehensively, thus not arguing about all species or all hunting purposes. Besides, when the needed information is highly sensitive, such as hunting, a practice that is considered illegal in Brazil (Brasil 1998), running the proper research method is crucial to the effectiveness of the survey and assessment. This strategy allowed us to dedicate field effort accurately to sites with a higher probability of occurrence of the assessed primate species or to survey more accurate information concerning its conservation status, besides past and current threats (e.g., Kierulff *et al.* 2005; Jerusalinsky *et al.* 2006; Marques *et al.* 2013a,b; Beltrão-Mendes and Ferrari 2019).

We identified local experts (Davis and Wagner 2003) using a set of approaches, but primarily unprompted and undirected interviews (Chizzotti 2005; Bernard 2011), in particular, by using the snowball technique to identify the most valuable potential interviewer (Goodman 1961; Johnson *et al.* 1989; Browne 2005; Bernard 2011; Printes 2011). In addition to their knowledge of the local wildlife, it was important to select experienced individuals that were resident in the vicinity of primate habitats, and are or were active in the exploitation of natural resources, in particular, hunting. We used colored plates (Mittermeier *et al.* 2007; Reis *et al.* 2015), and recordings of vocalizations (Emmons *et al.* 1998) to ensure the identification of primate species. The colored plates contained local and autochthonous species to ensure the correct identification of local species by the experts.

The data presented here are derived from previous studies of the distribution and occurrence of primate species in northeastern Brazil (Jerusalinsky *et al.* 2006; Marques *et al.* 2013a,b; Beltrão-Mendes and Ferrari 2019; Alonso *et al.* 2024; Jerusalinsky *et al.* unpub. data), together with records compiled by the authors of the present study. We surveyed 348 sites, distributed throughout the study area. Whenever the local occurrence of primates was confirmed, we compiled all possible information on the characteristics of the species and the type of exploitation (hunting or trapping, and their respective subcategories). These data were collected as part of a broader survey that focused on the mammalian fauna of the study area as a whole, although only the data on the hunting of primates are presented and analyzed here.

## Data analysis

Given the limited database available for some species, the data were analyzed per genus, which is justifiable given the similar characteristics of congeners, in particular in terms of the threats they face (see ICMBio 2018; IUCN 2024). As the assessment is limited primarily by the number of studies available for each species, the analyses of the qualitative data are descriptive and non-parametric.

The quantitative data were also grouped by genus for analysis, and null data or taxa with a prohibitively small number of records were excluded from the analyses, as necessary. Some hunting subcategories (medicinal use, pest control, and sports) were also excluded due to a reduced number of records. As the data were derived from field studies based on varying approaches and sampling effort, some adjustments were necessary to ensure reliable analyses. We used only the positive answers on hunting or trapping obtained in each study, for example, as a proportion of the number of informants interviewed. We analyzed the variation in the citations among the different primate genera by category (hunting or trapping) using Chi-square, and within each genus with the *post hoc* Bonferroni correction. We ran the analyses on the R platform v. 4.3.2 (R Core Team 2023), using RStudio v. 2023.12.1.402 (Posit team 2024), and the *stats* (R Core Team 2023) and *chisq.posthoc.test* packages (Ebbert 2019), considering  $\alpha = 0.05$  in all cases.

## RESULTS

### Qualitative Data

We identified 21 academic studies that contained 47 citations of species of all the six genera known to occur in the study area. These citations included four of *Alouatta*, two of *Brachyteles*, and three *Leontopithecus*, with eight for *Callithrix*, 14 for *Sapajus*, and 16 for *Callicebus*. Just over half of these citations (55.3%) referred to hunting and the other half (44.7%), to trapping (Figure 1; Additional File 1). In most cases (88.4%), the primates were hunted for bushmeat, although in all but one of the other records, the objective of the activity was not specified. Similarly, most (90.4%) citations of trapping referred to the capture of pets, while the remaining records were derived from scientific studies that involved trapping and trafficking surveillance.

