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Attitudes and Behaviors of Rural Residents Toward Different Motivations for Hunting and Deforestation in Protected Areas of the Northeastern Atlantic Forest, Brazil

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Abstract

Protected areas have become a vital conservation strategy to protect wildlife; however, illegal activities performed by local people within and around protected areas may undermine their conservation goals. We used information from 169 direct interviews with rural residents in order to understand the factors affecting illegal behaviors related to hunting and deforestation in three protected areas and a buffer zone of the Southern Bahian Atlantic Forest. We explored correlations between background factors, attitudes, norms, perceived behavioral control and behaviors toward different motivations for hunting (hunting for consumption, killing animals in retaliation for damage to crops or livestock, and keeping wildlife in captivity as pets), and deforestation based on insights from the Theory of Planned Behavior. Our results suggest that a combination of demographic factors, values held for protected areas and location influenced respondents' attitudes, descriptive norms, and perceived behavioral control in the study region. We also found that components of the Theory of Planned Behavior such as attitudes and descriptive norms may be good predictors of the studied behaviors. Increasing local support for and compliance with policies of the protected areas is necessary for the long-term efficacy of these areas and for protection of species. Our findings suggest that to change behaviors of residents toward conservation in the study area, management actions should consider people's attitudes and norms and the combination of background factors that influence these variables.

Keywords

conservation policies, local people, protected area management, Theory of Planned Behavior, use of resources, wildlife conservation

Introduction

Protected areas (PAs) have become a vital conservation strategy to conserve biodiversity. However, a growing scientific literature indicates that restrictions placed on the use of resources usually result in negative attitudes among local residents and problems for the management of the PAs (Andrade & Rhodes, 2012; Fiallo & Jacobson, 1995; Kideghesho et al., 2007; Larson et al., 2016). In addition, the level of dependence of local residents on natural resources (Baral & Heinen, 2007; Marshall, Marshall, Abdulla, & Rouphael, 2010; Sah & Heinen, 2001) and the perceived benefits that PAs provide to local people (Allendorf et al., 2006) may also influence

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their attitudes and behaviors toward the wildlife in PAs. Consequently, growing attention has been focused on gaining a deeper understanding of the relationship between local people, PAs, and their biodiversity.

Studies have investigated the relationship between local people and PAs (e.g., Baral & Heinen, 2007; Holmes, 2003; Infield, 1988) and between people and wildlife through attitudinal and behavioral research (e.g., Browne-Nunez & Jonker, 2008; Hill, 1998; Treves & Karanth, 2003; Wang & Macdonald, 2006). Such studies have contributed toward identification of residents' aspirations and opinions regarding conservation issues (Badola, Barthwal, & Hussain, 2012). In addition, identifying predictors of behaviors, including verifying possible associations with attitudes, is essential to predict the likely effectiveness of possible actions to influence and change behavior (St John, Edwards-Jones, & Jones, 2010). Based on this improved understanding of the importance of local people's attitudes to PA success, involvement of local residents in the creation and establishment of PAs and better sharing of benefits have increasingly been incorporated into PA policies worldwide (Gruber, 2010; McNeely, 1994; Naughton-Treves, Holland, & Brandon, 2005; Waylen et al., 2010).

In Brazil, many areas designated as PAs are occupied by people, so conflicts between inhabitants and PA management are a common problem (Abakerli, 2001; Arruda, 1999; Ferreira, 2004). Some of this is related to apparent increases in human–wildlife conflicts over the last decade, which threaten both people's livelihoods and conservation of the species involved (Conforti & Azevedo, 2003; Marchini & Crawshaw, 2015; Zimmermann, Walpole, & Leader-Williams, 2005). Other issues include PAs putting restrictions on natural resource harvesting. For example, in the Cerrado region, Ferreira and Freire (2009) suggested that people who rely on natural resources have more negative perceptions toward PAs, because the restrictions negatively affected their livelihoods. Sometimes people make links between the species that a PA is put in place to protect and their loss of livelihood options. For example, Engel, Marchini, Pont, Machado, and Oliveira (2014) reported that fishermen had negative perceptions toward the Ilha dos Lobos Wildlife Refuge and sea lions (*Otaria flavescens*) in southern Brazil, because they considered the presence of this species as an obstacle to their fisheries activities.

The Brazilian Atlantic Forest is an area where local people's relationships to PA management, and illegal activities related to the use of animal and plant species, such as hunting and deforestation, is of particular concern. It is considered a high priority conservation region, supporting a high number of endemic species (Myers, Mittermeier, Mittermeier, Fonseca, & Kent, 2000). Approximately 12% of the original Atlantic Forest cover remains and around 9% of its remaining fragments is under protection (Ribeiro, Metzger, Martensen, Ponzoni, & Hirota, 2009). Although conservation initiatives have increased over the past decades, investments to ensure biodiversity conservation continue to be scarce (Tabarelli, Pinto, Silva, Hirota, & Bedê, 2005) and illegal practices persist to negatively impact the remaining areas (Galindo-Leal & Câmara, 2005). Occurrence of illegal hunting of mammals species inside PAs and a buffer zone (BZ), located in southern Bahia (Figure 1), was suggested in a previous study (Castilho, De Vleeschouwer, Milner-Gulland, & Schiavetti, 2017).

Social-psychological models such as the theory of reasoned action and its extension, the Theory of Planned Behavior (TPB; Ajzen, 2012), have been used to understand and explain human behavior. However, few studies in conservation have used these models to investigate multiple predictors of behavior (St John et al., 2010). According to the TPB, behavioral intentions are a result of the combination of an individual's attitudes, norms, and perceived behavioral control. These intentions can then predict actual behavior (Ajzen, 1991). In addition, a wide variety of background factors can influence attitudes, norms, and perceived behavioral control, including demographic and socioeconomic factors, general attitudes and values, past experience, and knowledge (Ajzen & Fishbein, 2005). Contextual factors such as laws and government regulations can also interact and determine a behavior (Stern, 2000). According to the TPB, an attitude is considered the degree to which a person has a favorable or unfavorable evaluation of a specific behavior. Descriptive norms are perceptions of how other people behave, rather than what is approved of or not by others (Cialdini & Goldstein, 2004; St John et al., 2010) and perceived behavioral control is the perception about the ease or difficulty of performing a behavior (Ajzen, 1991).

