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ABSTRACT

Tourism has been indicated as an economic alternative to alleviate the burdens of human–wildlife conflicts. Our objective was to investigate the effects of community-based tourism and research on traditional communities' interactions with jaguars. This study was carried out in Mamirauá Reserve in the Brazilian Amazon, where a community-based tourism initiative operates and community-based research projects take place. One hundred and two semi-structured interviews were conducted in local communities between February 2020 and November 2021. General linear models were used to test if involvement with tourism or community-based research affected the measured variables. Where tourism was present, tolerance toward jaguars was higher. Areas where tourism and research were present had more positive attitudes toward jaguars, as well as a lower intention to kill jaguars. Our findings suggest that community-based tourism-related activities and research projects have had a positive effect on local human-jaguar relationships, improving tolerance and attitudes toward jaguars.

Introduction

Throughout history, large carnivores have inspired fear and admiration among humans (Kruuk, 2002). Interactions between humans and carnivores often lead to the persecution of carnivores due to economic losses incurred from depredation of livestock (Ripple et al., 2014), or social, cultural, or personal beliefs such as the perception of risk to one's safety (A. J. Dickman et al., 2014). Human communities suffer from these interactions, enduring economic losses, opportunity costs, and potential health hazards (Barua et al., 2013; Manoa et al., 2021). The increasing human population, coupled with the destruction of natural environments, sets the stage for an escalation in negative human–carnivore interactions (Anand & Radhakrishna, 2017), threatening large carnivores and putting pressure on vulnerable human communities.

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Felids and big cats in particular (*Panthera* spp.) are a primary source of human–carnivore conflict and are commonly persecuted when in contact with people (K. K. Holland et al., 2018) in retaliation to livestock depredation, but also as a preventive measure, or motivated by fear (Knox et al., 2019; Marchini & Macdonald, 2012). Jaguars (*Panthera onca*) are the largest felid in the Americas, the third largest felid in the world (Seymour, 1989), and are frequently involved in negative interactions with humans (Zimmermann et al., 2021). Human–wildlife conflicts, as these negative interactions are often called, are one of the main threats to the species range-wide (Quigley et al., 2017). The Amazon is considered the most important ecosystem for the long-term conservation of jaguars (Jędrzejewski et al., 2018); however, the species is regularly killed by ranchers and local villagers (Carvalho, 2019; Marchini & Macdonald, 2012) in addition to being threatened by wildfires and habitat loss (Menezes et al., 2021).

Tourism has long been pointed out as a viable and sustainable alternative to generate income for local communities as opposed to practices that are more predatory such as logging and commercial hunting (Macdonald et al., 2017; Mossaz et al., 2015; Romañach et al., 2007; F. R. Tortato & Izzo, 2017). In theory, earning money from tourism activities would dissuade local people from killing wildlife relevant to tourism operations (Macdonald et al., 2017). For example, studies have focused on the amount of money generated by tourism activities in contrast to the amount lost due to wildlife damage (F. R. Tortato et al., 2017). However, given that jaguars are killed for reasons other than just economic losses, the revenue from tourism does not guarantee to change people's attitudes and behaviors toward the species, especially if the money generated goes to a few ranchers or landowners rather than benefiting entire communities (Hemson et al., 2009). In this study, we assessed a tourism initiative that is considered as community-based tourism, here defined as community control and ownership over management and development that has direct financial benefits from the activity (Scheyvens, 1999; Zielinski et al., 2020).

Community-based research projects aim to integrate the involvement of local communities and resource users to harmonize the goals of biodiversity conservation and human wellbeing (Western & Wright, 1994). These projects have also been shown to promote positive attitudes toward wildlife and conservation, when local engagement is prioritized (Brooks et al., 2013; Larson et al., 2016). Community-based research programs may improve livelihoods and promote education and local empowerment, which can lead to conservation-oriented behavior (Campos-Silva et al., 2021; Fariss et al., 2022; Franco et al., 2021). For example, a community-based research project was able to collect unique data about wild felid hunting inside protected areas in the Brazilian Amazon, having direct implications over conservation and public policy (Valsecchi et al., 2023).

Conceptual Background

We considered that human killing of jaguars was the behavior of interest we wanted to assess, being the main negative impact on the species (Valsecchi et al., 2023). Therefore, we developed a theoretical framework based on the Theory of Planned Behavior (Ajzen, 1991) to investigate whether tourism activities and participation in research had a positive effect on the behavior of local people toward jaguars in Mamirauá Sustainable Development Reserve. According to the Theory of Planned Behavior, human behavior can be explained by attitudes toward the behavior, subjective norms, and perceived behavioral control. Attitudes are

defined as a favorable or unfavorable disposition toward performing the behavior. Subjective norms are an individual's perception of whether people who are important to them would approve or disapprove of such behavior. Perceived behavioral control represents the perception of difficulty to perform a behavior considering individual and circumstantial limitations (Ajzen, 1991; Armitage & Conner, 2001). These three variables influence behavioral intention, which is the most proximal determinant of individual behavior.