All the citations of both *Alouatta* and *Brachyteles* referred to hunting for bushmeat (Table 1), while *Leontopithecus* was cited twice as game hunting and once for trapping pets. Predictably, based on its body size, *Callithrix* was targeted primarily as a source of pets (Table 1), and *Sapajus* was sought almost equally

by hunters and trappers, whereas *Callicebus* was targeted mainly as game hunting. Titis (*Callicebus*), in turn, are notoriously difficult to maintain in captivity, in addition to their relatively small size (barely reaching one kilo), being a suboptimal target for subsistence hunters. One study (Jerusalinsky *et al.* 2013) indicated *Callithrix* as the most frequent genus as a pet, followed by *Sapajus* (Table 1).

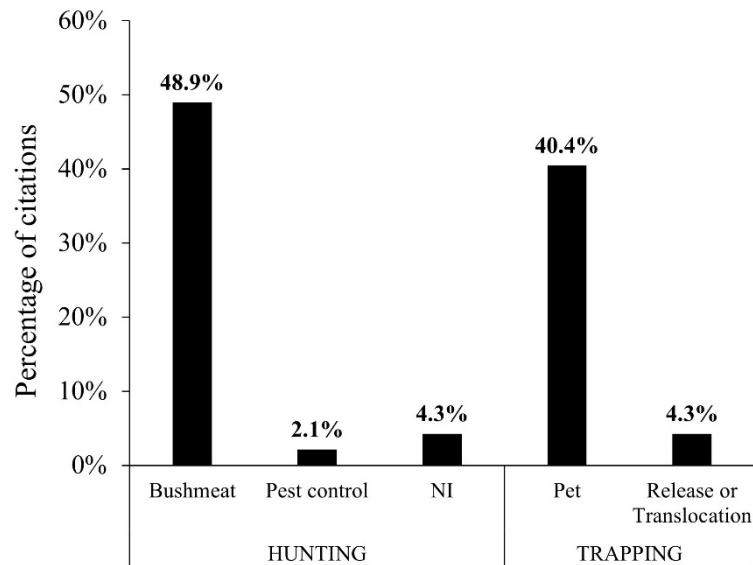
### Quantitative Data

Between 2006 and 2019, we surveyed 348 sites across the study area, and obtained 834 reports from local experts on the hunting and trapping of the local primate species. All these experts reported the local presence of *Callithrix*, while 818 cited *Sapajus*, and 738 referred to the genus *Callicebus*. Overall, 164 (30.4%) of the 539 informants questioned about the harvesting of bushmeat provided affirmative answer, while 189 (30.9%) of the 636 individuals consulted on the trapping of pets confirmed the practise. We recorded only one report of subsistence hunting for *Alouatta caraya*. As we did not interview all the informants comprehensively (see Methods), we selected 827 representative citations on subsistence hunting and 731 citations on trapping for analysis (Figure 2). Overall, *Callicebus* was cited most often as game (30.1%: 95 positive answers to 326 questions), while *Sapajus* was cited most often as a pet (35.7%: 80/224). Four informants reported hunting *Sapajus* for pest control because the capuchins damage their crops.

Overall (Figure 2), significant differences ( $\chi^2 = 33.982$ ;  $df = 2$ ;  $p < 0.0001$ ) were found among the three genera in the proportions of hunting and trapping. The *post hoc* analysis indicated that *Callicebus* was hunted significantly more frequently than it was trapped ( $p < 0.01$ ), with the opposite pattern being observed in *Sapajus* ( $p < 0.01$ ). However, while *Callithrix* was targeted more often for the capture of pets, the difference between the two types of exploitation was not significant ( $p = 0.607$ ) in this case.

## DISCUSSION

The historical data indicate that hunting and trapping are among the principal threats to primate populations, and that, after habitat loss and fragmentation, subsistence hunting is the principal driver of the local extinction of *B. hypoxanthus*, and the decline in the populations of howlers, *A. caraya* and *A. guariba*. These data also indicate that, while both *Callicebus* and *Sapajus* are targeted by hunters and trappers, *Alouatta* is target exclusively by hunters, and *Callithrix* for the acquisition of pets. The findings of the present study indicate clearly that hunting still threatens the populations of both *Callicebus* and



**Figure 1.** Relative frequency of reports of the hunting and trapping of the Neotropical primates of the states of Bahia and Sergipe, Northeastern Brazil, based on the academic literature published between 2005 and 2023. NI = Not Informed.