Some studies have suggested that attitudes can be good predictors of behavior, in the context of an understanding of social, cultural, and economic factors (Abbot, Thomas, Gardner, Neba, & Khen, 2001; Holmes, 2003), whereas other authors have suggested that attitudes do not necessarily translate in proconservation behaviors (Infield & Namara, 2001; Waylen, McGowan, & Milner-Gulland, 2009). However, attitudes are just one of the elements influencing behavioral intention, and specificity is necessary to better predict a behavior (attitude and behavior should be align and specific; St John et al., 2010). Studies using the TPB have suggested that norms and perceived behavioral control can also be good predictors of proconservation behavior. For example, Zubair and Garforth's (2006) study suggested that social norms and control beliefs influenced farmers' decisions to engage in farm forestry in Pakistan. Norms were also related to boating speed limits in manatee

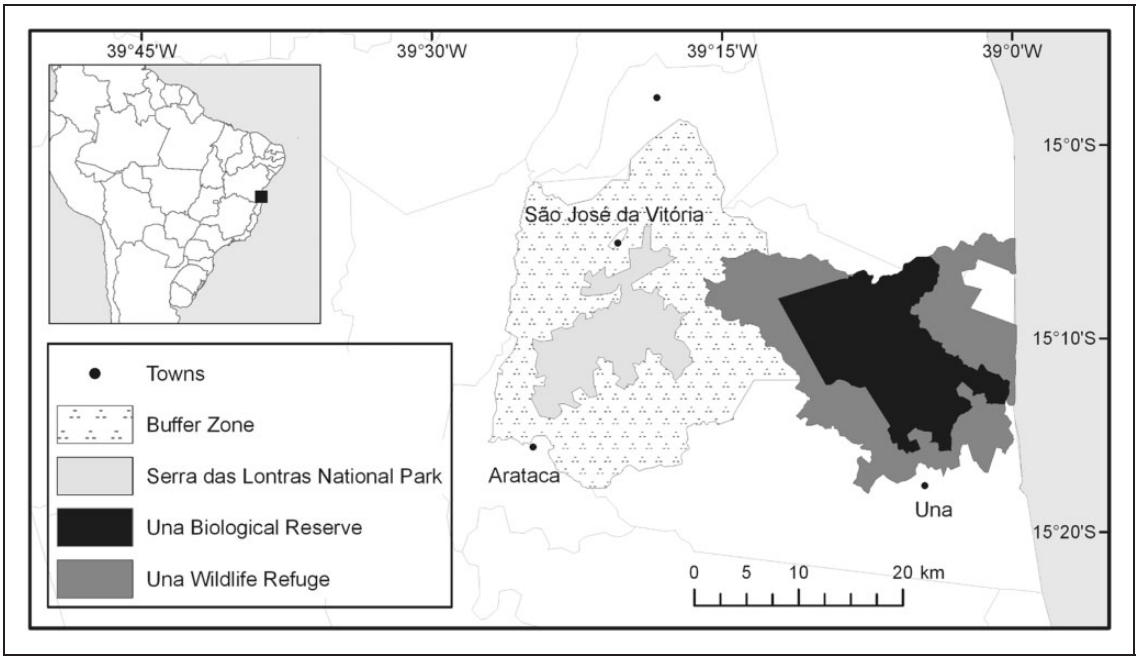

Figure 1. Study area composed of three protected areas and a buffer zone in southern Bahia, Brazil.

(*Trichechus manatus*) areas in Florida (Aipanjiguly, Jacobson, & Flamm, 2003).

Understanding attitudes toward, and factors affecting, illegal behaviors may assist managers to prioritize their actions to improve people's compliance with PA policies and protect wildlife species and forest inside these areas. Therefore, in this present study, we investigated attitudes, descriptive norms, perceived behavioral control and behaviors by rural residents in PAs and a BZ of the Brazilian Atlantic Forest, located in southern Bahia. Our study aimed to (a) identify background factors such as demographic and socioeconomic variables, general values toward PAs, and past experience with damage caused by wildlife; (b) identify residents' attitudes toward different motivations for hunting (hunting for consumption, hunting for commercial purposes, killing animals in retaliation for damage to crops or livestock, and keeping wildlife in captivity as pets) and deforestation (replacement of secondary forests with small-scale agriculture); (c) investigate descriptive norms toward hunting and deforestation; (d) investigate residents' perception related to presence and frequency of law enforcement (perceived behavioral control); (e) identify residents' illegal behaviors related to different motivations for hunting and deforestation; and (f) explore correlations between background factors, attitudes, norms, perceived behavioral control, and behaviors of rural residents toward hunting and deforestation within and around PAs based on relationships informed by the TPB.

We hypothesized that people with less positive attitudes toward different motivations for hunting and deforestation, who did not feel that there was a risk from law enforcement (perceived behavioral control), and who perceived that others were hunting or deforesting illegally (descriptive norms), were more likely to report carrying out these illegal behaviors themselves. We also hypothesized, based on the literature, that a number of background factors such as demographic and socioeconomic variables, general values toward PAs, and past experience with damage caused by wildlife would affect attitudes, norms, and perceived behavioral control.

Methods

Study Area

This research was conducted in three PAs (Una Biological Reserve [UBR], Una Wildlife Refuge, and Serra das Lontras National Park [SLNP]) and a BZ located mostly in the municipalities of Una and Arataca in southern Bahia, Brazil (Figure 1).