However, subjective norms may not be as effective in predicting behavior as descriptive norms; defined as the perception of how common a behavior is in a population (Armitage & Conner, 2001; Niemiec et al., 2020). For example, subjective norms were not significant in predicting the intention to kill jaguars in another study conducted in the Amazon, while descriptive norms were (Marchini & Macdonald, 2012). Therefore, we included descriptive norms in our framework instead of subjective norms. Marchini and Macdonald (2012) also showed that measuring behavioral intention directly may be a valid proxy for predicting jaguar killing behavior in the Amazon; hence, intention to kill jaguars was also included as a variable. To better assess the effect of tourism and research on the relationship between local people and jaguars, we also included tolerance toward jaguars as a variable (Table 1). Following the definition proposed by R. Kansky et al. (2016), tolerance was defined as the ability and willingness of an individual to absorb the extra potential or actual costs of living with wildlife.

Although some studies have highlighted the potential benefits of tourism and community-based research (Fariss et al., 2022; K. K. Holland et al., 2022), few studies have actually investigated the link between tourism or research and local people's attitudes toward large carnivorous species (e.g. Ohrens et al., 2021). Within this context, the objective of this study was to investigate the effects of community-based tourism and community-based research on traditional Amazonian communities' interactions with jaguars. More specifically, we wanted to assess (1) whether the residents in communities that are directly benefited from community-based tourism and are involved in research are more tolerant and have more positive attitudes, norms, and behavioral intentions toward jaguars compared to other communities that do not participate in tourism or research, and (2) if individuals directly engaged in tourism activities are more tolerant and have more positive attitudes, norms, and behavioral intentions toward jaguars than people who aren't engaged. We predicted that the individuals from communities that work with tourism would be more tolerant toward jaguars given the direct economic benefits that the species provides and would have attitudes that are more positive as well (Ohrens et al., 2021). We also predicted that jaguar killing would be perceived as less common in communities that work with tourism and are involved with research, since the perception of how common a behavior is within a population directly affects the intention to perform such behavior (Niemiec et al., 2020) and that local residents would have less intention to kill jaguars (Ohrens et al., 2021). Finally, we predict that individuals more engaged in tourism would have more conservation-oriented attitudes and a higher tolerance toward jaguars (K. K. Holland et al., 2022).

Material and methods

Study area

This study was carried out in Mamirauá Sustainable Development Reserve (hereafter Mamirauá Reserve; Figure 1), Amazonas state, Brazil. Mamirauá Reserve was created in

Table 1. Variables and responses used to assess the influence of tourism on human-jaguar interactions in mamirauá sustainable development reserve, Amazonas state, Brazil.

Variable	Items	Response	Response categories	Cronbach's α
Tolerance toward jaguars	Would you prefer if close to your community there were:	From "no jaguars" to "a lot of jaguars"	Scale from 1 to 5, being 1 more negative and 5 more positive toward the jaguar's presence	0.60
	Would you prefer if the number of jaguars in the region was:	From "a lot smaller" to "a lot larger"		
Attitudes toward jaguar killing	If a jaguar is seen around your community, it should be killed:	From "totally disagree" to "totally agree"	Scale from 1 to 5, being 1 more in favor and 5 less in favor of jaguar killing	0.83
	If a jaguar kills another community member's domestic animal, it should be killed:			
	If a jaguar kills one of your domestic animals, it should be killed:			
	If a jaguar attacks a person in your community, it should be killed:			
Perceived behavioral control	Would you be able to kill a jaguar that appeared in your community?	From "no way" to "absolutely"	Scale from 1 to 5, being 1 more capable of and 5 less capable of killing jaguars	0.47
	Killing a jaguar would be:	From "very easy" to "very hard"		
Descriptive norms	How many people in the region would agree to kill a jaguar if it is seen around the community?	From "no one" to "everyone"	Scale from 1 to 5, being 1 the perception that more people engaged in jaguar killing and 5 less people engaged in jaguar killing	0.77
	How many people in the region would agree to kill a jaguar if it kills a domestic animal?			
	How many people in the region would agree to kill a jaguar if it attacks a person?			
Intention to kill jaguars	Would you kill a jaguar if it is seen around the community?	From "no way" to "absolutely"	Scale from 1 to 5, being 1 with more intention to kill jaguars and 5 less intention to kill jaguars	0.80
	Would you kill a jaguar if it kills a domestic animal?			
	Would you kill a jaguar if it attacks a person?			
Involvement with tourism	Has anyone in your family ever worked with tourism?	Yes/No	Scale from 0 to 10, being 0 not involved and 10 very involved with tourism	Not applicable
	Have you ever worked with tourism?			
	Have you heard about jaguar tourism?			
	Have you ever worked in jaguar tourism?			
	Do you know someone who has worked with jaguar tourism?			