**Table 1.** Number of reports of the different uses of the Neotropical primate genera targeted by hunters in the Brazilian states of Bahia and Sergipe, based on the scientific literature published between 1997 and 2023.

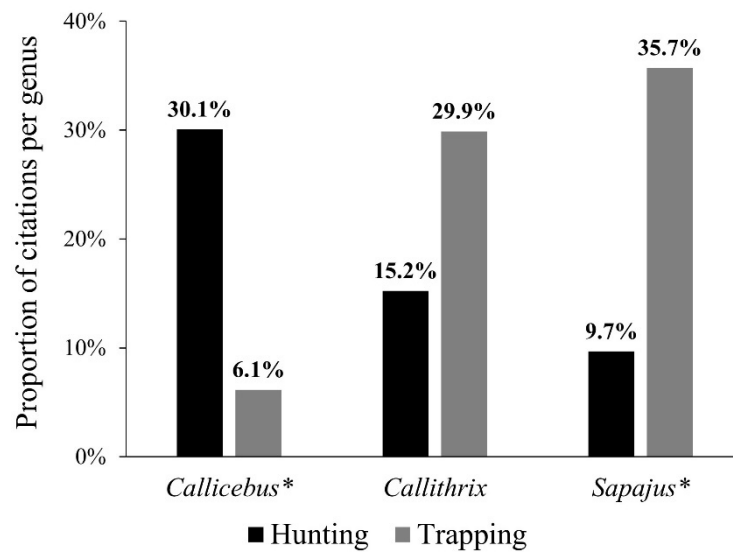
Genus	Number of reports of game hunting for				
	Bushmeat	Pest control	Not informed	Capture of pets	Scientific study
<i>Alouatta</i>	3	-	-	-	-
<i>Brachyteles</i>	2	-	-	-	-
<i>Callicebus</i>	9	-	2	5	-
<i>Callithrix</i>	3	-	-	6	-
<i>Leontopithecus</i>	2	-	-	1	-
<i>Sapajus</i>	5	1	-	6	2

*Sapajus*, although *Alouatta* is relatively rare or absent from most of the study area, which was reflected in the general paucity of reports, and may reflect habitat loss and hunting pressure. The absence of citations of *Brachyteles* was the result of local extinction in the areas surveyed.

In contrast with our expectations, *Callicebus* was one of the genera cited most often, both as game and pet, although this may reflect a sampling bias, given the number of the studies that focused specifically on this genus. As hunting is illegal in Brazil, it seems likely that the activity is largely under-reported, not only in monitoring programs (see Svensson *et al.* 2016), but also in specific research projects. The illegal nature of the activity will also likely reduce the presence of vestiges, that is, animal parts kept as tro-

phies. While these questions almost certainly affected the findings of the present study, they were consistent with the historical data (i.e., *Sapajus* and *Callithrix* mostly trapped as pet; see details below). There is also the synergic effect of the capture of pets – orphaned infants – as a byproduct of hunting for bushmeat, which is not often dealt with adequately in the available studies. The detection of this synergic effect during fieldwork would be limited even more by the illegal nature of hunting.

Overall, in fact, there is a general lack of studies of the impact of hunting on most of the primate species found in the study area, although both *Alouatta* and *Brachyteles* have clearly been impacted extensively, as reported by Castilho *et al.* (2019) for *A. guariba* and *B. hypoxanthus* in southeastern Bahia. In addition to



**Figure 2.** Relative frequency (percent) of citations of hunting and trapping of the three primate genera from the study area, based on interviews with 834 local residents at 348 sites distributed across the states of Bahia and Sergipe, in northeastern Brazil (data collected between 2006 and 2019). The asterisk (\*) indicates a significant difference ( $p < 0.01$ ) between the frequency of hunting and trapping in the respective genus.

being hunted widely as a source of bushmeat (Ramírez-Barajas and Calmé 2015; Alves *et al.* 2016), *Alouatta* is also sometimes targeted for medicinal or magical/religious purposes (Alves *et al.* 2016). While Castilho *et al.* (2019) did not obtain a single record of the hunting of *Leontopithecus chrysomelas* in southeastern Bahia, local residents perceived an increase in the local population of this species as a result of a halt in hunting activity. While *Sapajus* is targeted primarily for bushmeat and pets (Kierulff *et al.* 2005; Nascimento *et al.* 2013), there are some reports of medicinal use (Alves *et al.* 2016). Castilho *et al.* (2019) recorded a perceived decrease in the population of *Sapajus xanthosternos* due to overhunting, even though Teixeira *et al.* (2024) recorded low hunting rates in southern Bahia, which may nevertheless be the result of the few remnant populations that persist in the region.