UBR (World Conservation Union [IUCN] category Ia) was originally created in December 1980, with an area of 11,500 ha, to protect the remaining forest fragments in Southern Bahia and save the threatened golden-headed lion tamarin (*Leontopithecus chrysomelas*). Following expansion in 2007, the Reserve now extends across 18,500 ha in area, comprising one of the largest remnants of the Atlantic Forest in southern Bahia (Schroth et al., 2011). Una Wildlife Refuge (UWR, IUCN category III) was the former UBR's BZ. It was

established in December 2007, covering an area of 23,404 ha. SLNP (IUCN category II) was established in June 2010, with an area of 11,336 hectares. The Park comprises one of the last remnants of the Montane Atlantic Forest in northeastern Brazil (Schroth et al., 2011), which is crucial for the conservation of the endemic bird species *Acrobatornis fonsecai* (Pacheco, Whitney, & Gonzaga, 1996). The BZ comprises an area of 58,796 ha, located around the SLNP. There are approximately 970 properties inside the four areas.

The National System of Conservation Units' law (Art. 10 and 11 Federal Law 9.985/2000) states that all private areas within UBR and SLNP limits must be expropriated, while in UWR, private landownership is permitted, as long as the land use is compatible with conservation goals of the PA. If this condition is violated, private land must also be expropriated in UWR (MMA 2000). The expropriation involves payment for the rural property (including infrastructure and improvements to the land), in case the owner possesses the land title, or the compensation for existing improvements in the area, in case the individual has possession, but does not own a land title (MMA 2007). According to the Chico Mendes Institute for Biodiversity Conservation (ICMBio), the body responsible for managing all Federal PAs, expropriation of private properties within SLNP's boundaries is yet to be initiated. In UWR, no expropriations were made and in the longer established UBR, 51% of properties were expropriated.

According to the Federal Law (Law 9605/98—Law of Environmental Crimes) and Decree 6514/2008, hunting is forbidden throughout Brazil. Penalties are more severe for hunting inside PAs (Art. 29 Federal Law 9605/98). Killing an animal that causes damage to residents (retaliation) and keeping wild animals as pets are also not allowed in PAs. Replacing primary or secondary forest with agriculture is banned within the studied PAs. Normally, only fallow and unused lands can be considered for replacement, which requires formal authorization.

Data Collection

Data were collected from October 2012 to June 2014. Properties were randomly selected in the three PAs (UBR, UWR, and SLNP) and in the BZ connecting these areas, based on data obtained from ICMBio. We used a random number generator to choose properties to sample from this list. However, several selected properties were closed or we did not find any resident. Thus, we also conducted additional opportunistic sampling by including extra properties (usually the closest property to the selected one) to increase the sample size of interviews.

Semistructured interviews were conducted with one person per property, either the landowners or the workers (male or female) available during the visit. Only one person declined to participate in the direct interviews. This research was authorized by the ethics committee (State University of Santa Cruz—CAAE: 03600412.0.0000.5526) and managers responsible for the PAs (SISBIO-ICMBio: 34574-1). All interviews were conducted with the consent of respondents, and confidentiality was assured.

The questionnaire (Appendix) included closed-ended questions to gather information regarding (a) demographic and socioeconomic factors: gender, age, level of education, duration of residence, household size, government assistance (''*Bolsa Família*,'' a Program of supplementary income offered to low-income families), and occupation; (b) location (identification of the PA or BZ); (c) past experience with damage to crops or livestock caused by wildlife; (d) attitudes toward different motivations for hunting and deforestation; (e) perceptions about other people's behavior toward hunting in general (motivation not specified) and deforestation (descriptive norms); (f) perceptions about the presence and frequency of law enforcement (perceived behavioral control); and (g) behaviors toward different motivations for hunting and deforestation.

In addition, an open-ended question was used to investigate respondents' general views about the PAs, including the one where they lived. Subsequently, we classified these views according to the underlying values that they represented based on Kellert's (1993) classification of values of nature. Respondents' views were classified into only three categories of values of nature (naturalistic values, which represent a person's interest and affection for wildlife and outdoors; utilitarian values, which represents the material benefits that a person obtain from nature; and negativistic values, which represents a person's feeling of aversion or fear for wildlife; Kellert, 1993).

Assessment of behavior and its determinants. To investigate attitudes, respondents were asked to agree or disagree with statements about different motivations for hunting (hunting for consumption, hunting for commercial purposes, killing animals in retaliation for damage to crops or livestock, and keeping wildlife in captivity as pets) and deforestation (replacement of secondary forests with small-scale agriculture). However, in some cases, respondents did not completely agree with the statement, citing a condition for agreement. We decided to incorporate these responses into a different classification (''*partly agree*'').

We decided to investigate descriptive norms because the sensitiveness of the investigated behaviors, hunting, and deforestation. We found that it was more comfortable for the respondent to talk about other people's behavior (descriptive norms) than about what people would think about their own behavior (subjective

norms). Perceived behavioral control (the perceived ability to perform the behavior) was investigated in relation to the perceived presence of law enforcement officers in the area. According to Stern (2000), laws and government regulations represent contextual factors that may influence behaviors. In addition, Mintzer et al. (2015) suggested that behavioral control, represented by enforcement, may influence fishers' behavior toward killing botos in an Amazon PA.

To investigate behaviors, we questioned the respondents about whether they currently perform illegal activities related to hunting (hunting for consumption, hunting for commercial purposes, killing animals in retaliation for damage to crops or livestock, and keeping wildlife in captivity as pets) and deforestation (replacement of secondary forests with small-scale agriculture). Data about hunting prevalence (behavior) in the study region and respondents' perceptions about the community's hunting behavior (descriptive norm) were obtained from Castilho et al. (2017) to explore the correlation between attitudes, norms, perceived behavioral control, and behavior toward hunting. Unfortunately, data about hunting for commercial purposes (behavior) were scarce to make correlations.

