REPORT

Attitudes toward jaguars and pumas and the acceptability of killing big cats in the Brazilian Atlantic Forest: An application of the Potential for Conflict Index₂

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Abstract We explored the overall acceptability of killing jaguars and pumas in different scenarios of people–big cat interactions, the influence of attitudes toward big cats on acceptability, and the level of consensus on the responses. Data were obtained from 326 self-administered questionnaires in areas adjacent to Intervales State Park and Alto Ribeira State Park. Overall, people held slightly positive attitudes toward jaguars and pumas and viewed the killing of big cats as unacceptable. However, individuals that held negative attitudes were more accepting of killing. As the severity of people–big cat interactions increased, the level of consensus decreased. Knowing whether killing a big cat is acceptable or unacceptable in specific situations allows managers to anticipate conflict and avoid illegal killing of big cats.

Keywords Ecological corridors · Human–wildlife conflict · *Panthera onca* · Protected areas · *Puma concolor* · Wildlife

INTRODUCTION

Habitat loss and poaching are primary threats to wild felids (Zeller 2007; IUCN 2008; Loveridge et al. 2010). People kill jaguars (*Panthera onca*) and pumas (*Puma concolor*) for their skin and bones, for recreation, because of chance encounters, as a retaliatory response for livestock depredation, and because of the perceived threat to themselves and livestock (Carvalho and Pezzuti 2010; Loveridge et al. 2010; Robinson et al. 2014; Hiller et al. 2015). Commercial hunting for pelts has historically driven the decline of jaguars in Central and South America. With the implementation of laws (e.g., Brazilian Wildlife Protection Act in 1967, and the Convention of International Trade of

Endangered Species—CITES), commercial hunting of jaguars has declined, yet the survival of the big cats remains questionable (Costa et al. 2005; Carvalho and Morato 2013). The situation is critical for jaguars in the Atlantic Forest (AF) biome. There are approximately 150–300 individuals occurring in eight isolated sub-populations; the lowest densities are estimated for Intervales State Park and Alto do Ribeira Touristic State Park (PETAR) in Sao Paulo state (.66/km²; Paviolo et al. 2016).

Although some large protected areas in the Atlantic Forest have good habitat quality for jaguars, illegal hunting of jaguars is still widespread and threatens the survival of the species (Paviolo et al. 2016). Jaguars are illegally killed both inside and outside protected areas. At the borders of protected areas, however, jaguars are most vulnerable to human-induced mortality, as human settlements and agricultural frontiers continue to expand (Woodroffe and Ginsberg 1998). Reducing jaguar mortality and the illegal hunting of their prey are necessary to avoid the extinction of the largest felids in the Atlantic Forest (Paviolo et al. 2016).

Human–big cat conflict in the Atlantic Forest is not as evident as it is in the Amazon or Pantanal where the population densities of these species are higher and livestock depredation is more frequent (e.g., Zimmermann et al. 2005; Marchini and Macdonald 2012). Human-induced mortality, however, is a major threat to jaguars in the Atlantic Forest. People–big cat encounters are relatively rare in this region, but domestic animal depredation by big cats has been reported in areas adjacent to Intervales and PETAR State Parks (e.g., Palmeira and Barella 2007). A study of jaguars in the Atlantic Forest recommended the mitigation of all sources of jaguar mortality and the need to improve the connectivity of these isolated populations (Paviolo et al. 2016). Beyond the biology and geography, it

is equally important to explore the human dimensions of people–big cat coexistence.

Human dimensions of wildlife (HDW) suggests that human behavior toward wildlife is influenced by a hierarchy of cognitions ranging from basic values and value orientations to more specific norms, attitudes, and emotions (Manfredo 2008; Vaske and Manfredo 2012; Dickman et al. 2013). Of these predictors, attitudes have been the focus of numerous investigations (Manfredo et al. 2004). Attitudes reflect an individual's evaluation of an object (e.g., a wildlife species) and include cognitive (i.e., beliefs) and affective (i.e., positive or negative) components (Manfredo 2008). Attitudes are categorized as implicit or explicit. Implicit attitudes measure automatic and unconscious evaluations; explicit attitudes measure conscious evaluations that an individual is aware of and able to express (Manfredo 2008). HDW research has focused on explicit attitudes (Vaske and Manfredo 2012) and has found that situation and context differences often influence the evaluation of the object (Manfredo et al. 1998). The acceptability of attitude toward killing a big cat, for example, is likely to differ depending on whether the person has observed tracks near their home, has seen the animal, or a big cat has killed a pet and/or livestock (i.e., Manfredo et al. 1998; Bruskotter et al. 2009; Jacobs et al. 2014).

Acceptability reflects the extent to which an individual considers a particular action acceptable or unacceptable (Jacobs et al. 2014). Acceptability can be treated as norm or attitude, depending upon context. In this article, acceptability of killing big cats is treated as an attitude (i.e., an evaluation of a particular action). Because people do not necessarily share similar attitudes regarding what behaviors are acceptable or unacceptable, conflict can arise. In this article, we used the Potential for Conflict Index₂ (PCI₂) (Vaske et al. 2010) to measure consensus regarding the acceptability of killing jaguars/pumas.