1990, covers an area of 11,240 km^2, and has a population of 11,304 people (IDSM Instituto de Desenvolvimento Sustentável Mamirauá, 2014). Its communities are divided into geo-political sectors where residents organize natural resource management practices and elect local leaderships (IDSM Instituto de Desenvolvimento Sustentável Mamirauá, 2014). The

main sources of income are fishing, small-scale agriculture, and the extraction of wood and non-timber forest products (Moura et al., 2016). Residents in this area are mainly descendants of indigenous populations and immigrants from the Northeast region of Brazil who came to work in rubber extraction in the 19th and 20th centuries (IDSM, 2014).

This study was carried out in three sectors of the reserve, namely Mamirauá, Jarauá, and Aranapu sectors (Figure 1). These sectors are similar regarding how the communities were historically formed and how they are organized socio-politically (Moura et al., 2016). However, research and management activities began in Mamirauá and Jarauá sectors, meaning these areas have been influenced by these activities longer than any other in the reserve. Mamirauá sector has also been influenced by tourism activities for over 20 years (see details below).

Inside Mamirauá Reserve, there is a community-based tourism initiative called Uakari Lodge that operates exclusively in one of its geopolitical sectors, namely Mamirauá sector. This project was created in 1997 by Mamirauá Sustainable Development Institute in partnership with local communities. Local people receive training and are employed at the lodge. The revenue from tourism is shared among all communities inside the sector to be used for projects that will benefit the community, such as building a school or buying a speedboat. To this day, the lodge has generated R$ 4,397,000 (roughly US$ 879,400) that has been shared between local communities and benefited over 100 families. In partnership with Uakari Lodge, the Ecology and Conservation of Felids in Amazonia Research Group of Mamirauá Institute created an opportunity for jaguar sighting tourism, called Jaguar Expedition. The tourists can observe jaguars that are radio-collared and monitored by the research group during the flood season when the jaguars adopt an arboreal lifestyle (Ramalho et al., 2021). This initiative generates income that funds research activities and is also distributed between the local communities, adding to the revenue generated by regular tourism activities. So far, since the initiative was implemented in 2014, the Jaguar Expedition tours alone have generated over R$ 47800 Brazilian reais (roughly US$ 9,560) for local communities. In addition, research activities in the region have been ongoing for over 30 years, and have always prioritized community engagement and participation. The level of participation in research varies depending on the sector of the reserve, with some areas being more engaged than others. Community-based research activities include wildlife monitoring and collecting data from sustainable resource management programs.