Data Analysis

We grouped UBR with UWR and SLNP with BZ to statistically compare the data between locations due to lower numbers of interviews in two of the areas (UBR and SLNP). This grouping was done based on the proximity of the areas and history of PAs' creation. UWR used to be the UBR's BZ and management activities usually have occurred in both areas (IBAMA, 1997). In addition, the expanded area of UBR, where most of UBR residents live, was created at the same time as UWR, while SLNP and its BZ were created more recently.

Data were analyzed using R software (R Core Team, 2014). Attitudes and behaviors were analyzed individually, as single items. The relationships between background factors (demographic and socioeconomic variables, values held for PAs, location, and past experience related to damage to crops or livestock caused by wildlife), the components of the TPB (attitudes, descriptive norms, and perceived behavioral control), and behaviors (Figure 2) were explored using Pearson χ^2 and Fisher tests (Contingency Tables). Details of variables and relationships between variables specific for each behavior investigated are shown in Figure S1. We did not use a multivariate analysis to explore the relative effects of the different variables due to the small sample size and the incomplete nature of the specification of the framework (based on the TPB); therefore, this study should be seen as an exploration of the relationships between elements as a guide and precursor to more detailed research.

Results

Background Factors

We performed 169 interviews with rural residents, of which 74% were men and 26% were women. Details of respondents' demographic and socioeconomic factors are described in Table 1.

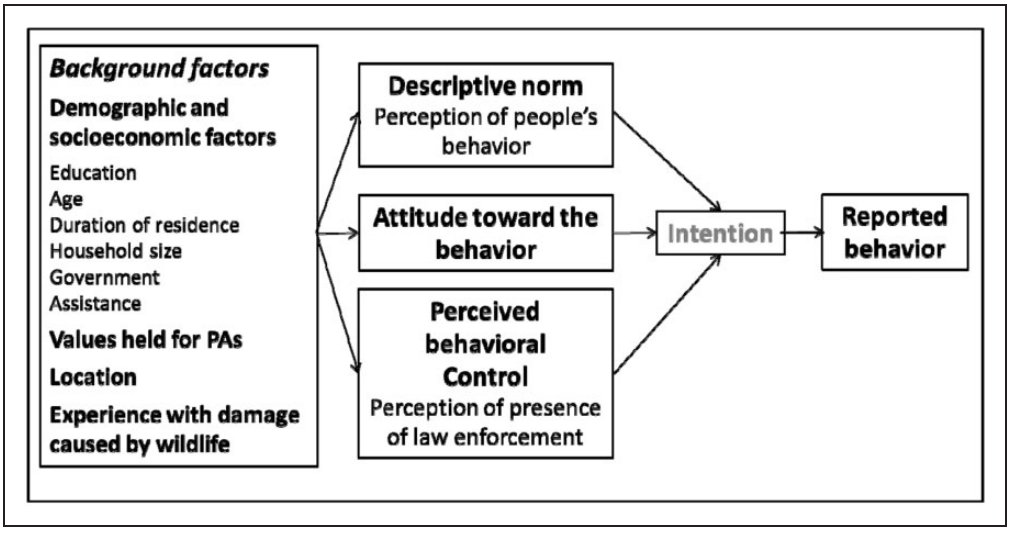

Figure 2. Illustration of the variables assessed in this study to explain behaviors toward different motivations for hunting (hunting for consumption, hunting for commercial purposes, killing animals in retaliation for damage to crops or livestock, and keeping wildlife in captivity as pets), and deforestation (replacement of secondary forests with small-scale agriculture; adapted from the Theory of Planned Behavior, Ajzen & Fishbein, 2005). The variables hypothesized to affect reported behaviors are listed here, as well as the background variables we expect to influence the components of the Theory of Planned Behavior.

Table 1. Demographic and Socioeconomic Variables of Respondents in Protected Areas of Southern Bahia.

	UWR-UBR ($n = 94$)	SLNP-BZ ($n = 75$)	Total ($n = 169$)	Test	p
Age				$\chi^2 = 0.56$	.75
18–40 years	27%	29%	28%		
41–60 years	42%	46%	44%		
61–84 years	31%	25%	28%		
Duration of residence				$\chi^2 = 1.85$	.40
0–10 years	40%	40%	40%		
11–30 years	41%	33%	37%		
31–62 years	19%	27%	23%		
Household size				$\chi^2 = 3.53$	.17
1–3 people	56%	56%	56%		
4–6 people	32%	39%	35%		
7–21 people	12%	5%	9%		
Education				$\chi^2 = 9.03$	.03*
Minimal	50%	27%	40%		
Primary	26%	43%	34%		
Middle school	12%	15%	13%		
High school–college	12%	15%	13%		
Occupation				$\chi^2 = 0.89$	.34
Related to agriculture	90%	85%	88%		
Government assistance				$\chi^2 = 3.12$	.08
Yes	54%	41%	48%		

Note. UWR = Una Wildlife Refuge; UBR = Una Biological Reserve; SLNP = Serra das Lontras National Park; BF = buffer zone; χ^2 = Pearson Chi-square.
*$p < .05$.

Table 2. The Positive and Negative Values Expressed in Response to an Open-Ended Question About the Respondents' Views on the Protected Areas ($n = 166$).