While Alves *et al.* (2016) reported that *Callicebus barbarabrownae* was targeted only as a pet, Printes (unpub. data) recorded the medicinal use of this species, for the treatment of neurological disorder (for nerves' health, free transcription). According to Printes (pers. obs.), the informant reported eating only the flash (with no fat or organs) and did not describe any specific way of preparing. Almeida *et al.* (2023), on the other, reported the game hunting of *Callicebus coimbrai*, in both mandatory reserves and privately-owned protected areas (RPPN – Reservas Particulares do Patrimônio Natural; Private Natural Heritage Reserves). Castilho *et al.* (2019) and Teixeira *et al.* (2024) recorded the game hunting of *Callicebus melanochir* in protected areas in southeast-

ern Bahia, albeit at low frequencies.

*Callithrix* is known to be hunted both for meat and the pet trade (Souza and Alves 2014; Barbosa *et al.* 2022; Alves *et al.* 2023), although (Alves *et al.* 2016) reported the medicinal use of these marmosets. In the present study region, Almeida *et al.* (2023) confirmed the widespread capture of *Callithrix jacchus* for pets, although Castilho *et al.* (2019) did not record any hunting of *Callithrix kuhlii* in southeastern Bahia.

Worldwide, primates are hunted primarily for bushmeat, and secondarily for the pet trade, although traditional medicine and ornamental use are also minor factors in some cases (Ripple *et al.* 2016), but not in the present study. In some cultures, the hunting of primates is enhanced by local traditions (Bobo *et al.* 2015), whereas in other cultures, taboos limit the hunting and consumption of primates (Landim *et al.* 2023). As for other game mammal species (Alves *et al.* 2016, 2023), however, the hunting of primates for food tends to focus on medium- to large-body species (Ripple *et al.* 2016; Constantino 2018), as observed in the cases of *Alouatta*, *Brachyteles*, and *Sapajus* in the present study. Body mass is an important factor driving the decision making of hunters, who require an adequate tradeoff between effort and returns (Castilho *et al.* 2019). A secondary driver in the case of primate hunting is the taste of the meat. In Brazzaville, Congo, for instance, Mbete *et al.* (2011) identified that five species of *Cercopithecus* were preferred over 16 primate species. In the present study, however, the pet trade was the main secondary driver of primate hunting, so the value of pets should also figure in the equa-

tion. The history of local human settlements may also be an important factor, given that primates are commonly used as pets (Parathian and Maldonado 2010) and are an important source of protein (Prado *et al.* 2012) among indigenous tribes. Thus, hunting could be a previous path for primate extinction in current settlements and villages in eastern Brazil, which may have been developed with the contribution of an earlier local indigenous culture.

Hunting inevitably leads to population decline (Silva *et al.* 2005, 2016; Canale *et al.* 2012; Madhusudan and Karanth 2002), although it can also have negative impacts on the behavior, vocalizations, and social structure of the hunted species (Thoisy *et al.* 2000; Papworth *et al.* 2013). In particular, the preference for females carrying young, which can be traded as pets (Silva *et al.* 2005) can have a major impact on social structure, and lead to a much more rapid decline in population numbers (e.g., Silva *et al.* 2016).

The impacts of hunting are determined by local biological, socioeconomic, and political contexts, which require complex conservation solutions (Barboza *et al.* 2016; Alves *et al.* 2023). In the present case, hunting has led to the local extinguished or drastic reduction in the populations of some species, which would require special attention in the planning of conservation strategies for the remaining populations. Protected areas play a crucial role in the protection and conservation of mammals, including game species and primates (Lee and Priston 2005; Canale *et al.* 2012), and the establishment of protected areas throughout the geographic range of the target species would be essential to prevent their extirpation. Despite the adequate federal legislation and the existence of a relatively well-structured monitoring system, it appears to be difficult to suppress hunting activities definitively in Brazil, and historically, most measures have been largely ineffective (Galetti and Dirzo 2013; Tomas *et al.* 2018; Alves *et al.* 2023). A potentially lucrative alternative would be to develop specific hunting agreements (Printes 2011; Oliveira and Calouro 2019) and management strategies (Alves *et al.* 2023; Almeida *et al.* 2023) aligned with the local characteristics of each biome, which could be tested in controlled trails to evaluate their effectiveness for the conservation of the target species.