Data collection

This study was conducted in February 2020 and from August – November 2021. The sampling gap was due to the COVID-19 pandemic, which prevented any fieldwork from March 2020 to July 2021. In order to assess the influence of tourism on local communities, three groups of stakeholders were surveyed: (1) stakeholders from communities in Mamirauá sector of Mamirauá Reserve, who are directly benefited from the Uakari Lodge community-based tourism initiative and have interacted frequently with researchers for two decades; (2) stakeholders from communities in Jarauá sector of Mamirauá Reserve, who have not benefited from tourism activities but have also interacted frequently with researchers for two decades; (3) stakeholders from Aranapu sector of Mamirauá Reserve where communities have had limited contact with research activities and do not have tourism (Figure 1). The intensity with which the communities interact with researchers was defined
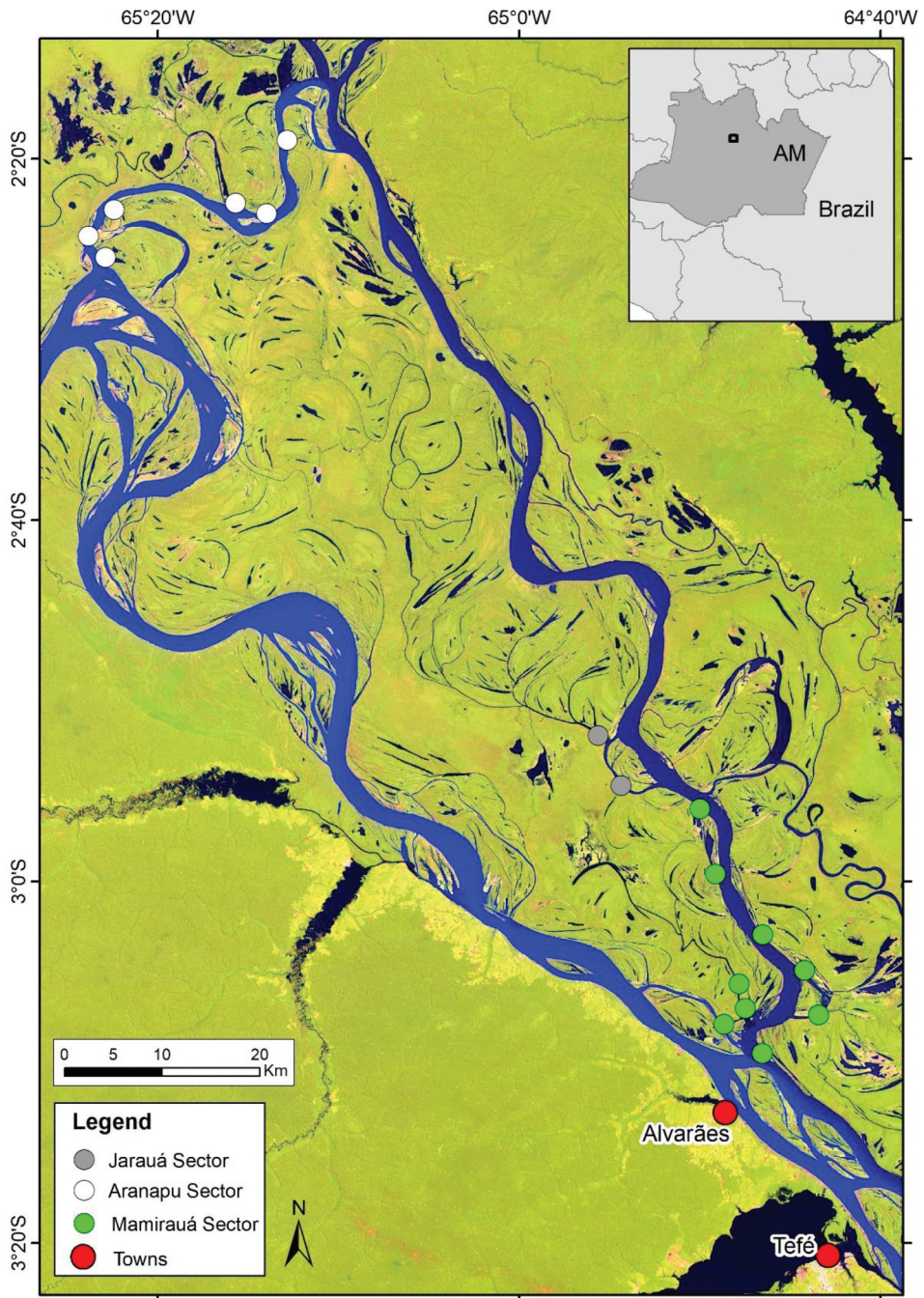
Figure 1. Mamirauá sustainable development reserve, amazonas state, Brazil, and location of each community surveyed in three different geographic areas: Aranapu, Jarauá, and mamirauá sectors.

by how long research projects have taken place in these communities, as well as how many research projects have involved the communities over time.

Semi-structured interviews were conducted in a systematic sampling framework (Newing, 2011), where the head of the household was interviewed in the first house of each community, the second house was skipped, the third house was surveyed, and so forth, repeating this pattern of surveying every other house until the end of the community was reached. Local communities in this region are arranged linearly along the riverbanks so going from one end of the community to the other was straightforward and ensured that sampling encompassed all households. Communities in this region have approximately five to 20 households each. Head of households were considered as adults 18 years of age or older, independent of gender. Only one person was interviewed per household. Prior to the interviews, permission to survey each community was requested from a locally elected representative who acts as the leadership in the community. The objectives of our study were explained, and permission to interview local villagers was requested. Before each interview, verbal consent was obtained from the participants after explaining the objectives of our study. This study was approved by Mamirauá Institute's Research Ethics Committee (nº 27996719.6.0000.8117).

The questionnaire was designed using questions that had been previously tested over years of social science and human dimensions-related fieldwork done in the same communities as the ones surveyed in our study to make sure they were socially and culturally adequate. This was done to ensure that the language, expressions, and vocabulary used in the questionnaire were easily understandable to local community members. Additionally, 10 pilot interviews were conducted before data collection to test whether the questionnaire was suitable and to make final adjustments. The first author, who is Brazilian, and who was accompanied by a local field assistant, conducted all interviews. To minimize bias, the interviewer was as neutral as possible in behavior and appearance, using commonly used clothing and local language expressions, and spent one to two hours with each interviewee, participating in local activities such as farming, fishing, and talking informally before engaging in the interview.