	% citing
Positive views on the PAs representing naturalistic values (interest and affection for wildlife and outdoors)	
Conserve nature	25
Protect wild animals	20
Protect forest	11
Positive views on the PAs representing utilitarian values (material benefits)	
Protect springs and water bodies	25
Improve the rainfall regimes	6
Improve people's health	2
Negative views on PAs representing utilitarian values (absence of material benefits)	
People cannot work, as it is prohibited to replace forest with agriculture	42
People must relocate/government does not pay a fair value for the properties	11
Logging is forbidden, neither for use within the property	5
It is not allowed to do anything	4
Hunting is prohibited	2
Increase in unemployment	2
Residents have neither support nor information	2
Usage of fire is prohibited	1
Enforcement agents bother people	1
Wild animals cause damage to plantations	1
Negative views on PAs representing negativistic values (feeling of aversion or fear for nature)	
Increase of dangerous animals	6

Note. Respondents' views were classified according to the underlying values that they represented based on the Kellert's classification of values for nature (Kellert, 1993).

Based on responses of the open-ended question about the respondents' views on the PAs (Appendix), 38% of respondents cited both positive and negative values for PAs, 33% cited only negative values, and 29% cited only positive values. Respondents' views classified into positive values included the protection of wild animals, forests, and water bodies and negative values included the restrictions and prohibitions of land and wildlife use (Table 2).

Forty-nine percent of respondents had experienced problems with wildlife causing damages to their plantations or livestock loss. Many mentioned having given up raising animals because of these problems. Wild animals usually causing livestock loss or crop damage include *Pecari tajacu* and *Hydrochoerus hydrochaeris* (which destroy cassava and corn plantations) and carnivore species (e.g., *Cerdocyon thous*, *Leopardus* sp., *Procyon cancrivorus*, *Didelphis aurita, Eira barbara, Boa constrictor*) which consume chickens.

Descriptive Norms

Fifty-six percent of respondents perceived a reduction in hunting activities in the study region, and 44% said that hunting had not changed in prevalence. Fifty-four percent of respondents believed that people are not deforesting anymore and forest areas are increasing, 31% believed that people are not deforesting anymore and forest areas remain the same, and 15% believed that people continue to deforest.

Perceived Behavioral Control

Forty-nine percent of respondents believed that law enforcement in their villages is active and have the same frequency over the last years, 35% commented that law enforcement is nonexistent or have low frequency, and 16% related that patrols are active and have increased

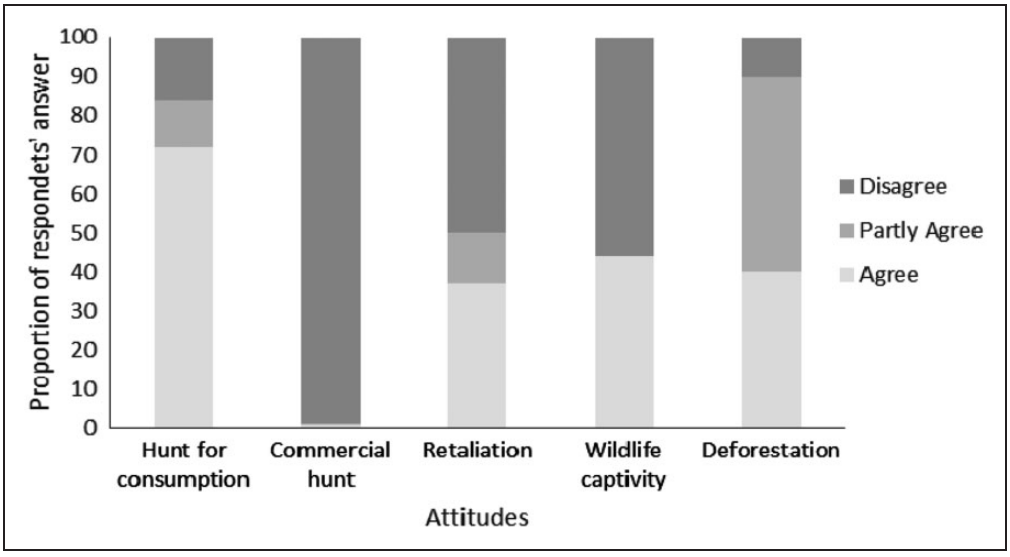

Figure 3. Respondents' attitudes toward different motivations for hunting and deforestation. The statements were phrased as "hunt for consumption should be allowed," "hunt for sale (commercial purposes) should be allowed," "kill animals in retaliation for damage caused should be allowed," "keep wildlife in captivity as pets should be allowed," and "replace forests with small-scale agriculture (deforestation) should be allowed."

over the last years. Eight respondents complained about PA employees, indicating that they were neither prepared to talk with residents nor listen to them; others complained that law enforcement agents acted inappropriately, persecuting residents. On the other hand, four respondents mentioned that recently PA staff had started to inform and guide people instead of only controlling and punishing.

Attitudes

We found negative attitudes toward restrictions on hunting, revealing respondents' desire to use wild animals, especially for consumption. On the other hand, we found a proconservation attitude related to commercial hunting (Figure 3).

Many respondents who agreed with hunting for consumption quoted a religious justification such as "God made wild animals for us to eat" or "God left wild animals to feed the poor." They believed the law could be more flexible and only trade-hunters should be punished by law. However, respondents who partly agreed declared that hunting should be permissible only for subsistence. People who disagreed stated that if hunting for consumption was allowed, wild animals would probably disappear. Some respondents felt that it is no longer necessary to subsist on wild meat; people could raise animals and have more opportunities to earn money from employment. Almost all respondents disagreed that hunting for sale should be allowed. Respondents that partly agreed with retaliation (killing animals that caused damage) declared that they would kill the animal only if it was considered a good wild meat for consumption, and if not they would scare the animal away. Some respondents who disagreed suggested that plantation areas could be fenced off or wild animals be scared away, but most believed that government/PA managers should either assist residents to avoid such conflicts or compensate people for wildlife damage. More than half of respondents believed that it is not right to keep wild animals in captivity, whereas the other half felt that there is no problem having a wild animal at home if you can take care of it.

With respect to the attitude of replacing forest with small-scale agriculture, respondents that partly agreed cited that clearance should be allowed only for secondary forests or specific areas, particularly those not close to water bodies (Figure 3).