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## DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

## CONFLICT OF INTEREST

The author has no conflicts of interest to declare.

## CONTRIBUTION STATEMENT

FRS conceived the presented idea, carried out the experiment and the data analysis, as well as composed the final writing of the manuscript.

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## Additional Files

**Add File 1.** Citations of the hunting and trapping of primates (qualitative data) in the Brazilian states of Bahia and Sergipe, northeastern Brazil, identified in the academic literature published between 2005 and 2023.

FAMILY / Genus / Species	HUNTING			TRAPPING			
	Bushmeat	Pest control	Not Informed	References	Pet	Release / Translocation	References
<b>CALLITRICHIDAE</b>							
<b>Callithrix</b>							
<i>Callithrix geoffroyi</i>					1		Levacov et al. (2011) Levacov et al. (2011);
<i>Callithrix jacchus</i>	1			Jerusalinsky et al. (2013)	3		Jerusalinsky et al. (2013); Almeida et al. (2023)
<i>Callithrix penicillata</i>					1		Levacov et al. (2011)
<i>Callithrix</i> spp.	1			Canale et al. (2012)	1		Nascimento et al. (2013)
<b>Leontopithecus</b>							
<i>Leontopithecus chrysomelas</i>	2			Castilho et al. (2019); Teixeira et al. (2020)	1		Nascimento et al. (2013)
<b>CEBIDAE</b>							
<b>Sapajus</b>							
<i>Sapajus libidinosus</i>					1		Nascimento et al. (2013) Santos and Martinez (2015)
<i>Sapajus robustus</i>					1		Nascimento et al. (2013)

Continua...ou to be continued...

FAMILY / Genus / Species	HUNTING			TRAPPING			
	Bushmeat	Pest control	Not Informed	References	Pet	Release / Translocation	References
						1	Santos and Martinez (2015)
<i>Sapajus xanthosternos</i>	5			Kierulff et al. (2005); Canale et al. (2012); Lernould et al. (2012); J erusalinsky et al. (2013); Castilho et al. (2019)	3		Kierulff et al. (2005); Jerusalinsky et al. (2013); Nascimento et al. (2013)
<i>Sapajus</i> spp.		1		Beltrão-Mendes et al. (2011)	1		Levacov et al. (2011)
<b>PITHECIIDAE</b>							
<b>Callicebus</b>							
<i>Callicebus barbarabrownae</i>	3			Marinho-Filho and Veríssimo (1997); Printes (2007); Estrela et al. (2011)	1		<b>Present study</b>
<i>Callicebus coimbrai</i>	4		1	Marques et al. (2013a) Sousa et al. (2008); Jerusalinsky et al. (2013); Hilário et al. (2017); Almeida et al. (2023)	3		Jerusalinsky et al. (2006, 2013); Nascimento et al. (2013)
<i>Callicebus melanochir</i>	1		1	Marques et al. (2013b) Castilho et al. (2019)			
<i>Callicebus</i> spp.	1			Canale et al. (2012)	1		<b>Present study</b>
<b>ATELIDAE</b>							
<b>Alouatta</b>							

Continua...ou to be continued...

FAMILY / Genus / Species	HUNTING			TRAPPING			
	Bushmeat	Pest control	Not Informed	References	Pet	Release / Translocation	References
<i>Alouatta caraya</i>	1			Printes (2007)			
<i>Alouatta guariba</i>	1			Kierulff et al. (2005)			
<i>Alouatta</i> spp.	1			Canale et al. (2012)	1		Nascimento et al. (2013)
<b>Brachyteles</b>							
<i>Brachyteles hypoxanthus</i>	2			Kierulff et al. (2005); Canale et al. (2012)			
<b>Total</b>	<b>23</b>	<b>1</b>	<b>2</b>		<b>19</b>	<b>2</b>	