Instrument development

To quantitatively analyze the components in this study, multiple questions were asked for each construct – tolerance toward jaguars, attitudes toward jaguars, descriptive norms, perceived behavioral control over jaguar killing, and behavioral intention to kill jaguars. Tolerance toward jaguars was measured by asking respondents if they preferred a higher or lower number of jaguars around their community (e.g. Bruskotter et al., 2015). Attitudes toward jaguars were measured by asking respondents if they agreed or disagreed that jaguars should be killed under different scenarios. Descriptive norms were measured by asking respondents for their perception on how many people in the reserve would agree to kill jaguars under different scenarios. Perceived behavioral control was measured by asking respondents whether they considered themselves capable of killing the next jaguar that appeared in their community and the difficulty of doing so. Intention to kill jaguars was measured by asking if the respondent would himself or herself kill a jaguar under the same scenarios described for attitudes toward jaguars. We recorded all the questions on a five-point scale coded 1–5

and, since each construct was obtained with multi-item scales, we added the scores for each question and obtained an average scale for the construct (Table 1). We used Cronbach's alpha to assess the internal consistency of the scales (i.e. an estimate of how consistently individuals respond to the items within a scale; Vaske, 2008; Table 1).

Specific questions were asked inside the Mamirauá sector where tourism is present to assess each respondent's involvement in tourism activities. Respondents were asked if they had ever worked with the tourism sector, if they had worked specifically in jaguar-sighting tours, if they saw any jaguars while working in the jaguar-sighting tours, among other questions, which were coded in a binary response format of one or zero (Table 1). These responses were added resulting in a score of zero to ten depicting respondent's involvement in tourism.

Data analysis

Five sets of general linear models (GLMs) were used to test which factors affect tolerance, attitudes, descriptive norms, perceived behavioral control, and behavioral intention considering all areas where interviews were conducted collectively. The models were defined a priori based on which variables might influence jaguar killing behavior. Therefore, each model contained one of the following response variables: (1) tolerance toward jaguars; (2) attitudes toward jaguars; (3) descriptive norms; (4) perceived behavioral control; and (5) intention to kill jaguars. In addition, each model had five explanatory variables: respondent's age, education level, religion, sex, and area where the respondent lives. Area where the respondent lives was used as a proxy for tourism's influence on human-jaguar interactions since communities in Mamirauá sector are involved in tourism and research activities, communities in Jarauá sector are involved only in research activities, and communities in the Aranapu sector aren't involved in tourism activities or research.

To assess whether the degree to which a respondent was involved with tourism influenced the measured variables, another set of GLMs was performed considering only the interviews conducted inside the Mamirauá sector, where tourism is present. The models were defined a priori and contained the same response variables described above. The same explanatory variables were used in these models except for the area where the respondent lives, which was replaced by the tourism involvement score.

All models were checked for overdispersion and multicollinearity. Analyses were conducted in R (R Core Team, 2021).

Results

A total of 17 communities were surveyed; 102 interviews were conducted, 52 in Mamirauá, 20 in Jarauá, and 30 in Aranapu sector, respectively. Forty-six percent of respondents were female ($n = 47$) and 53.9% were male ($n = 55$). Respondent age ranged from 19 to 78 years (mean = 41.5 years; SD = ±14.4). Over 40% of the respondents had not completed elementary school ($n = 45$), less than 20% of the respondents had either completed elementary school or incomplete middle school ($n = 18$), and over 25% of the respondents had completed middle school ($n = 26$). Only four respondents had a university degree (3.9%), and nine had no formal education (8.8%). The most common religion among respondents was Catholic ($n = 64$; 62.8%), while 27.5% of the respondents identified themselves as

Evangelical ($n = 28$). Eight respondents declared they had no religion (7.8%), and only two had an unspecified religion.