Effects of Background Factors on Attitudes Toward Different Motivations for Hunting and Descriptive Norm Related to Hunting

Three demographic factors were correlated with attitudes toward hunting; education, duration of residence, and age. Respondents with a primary education agreed more with hunting for consumption (Fisher test, $p = .005$) and retaliation (Fisher test, $p = .01$). In addition, respondents with lower duration of residence agreed more with hunting for consumption (Fisher test, $p = .04$). Middle-aged respondents agreed more with hunting for consumption ($\chi^2 = 9.534$, $df = 4$, $p = .05$). However, demographic and socioeconomic factors did not influence the descriptive norm related to hunting.

Positive values of PAs were related to proconservation attitudes toward hunting for consumption (Fisher test, $p = .03$) and proconservation attitudes toward retaliation ($\chi^2 = 9.56$, $df = 4$, $p = .05$). But no association was found with attitudes toward keeping wild animals as pets ($\chi^2 = 1.28$, $df = 2$, $p = .53$). This suggests that people who have positive values toward PAs have positive attitudes toward wildlife conservation in general. Values related to PAs were not correlated with the descriptive norm related to hunting.

Location was not correlated with attitudes toward different motivations for hunting, neither with the descriptive norm toward hunting. We did not identify associations between people having experienced damage and their attitude toward retaliation ($\chi^2 = 4.2607$, $df = 2$, $p = .12$) or between having experienced damage and attitudes toward hunting for consumption ($\chi^2 = 0.19$, $df = 2$, $p = .91$). This variable was not correlated with the descriptive norm toward hunting.

Effects of Background Factors on Attitudes Toward Deforestation and Descriptive Norm Related to Deforestation

One demographic factor was correlated with the attitude toward deforestation; respondents with lower duration of residence agreed more with replacing secondary forest with small-scale agriculture (Fisher test, $p = .02$). We found a correlation between age and the descriptive norm related to deforestation; perception of forest decreasing was higher among young respondents ($\chi^2 = 9.788$, $df = 4$, $p = .044$).

Positive values of PAs were related to proconservation attitudes toward replacing forest with small-scale agriculture (Fisher test, $p = .001$). We found a correlation between values of PAs and the descriptive norm related to deforestation; perception of forest increasing was lower among respondents with positive values of PAs ($\chi^2 = 11.666$, $df = 4$, p value $= .020$).

Location was correlated with the attitude toward deforestation; people in SLNP-BZ were more likely to agree partially with replacing forest with small-scale agriculture than people in UBR-UWR ($\chi^2 = 8.8764$, $df = 2$, $p = .012$). We found a weak correlation between location and the descriptive norm related to deforestation; the perception of forests increasing was slightly higher among respondents of UWR-UBR ($\chi^2 = 4.93$, $df = 2$, $p = .08$).

Effects of Background Factors on Perceived Behavioral Control

Demographic and socioeconomic factors, values related to PAs, and experience with damage to crops or livestock caused by wildlife did not influence perceived behavioral control. However, location was related to perceived behavioral control; people in SLNP-BZ perceived a lower frequency of law enforcement compared to respondents in UBR-UWR ($\chi^2 = 51.64$, $df = 2$, $p < .001$).

Reported Behaviors

The proportion of respondents performing illegal behaviors related to deforestation and different motivations for hunting, including hunting for consumption, retaliation, and keeping wild animals as pets, is shown in Table 3. Wildlife kept as pets usually included birds (88% of responses; songbirds and parrots), but mammal species such as the collared peccary (4%; *Pecari tajacu*) and kinkajou (4%; *Potos flavus*), and reptiles (4%; red-footed tortoise; *Chelonoidis carbonaria*) were also cited.

Thirty-two percent of respondents admitted having replaced secondary forests with small-scale agriculture. Despite a desire to perform the behavior, 3% of respondents stated that they did not replace secondary forests with small-scale agriculture either because it was prohibited or because they did not know if they were allowed to do it.

Effects of the Components of the TPB on Behaviors Related to Different Motivations for Hunting and Deforestation

Positive attitudes toward hunting were associated with proconservation behaviors toward hunting. People who disagreed with retaliation killed fewer animals that cause damage than those who agreed ($\chi^2 = 22.4663$, $df = 1$, $p < .001$). Respondents who disagreed with keeping wildlife as pets had less wildlife as pets than those who agreed

Table 3. Proportion of Respondents Performing Illegal Behaviors Related to Different Motivations for Hunting and Deforestation in Protected Areas and Buffer Zone of the Atlantic Forest.

	UWR-UBR	*SLNP-BZ*	*p value* (χ^2)
Replace secondary forest with small-scale agriculture ($n = 165$)	32%	31%	.82
Retaliation (kill animals that cause damage, $n = 72$)	15%	22%	.45
Keep captured wild animals as pets ($n = 163$)	21%	15%	.40
Hunting for consumption ($n = 169$)	46%	61%	.04

Note. The relationship between the reported behaviors and location is also shown. UWR = Una Wildlife Refuge; UBR = Una Biological Reserve; SLNP = Serra das Lontras National Park; BF = Buffer Zone; χ^2 = Pearson Chi-square test.

($\chi^2 = 12.544$, $df = 1$, $p < .001$). Respondents who disagreed with hunting being allowed for consumption hunted less than those who agreed ($\chi^2 = 14.261$, $df = 2$, $p < .001$). However, no association was found between attitudes and the behavior of replacing forest with small-scale agriculture ($\chi^2 = 1.95$, $df = 2$, $p = .37$).