Potential for Conflict Index₂—PCI₂

Traditional measures of consensus have included standard deviation, coefficient of variation, and interquartile range (Krymkowski et al. 2009; Manning 2011). All of these measures, however, do not have an upper bound, which challenges the interpretation of findings. The PCI₂ was developed to help address these issues (Vaske et al. 2010). The PCI₂ ranges from 0 to 1. The least amount of consensus and greatest potential for conflict (PCI₂ = 1) occurs when responses are equally divided between two extreme values on a response scale (e.g., 50% extremely unacceptable, 50% extremely acceptable). A distribution with 100% at any one point on the response scale yields a PCI₂

of 0 and suggests complete consensus and no potential for conflict.

PCI₂ results can be displayed as graphs. Degree of consensus is illustrated as bubbles where the size of the bubble depicts the magnitude of the PCI₂ value and indicates the extent of potential conflict (or consensus) regarding acceptance of a particular issue. A small bubble represents little potential for conflict (i.e., high consensus) and a larger bubble represents greater potential for conflict (i.e., low consensus). The center of the bubble represents the mean evaluative response as plotted on the vertical axis. The bubble's location relative to the neutral point illustrates whether or not the distribution of acceptance is skewed (Vaske et al. 2010).

To better understand the potential conflict index related to attitudes on the acceptance of killing a big cat, we explored attitudes toward jaguars and pumas, as well as differences among people who hold positive, negative, and neutral attitudes across three scenarios of human–big cat interactions: (1) see the tracks of a jaguar/puma close to home; (2) see a jaguar/puma close to home; and (3) have a domestic animal (pet and/or livestock) killed by a jaguar/puma. The following hypotheses were advanced:

H₁ Overall mean acceptability of killing a big cat will increase as the severity of the human–cat interaction increases (i.e., scenario: tracks seen, big cat seen, domestic animals attacked).

H₂ Within a scenario, individuals with a negative attitude toward jaguars/pumas will accept killing a big cat more than those with neutral or positive attitudes.

H₃ Consensus regarding the overall acceptability of killing a big cat will increase (i.e., smaller PCI₂) as the severity of the human–cat interaction increases (i.e., scenario: tracks seen, big cat seen, domestic animals attacked).

H₄ Within a scenario, individuals with a negative attitude toward jaguars/pumas will have more consensus (i.e., smaller PCI₂) regarding the acceptability of killing a big cat than those with neutral or positive attitudes.

MATERIALS AND METHODS

Study area

Brazil's Atlantic Forest is one of 25 recognized hotspots for biodiversity in the world. Because of urban expansion, illegal logging, animal and plant poaching, the Atlantic Forest is arguably the most threatened forest ecosystem on the planet (Ribeiro et al. 2009). The study was carried out in the rural areas of Ribeirão Grande (7690 inhabitants, 5.065 rural residents; 22.26 hab/km²) and Iporanga (4316

inhabitants, 2486 rural residents; 3.73 hab/km²). Both municipalities are located adjacent to two protected areas along the Serra do Mar ecological corridor in the southwest of São Paulo State, Brazil: Intervales State Park and PETAR State Park (Fig. 1). The main economic activities in the region are small-scale livestock production and subsistence agriculture (Carlos Botelho Management Plan 2008).

Intervales State Park (41 700 ha) was established in 1995 and PETAR (35,772 ha) was established in 1958. These two protected areas are part of the core zone of the Atlantic Forest Biosphere Reserve, and were recognized by UNESCO as a World Natural Heritage Site. This zone represents the largest preserved fragment of the Atlantic Forest; the Paranapiacaba Ecological Continuum (PEC). The study area was located within one of the 182 potential ecological corridors for jaguars identified by Rabinowitz and Zeller (2010). Due to the low probability of long-term jaguar survival (Sanderson et al. 2002) the area has been classified as “highest priority” for conservation. Although internationally jaguars and pumas are classified as Near Threatened and Least Concern, respectively (IUCN 2008), both species are vulnerable in Brazil (Machado et al. 2008). In the Atlantic Forest, jaguars are critically endangered (Paviolo et al. 2016).

Data collection

Data were collected during May and June 2014. To reach areas where road access was difficult, we sent 490 self-administered questionnaires to rural residents via children in 12 elementary schools. We adopted this distribution method due to the remoteness of the homes, and the lack of landline phones in the area. A cover letter explaining the study and requesting the participation of one member of the family (mother, father, or guardian) was sent along with the questionnaires. Questionnaires were returned via the school children within 10 days.

In addition, high school students completed the questionnaire in the classroom. Past research shows that young people tend to hold more positive perceptions of wildlife compared to adults (e.g., Cella et al. 2016). The high school was randomly selected from four possible high schools, and all the students between 15 and 17 years of age present in the classroom were asked to answer the questionnaire. Before the questionnaire was distributed, we explained the purpose of the study and invited the participation of all students.