When comparing the different sectors of the reserve, we found that where tourism was present, tolerance toward jaguars was higher ($\beta = -0.14$, sd $= 0.03$, $t = -4.37$, $p < .01$). Attitudes toward jaguars were significantly more positive where tourism was present and where research was present, (βtourism $= -0.24$, sd $= 0.04$, $t = -6.08$, $p < .01$; βresearch $= -0.19$, sd $= 0.05$, $t = -3.92$, $p < .01$) compared to where there was no tourism and less research. Descriptive norms in relation to jaguar killing behavior were significantly lower where tourism was present (βtourism $= -0.08$, sd $= 0.03$, $t = -2.53$, $p = .01$) and where research was present (βresearch $= -0.12$, sd $= 0.04$, $t = -3.25$, $p < .01$) compared to where there was no tourism and less research activities, meaning jaguar killing was perceived as more common where there was no tourism or research. Perceived behavioral control had a low internal consistency ($\alpha = 0.47$), therefore this variable was excluded from the analyses (Table 1). Areas where tourism and research were present had a significantly lower intention to kill jaguars (βtourism $= 1.38$, sd $= 0.19$, $t = 7.14$, $p < .01$; βresearch $= 1.33$, sd $= 0.25$, $t = 5.26$, $p < .01$), meaning the intention to kill jaguars was significantly more prevalent among respondents where tourism was absent and research activities were less common. Tolerance toward jaguars was higher among men ($\beta = -0.07$, sd $= 0.06$, $t = -2.90$, $p < .01$), and at the same time, men had a significantly higher intention to kill jaguars ($\beta = -2.15$, sd $= 0.22$, $t = -9.93$, $p < .01$; Figure 2). Respondent's age, religion, and education level had no significant effects on the variables tested. Full regression model results are included in Table 2.

For the analysis conducted only with respondents from the Mamirauá sector where tourism was present, involvement with tourism, age, and religion had no significant effect on the variables. Tolerance toward jaguars was higher among men than women ($\beta = -0.12$, sd $= 0.04$, $t = -3.12$, $p = .02$). No other factor significantly affected attitudes toward jaguars and descriptive norms in relation to jaguar killing. In accordance with the analysis that assessed all sectors of the reserve, men also had a significantly higher intention to kill jaguars ($\beta = -1.09$, sd $= 0.17$, $t = -8.72$, $p < .05$). However, respondents with a university degree had a significantly higher intention to kill jaguars ($\beta = -2.37$, sd $= 0.15$, $t = -6.51$, $p = .01$).

Discussion

Our study sheds light on how local villagers perceive and interact with jaguars under different scenarios, and how community-based tourism affects this relationship. We detected a higher tolerance for jaguars' presence in the Mamirauá sector of the reserve, where community-based tourism is present, suggesting that tourism-related activities may have a positive effect on local human-jaguar interactions. Studies have highlighted tourism's conservation potential, especially for large carnivores (K. K. Holland et al., 2022; Macdonald et al., 2017; Mossaz et al., 2015; F. R. Tortato & Izzo, 2017), as well as how tourism may be a catalyst to improve perceptions and tolerance toward wildlife (Caruso et al., 2020; Romañach et al., 2007; Ziegler et al., 2021). However, tourism's conservation potential is limited when its benefits are not equally shared by local stakeholders (Hemson et al., 2009; Ohrens et al., 2021). Furthermore, other studies have indicated that tourism can improve human–wildlife interactions without actually
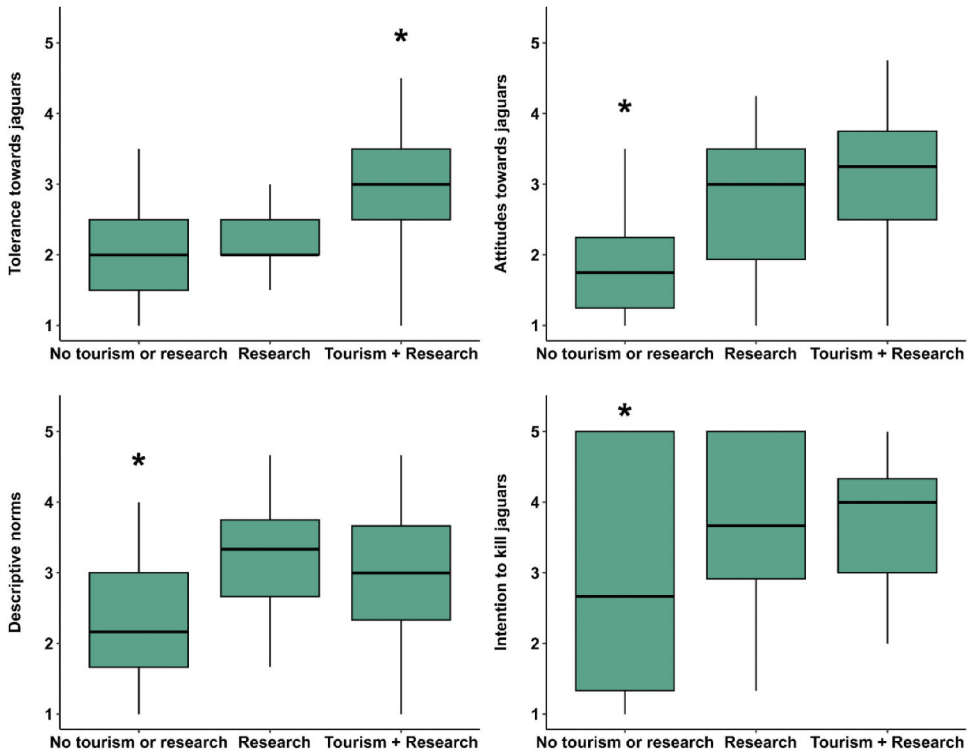
Figure 2. Comparison of variables that assessed human-jaguar interactions in three sectors of mamirauá sustainable development reserve, Amazonas state, Brazil. Aranapu sector with no tourism or research, Jarauá sector with research, and mamirauá sector with tourism and research. Higher scores indicate more positive human-jaguar interactions. Stars on top of each boxplot represent statistical difference ($p < .05$) between geographic areas.