Descriptive norm related to hunting was correlated to the behavior of hunting for consumption; people who perceived a reduction in hunting activities in the region hunted less, whereas people who perceived hunting is continuing hunted more ($\chi^2 = 8.94$, $df = 1$, $p = .002$). However, descriptive norm related to hunting was not correlated to the behavior of retaliation ($\chi^2 = 1.78$, $df = 1$, $p = .18$) or keeping wildlife in captivity as pets ($\chi^2 = 0.27$, $df = 1$, $p = .60$). No association was identified between perceptions of law enforcement and hunting for consumption ($\chi^2 = 3.5645$, $df = 2$, p value $= .168$), retaliation (Fisher test, $p = .648$), or keeping wildlife in captivity as pets ($\chi^2 = 0.75$, $df = 2$, $p = .688$).

No association was found between the attitude toward deforestation and the behavior of replacing forest with small-scale agriculture ($\chi^2 = 1.95$, $df = 2$, $p = 0.37$). Descriptive norm related to deforestation was correlated to this specific behavior; respondents who perceived that people continue to deforest, tended to deforest more ($\chi^2 = 5.80$, $df = 2$, $p = 0.05$). We did not identify effects of perceived behavioral control on the behavior related to deforestation ($\chi^2 = 1.25$, $df = 2$, $p = 0.533$).

Discussion

The TPB suggests that an individual's reported behavior is determined by a context-dependent combination of attitudes, norms, and perceived behavioral control (Ajzen & Fishbein, 2005). In this study, we carried out a preliminary exploration of predictors of behaviors toward different motivations for hunting and deforestation in the study region, using the TPB framework as a guide to structure our analysis. Our results suggest that a combination of demographic factors, values held for PAs, and location influenced respondents' attitudes, descriptive norms, and perceived behavioral control in the study region. We also found that components of the TPB such as attitudes (only for hunting) and descriptive norms may be good predictors of the studied behaviors.

Hunting

Our results suggested that most respondents have a strong desire to hunt for consumption. This is a big issue because it goes against the PAs' policies and the Federal law and represents a potential threat to wildlife conservation inside PAs. In addition, illegal hunting is occurring in the study region (Castilho et al., 2017) and has been considered a constant problem within the PAs of Bahia State (Schiavetti, Magro, & Santos, 2012). The desire of respondents to kill animals that have caused damage is also of concern, because human–wildlife interactions have grown in frequency, intensity, range, and diversity throughout Brazil (Marchini & Crawshaw, 2015). Despite that an interesting and favorable finding for wildlife conservation was that respondents in both locations did not support the desire to hunt for income. Considering this, management actions should capitalize on positive values that people already perceive that PAs provide and attempt to mitigate the negative ones (Allendorf et al., 2006).

Deforestation

Considering that most respondents are involved in agricultural activities, their biggest complaint was that they were restricted from replacing secondary forests with small-scale agriculture, which hindered their work and livelihood. This feeling was reflected in negative attitudes toward the PAs and forest conservation, and also in negative behavior, since some of the respondents admitted to having replaced secondary forest with small-scale agriculture. The policies of the studied PAs state that only areas that do not classify as forest in the initial or more advanced stages of regeneration are subject to authorization for clear-cutting. According to SOS Mata Atlântica and INPE (2015), deforestation rates in the Atlantic Forest have reduced compared with recent years, but Bahia State was the state with the third highest deforestation rate. Between 2012 and 2013, the municipality of Una lost 46 ha of forest (SOS Mata Atlântica & INPE, 2015). Moreover, according to PA managers, illegal deforestation has been registered during law enforcement events recently conducted in UBR and UWR. This highlights a potential mismatch between residents' perceptions, 85% of whom said that people in the region were no longer deforesting, and the perceptions of conservation managers, which requires further investigation. Deforestation by local residents represents a great challenge for PA management, because reconciling land use and biodiversity conservation within PAs requires precautionary measures to ensure protection of the remaining fragments, without harming residents' livelihoods.

Effects of Background Factors

A combination of background factors influenced respondents' attitudes, descriptive norms, and perceived behavioral control in the study region. Formal education and duration of residence were the most important demographic variables related to attitudes toward different motivations for hunting and deforestation. Those with primary education tended to have less proconservation attitudes toward hunting. Castilho et al. (2017) also

found a relationship between primary education and higher prevalence of hunting. However, this correlation is not clear and needs further investigation. Unlike other studies which identified a relationship between long-term residency and negative attitudes (Newmark et al., 1993), we found that more recent arrivals had more negative attitudes toward hunting and deforestation in the PAs. This could be due to the long-term respondents being more attached to their areas, valuing the wildlife and natural environments more (Ferreira & Freire, 2009; Larson et al., 2016), or because long-term residents have experienced the consequences of the large-scale deforestation and overhunting that were prevalent in the region prior to the creation of the PAs. Communication programs can help to avoid conflicts over the use of natural resources and improve awareness among residents (Ferreira & Freire, 2009; Masud, Kari, Yahaya, & Al-Amin, 2014; Ormsby & Kaplin, 2005), especially for more recent arrivals. Age was the only social factor correlated to the descriptive norm related to deforestation. The greater perception of ongoing deforestation among younger respondents may be related to different experiences and different temporal perspectives. Older respondents may have experienced the large-scale deforestation before the creation of the PAs and consequently had different perceptions of current deforestation levels. This could represent the phenomenon of environmental generational amnesia, a form of Shifting Baseline Syndrome, where individuals fail to pass their knowledge and experience to future generations, and consequently younger people are not aware of past biological conditions (Papworth et al., 2009).

In general, respondents who expressed positive values toward the PA had more positive attitudes toward hunting and deforestation. General values are among multiple variables that may influence people's beliefs (Ajzen & Fishbein, 2005). Location had a minimal influence on attitudes; however, it affected descriptive norms and perceived behavioral control. These results suggest that differences between the PAs were not enough to change the opinions or beliefs of local people toward hunting and deforestation in the study region but may influence how people perceive management actions such as law enforcement and others' behaviors. Most reported behaviors did not differ by location. Similarly, Castilho et al. (2017) did not find a clear difference in hunting prevalence between the PAs but found that respondents in UBR-UWR perceived a greater decrease in hunting compared to respondents in SLNP-BZ.