testing this hypothesis (Porfírio et al., 2016) or quantified the economic benefits of tourism without assessing how this translates into local stakeholder perceptions toward wildlife (F. R. Tortato et al., 2017).

The jaguar tourism may play an important role in shaping human-jaguar relationships for two main reasons. First, the additional revenue that stems from this activity associates the jaguars' presence with economic benefits that are distributed among local communities equally (Hemson et al., 2009; Ohrens et al., 2021). In Chile, puma (*Puma concolor*) tourism increased the tolerance of local ranchers toward the species, although the costs and benefits of puma tourism were not equally shared by the stakeholders (Ohrens et al., 2021). The other reason is the positive experiences that local villagers have had while participating in jaguar tourism – being able to observe jaguars in a novel, non-threatening way – which can be a key driver of tolerance (R. Kansky et al., 2016, 2021). During the interviews, it was common to hear from those who participated in jaguar tourism as local guides that they lost their fear of jaguars, and realized how the species wasn't as ferocious and dangerous as they were led to believe. These are two common aspects of wildlife tourism that can be explored to increase tolerance toward conflict-prone species in other contexts and can play a significant role in shifting social norms toward conservation-oriented behavior.

Table 2. Coefficients for the general linear models performed testing whether tolerance toward jaguars, attitudes toward jaguars, descriptive norms, and intention to kill jaguars are influenced by respondent's age, education level, religion, sex, and area where the respondent lives.

Independent Variable	Tolerance model			Attitudes model			Descriptive Norms model			Intention to kill model		
	β	SD	t	β	SD	t	β	SD	t	β	SD	t
Age	-8.88×10^{-4}	9.12×10^{-4}	-0.97	4.52×10^{-4}	0.001	0.66	-0.001	9.08×10^{-4}	-1.56	0.002	0.007	0.39
Education Level												
elementary incomplete	0.07	0.04	1.57	0.02	0.05	0.47	0.08	0.05	1.65	-0.56	0.31	-1.82
high school complete	-0.01	0.04	-0.3	-0.01	0.05	-0.24	-0.01	0.05	-0.27	-0.38	0.35	-1.1
high school incomplete	0.01	0.05	0.11	-0.08	0.06	-1.53	-0.02	0.05	-0.34	0.79	0.46	1.7
university degree	-0.02	0.06	0.76	-0.12	0.07	-1.62	-0.03	0.07	-0.48	0.16	0.52	0.31
no education	0.1	0.06	1.68	-0.02	0.06	-0.32	0.007	0.06	0.14	-0.71	0.38	-1.88
Religion												
protestant	0.01	0.02	0.56	0.01	0.03	0.47	0.008	0.03	0.26	0.22	0.2	1.14
other	0.08	0.12	0.67	-0.08	0.08	-0.93	0.01	0.1	0.1	-1.12	1.1	-1.02
none	0.05	0.05	0.92	1.39×10^{-4}	0.05	0.003	-0.006	0.05	-0.13	-0.36	0.26	-1.36
Sex												
male	-0.07**	0.06	-2.9	0.001	0.02	0.09	0.04	0.02	1.82	-2.15**	0.22	9.93
Sector												
tourism + research	-0.14**	0.03	-4.37	-0.24**	0.04	-6.08	-0.08*	0.03	-2.53	1.38**	0.19	7.14
research	-0.004	0.04	-0.1	-0.19**	0.05	-3.92	-0.12**	0.04	-3.25	1.33**	0.25	5.26

*p < .05, **p < .01.

Attitudes toward jaguars were more positive, while descriptive norms in relation to jaguar killing and intention to kill jaguars were lower in Mamirauá (tourism and research) and Jarauá (research) sectors. In these locations, local people were less favorable toward killing jaguars, thought fewer people would engage in jaguar killing in their communities, and were less prone to killing jaguars themselves. The presence of decades-long community-based research projects in these communities may play an important role in shaping the relationship between local stakeholders and jaguars. Community-based natural resource management and participation in research projects have been identified as effective ways to promote positive attitudes toward conservation (Brooks et al., 2013; Infield & Namara, 2001) and conservation-oriented behavior (Nilsson et al., 2016). Community-based research initiatives may help reduce inequalities and achieve systemic change by generating professional capacity and competence in local stakeholder groups (Devia et al., 2017; J. Jagosh et al., 2012, 2015). These community-based initiatives are especially effective in promoting the conservation of natural resources and wildlife when they empower local people, provide economic benefits, and encourage self-governance while also increasing the sustainability of research goals over time through local participation (Campos-Silva et al., 2021; Fariss et al., 2022; Franco et al., 2021; Nilsson et al., 2016). Therefore, our results suggested that contact with research activities alone or with tourism influence local villagers' relationship with jaguars. These findings suggest that both community-based tourism and community-based research can bring positive change regarding wildlife conservation and can be valuable tools for improving human–wildlife interactions and influencing social and psychological factors that affect these interactions.

In our study area, gender differences in daily activities can be pronounced. For example, higher intention to kill jaguars among men may partially be explained because hunting is a task traditionally undertaken by this group in our study area (Valsecchi et al., 2023). Despite having less tolerance toward jaguars, during the interviews women never reported any intention to kill jaguars themselves, which supports the seemingly paradoxical higher tolerance for jaguars and higher intention to kill jaguars detected in men. Although age and religion have been shown to have an impact over human–wildlife interactions in other studies (A. J. Dickman, 2010; Knox et al., 2019Nair et al., 2021), these factors did not influence on human-jaguar relationships in our study.

In the analysis conducted only within the Mamirauá sector, where tourism was present, men also expressed both higher tolerance toward jaguars and higher intention to kill jaguars – again, likely because of their hunting role (Valsecchi et al., 2023). Contrary to expectations, the small number of respondents with a university degree ($n = 2$) had a higher intention to kill jaguars. Although a higher level of education is generally associated with more positive attitudes and perceptions toward jaguars (Álvarez & Zapata-Ríos, 2022), this is not always the case (Caruso et al., 2020). Unlike other studies focused on human–carnivore interactions (Hemson et al., 2009), respondent's personal involvement with tourism did not affect any factors.

Unlike for-profit tourism initiatives, where only a small fraction of stakeholders benefit from this activity, which can generate inequalities in revenue sharing (Hemson et al., 2009; Sekhar, 2003; Walpole & Goodwin, 2001), tourism in our study area is community-based. Therefore, tourism benefits are shared equally among local communities and improve well-being (K. K. Holland et al., 2022; Ozorio et al., 2016; Zielinski et al., 2020). This may influence overall attitudes and

tolerance regarding human–wildlife interactions and conservation among local villagers regardless of their direct involvement in tourism (Archabald & Naughton-Treves, 2001; Snyman, 2012). The overarching influence of community-based tourism is an important aspect to be considered by researchers and practitioners intending to apply tourism as an economic alternative to alleviate potential burdens of coexisting with wildlife elsewhere.

Although our results are encouraging, it must be kept in mind that only a small area in the reserve benefits from tourism and participates intensively in research, and replicating these programs in other regions of Central Amazonia may be challenging due to logistical and infrastructural constraints, as well as other forms of conflict particular to other regions. Also, it would be important for further studies to address the possibility of confounding factors that may be influencing the variables tested and were not encompassed in this study. For example, it may be interesting to assess whether distance to the nearest town or easier access to information may play a role in determining human-jaguar interactions. Another factor that could be further analyzed in future studies is previous experiences (positive or negative) with jaguars, as this variable can also play an important role in determining tolerance (R. Kansky et al., 2016).

Conclusion

Our results corroborate the assertion that tourism is an important and effective means of improving human–wildlife relationships while also indicating that community-based research programs may contribute to positive human–wildlife relationships.

It is worth noting that in areas where there are high incidences of negative human–wildlife interactions, applying a similar approach of incentivizing both community-based tourism and community-based research projects may be a valid alternative to improve tolerance and attitudes toward wildlife. Our study provides valuable insights regarding the assumption that tourism benefits may go beyond economic income, translating into more positive attitudes and tolerance, and less intention to kill jaguars. In summary, community-based tourism and research in Mamirauá Reserve are important tools in improving local communities' livelihoods while simultaneously improving their relationship with jaguars and assisting in the conservation of the species.

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