Studies have suggested that previous negative interactions with wildlife can explain residents' negative attitudes toward wildlife (Liu et al., 2011; Naughton-Treves, Grossberg, & Treves, 2003; Parry & Campbell, 1992) and PAs (De Boer & Baquete, 1998). However, we did not find this association. Despite the desire to kill wildlife and anger expressed by some respondents due to their losses, others who had also experienced losses had positive views of human–wildlife interactions, understanding the need and opportunity for animals to feed. Moreover, factors such as fear of punishment or desire to consume certain wild animals causing damage also appeared to contribute to whether retaliatory killings have been carried out or not.

Although the relationship between respondents and PA employees was not directly investigated, some respondents stated that they felt oppressed by the laws and the control exerted by PA staff, and that information about regulations for resource utilization and how to get legal authorization were lacking. This interaction deserves further investigation in the future, considering that good relationships between PA staff and local people can influence proconservation attitudes (Anthony, 2007; Newmark et al., 1993; Ormsby & Kaplin, 2005) and enhance the potential for achieving PA objectives (Stern, 2008).

Effects of the Components of the TPB on Behaviors Related to Different Motivations for Hunting and Deforestation

We found that positive attitudes toward hunting were positively correlated with proconservation behaviors related to hunting. Attitudes are often good predictors of behaviors when item specificity and alignment is high (Vaske & Manfredo, 2012). It is hard to know whether these correlations were a result of social desirability bias (people answering questions about illegal behaviors based on what they thought we wanted to hear). Respondents appeared to be comfortable answering direct questions honestly, however. In addition, descriptive norms, such as the perception of other people's behavior toward hunting and deforestation, were correlated with the specific behaviors, suggesting that the way respondents perceived other people's behavior in the study region may reflect their own behavior. Indirect questioning techniques can reduce social desirability bias and could be used in future studies (Castilho et al., 2017; St John et al., 2010).

Contrary to other studies that have suggested that perceived behavioral control may represent a good predictor of behavior (e.g., Mintzer et al., 2015; Zubair & Garforth, 2006), we found that respondents' perception of law enforcement did not influence their behavior. The presence of law enforcement is just one element of perceived behavioral control, and considering that predictors of behaviors should be specific to each behavior investigated (St John et al., 2010), it may be that other unmeasured and more specific components of behavioral control (such as time availability or skill) might be more influential. In addition, people's perception of enforcement may not be enough to prevent negative behaviors because the activities performed involved the use of resources essential to local communities' livelihoods (De Boer & Baquete, 1998).

Our study did not address all the components of the TPB (in particular, excluding behavioral intention and subjective norms and exploring a nonspecific part of perceived behavioral control and a general descriptive norm related to hunting), precluding the appropriate use of the TPB framework and full analysis through structural equation modeling or multivariate regression. However, it indicates areas which conservation managers need to address in order to change residents' behavior with respect to two important conservation issues, deforestation and hunting.

Implications for Conservation

Our study suggests that to change behaviors of rural residents toward different motivations for hunting and deforestation in and around PAs of the Southern Bahian Atlantic Forest, management actions should consider people's attitudes and norms and the combination of background factors that influence these variables. Raising compliance with conservation policies in PAs is challenging, particularly if we consider that managers have scarce human and financial resources (Galindo-Leal & Câmara, 2005; Schiavetti et al., 2012). However, to achieve long-term effectiveness of PAs, it is widely accepted that local communities should support these areas as well as their conservation policies and actions (Allendorf, 2007; Fiallo & Jacobson, 1995; McNeely, 1994). It is therefore essential to engage local people to a greater extent, guaranteeing that residents and their concerns will be included in the management strategies (Andrade & Rhodes, 2012).

Appendix

Table A1. Relevant extracts from the questionnaire used to investigate predictors of behaviors in protected areas and a buffer zone in northeastern Atlantic Forest, Brazil.

Part I: Background factors
Location: () UBR; () UWR; () SLNP; () BZ
Age: Duration of residence: Level of formal education:
Number of people living at home:
Government assistance: () yes; () no
Past experience with damage to crops or livestock loss caused by wildlife: () yes; () no
Perception of Protected Areas: () positive; () negative; () both. Why?
Part II: Attitudes towards different motivations for hunting and deforestation
Hunt for consumption should be allowed. () agree; () disagree; () partly agree, why?
Hunt for sale should be allowed. () agree; () disagree; () partly agree, why?
Kill animals in retaliation for damage caused should be allowed. () agree; () disagree; () partly agree, why?
Keep wildlife in captivity as pets should be allowed. () agree; () disagree; () partly agree, why?
Replace forests with small-scale agriculture should be allowed. () agree; () disagree; () partly agree, why?
Part III: Descriptive norms
Do you think that people in the region hunt? () yes; () no
Do you think that people in the region deforest? () yes; () no
Part IV: Perceived behavioral control
Is there law enforcement to control people's activities in the region? () yes; () no. If yes, do you think law enforcement is low, the same or increasing?
Part V: Behaviors related to different motivations for hunting and deforestation
Do you replace secondary forest with small-scale agriculture? () yes; () no
Do you kill animals that cause damage to crops or livestock? () yes; () no
Do you keep captured wild animals as pets? () yes; () no
Do you hunt for consumption? () yes; () no
Do you hunt for commercial purposes? () yes; () no
Part VI: Open-ended question on respondents' views about the PAs
Do you think PAs improve or worsen residents' lives? Which aspects improve and which aspects worsen residents' lives?
Positive views representing positive values.
Negative views representing negative values.

Note. The questionnaire has been divided up into different parts representing the TPB components for ease of reference; this division was not given to the respondents.

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Supplemental Material

Supplementary material for this article is available online.

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