All of the respondents had the option to not participate in the study. Appropriate ethics and approvals were obtained for the research from Memorial University of

Fig. 1 Study area highlighting the municipalities of Iporanga and Ribeirão Grande adjacent to Alto do Ribeira State Park (dark gray) and Intervales State Park (light gray)

Newfoundland. We collected 326 completed questionnaires; 139 from high school students (response rate = 65%), and 187 that were distributed by the elementary students (response rate = 38%).

To assess the acceptability of killing jaguars and pumas, respondents were asked to evaluate the extent to which they agreed or disagreed with killing a big cat in different scenarios: (1) the tracks of a jaguar/puma are seen close to their home; (2) a jaguar/puma is seen close to their home; and (3) a domestic animal (pet and/or livestock) is killed by a jaguar/puma. These questions did not specify who would kill the predator. A fourth scenario asked people to evaluate the extent to which they agreed or disagreed with the following sentence: “If a jaguar/puma attacks my domestic animals (pet and/or livestock), I should be allowed to kill the predator.” Separate questions were asked for jaguars and pumas. Responses were coded as (−2) strongly disagree, (−1) disagree, (0) neutral, (+1) agree, and (+2) strongly agree for analysis.

Attitudes toward jaguars and pumas were assessed through six items: (1) Jaguars are nuisance animals in the region, (2) Pumas are nuisance animals in the region, (3) Jaguars pose a threat to people in the region, (4) Pumas pose a threat to people in the region, (5) I like/dislike jaguars, and (6) I like/dislike pumas. Responses for items 1–4 were (−2) strongly agree, (−1) agree, (0) neutral, (+1) disagree, (+2) strongly disagree (recoded from 1 to 5). Responses for items 5–6 were (−2) strongly dislike, (−1) dislike, (0) neutral, (+1) like, (+2) strongly like (recoded from 1 to 5). Negative mean scores represent negative attitudes and positive mean scores represent positive attitudes toward these species.

Data analysis

Paired *t*-tests were used to compare responses for jaguars and pumas, and to compare the mean of the overall acceptability of killing big cats responses across scenarios. No statistically significant differences were found between jaguars and pumas for the variables addressed in this article. Therefore, these two species were combined and the results are described in terms of “big cats”. Cronbach’s alpha (Cronbach and Schavelson 2003) was used to estimate the internal consistency of the attitudinal scale (6 items). One-way analysis of variance (ANOVA) was used to compare mean responses of people holding negative, neutral, and positive attitudes toward big cats within each scenario. To examine differences in consensus among negative, neutral, and positive attitudes, as well as among the overall acceptability of killing a big cat, the PCI_2 difference test was used (Vaske et al. 2010).

RESULTS

Sample

Fifty-six percent of the respondents were female, and 44% were male. Fifty-seven percent were adults (>18 years old), and 43% were high schools students between 15 and 17 years old. There was no substantive differences between men and women ($t(246.8) = -1.09$, $p = .27$), and although there was a small statistical difference between youth and adults, the effect size was less than minimum ($\eta = .06$; Vaske 2008), therefore these groups were combined for analysis.

Acceptability of killing a big cat across scenarios

There was no statistical difference between the jaguars or pumas, so the responses for the two species were combined. Overall, people did not agree with killing a big cat ($M = -1.12$, $SD \pm .85$). Irrespective of scenario, 74% disagreed with killing a big cat, 14% were neutral, and 12% accepted killing a jaguar or puma. There were, however, significant differences in the overall mean acceptability of killing a big cat across some of the scenarios, supporting hypothesis 1. On average, people disagreed with killing a big cat in scenario 1 (tracks seen) ($M = -1.24$, $SD = 0.89$) (Fig. 2). Four-fifths (83%) considered the killing of a big cat in scenario 1 unacceptable, 12% were neutral, and 5% accepted killing a big cat. On average, people also disagreed in killing big cats in scenario 2 (big cat seen) ($M = -1.21$, $SD = 0.96$). While 83% of the respondents considered killing unacceptable even if they saw a big cat close to their residences, 10% were neutral, and 7% accepted the killing of big cats. In scenario 3 (domestic animal killed), people on average, disagreed in killing big cats ($M = -0.94$, $SD = 1.10$). If a domestic animal was killed, for 72% killing a big cat was unacceptable; for 13% it was acceptable. In scenario 4 (a domestic animal is attacked by a big cat and the respondent kills the predator), people were slightly more accepting with killing big cats ($M = -0.62$, $SD = 1.20$). Nearly two-thirds (60%) considered killing big cats unacceptable in this scenario, 21% were neutral, and 19% indicated the behavior was acceptable.

There was no significant difference in the mean acceptability of killing a big cat between scenario 1 and scenario 2 ($t(318) = .49$, $p = .623$). However, the mean for scenario 1 differed from scenario 3 ($t(311) = 5.51$, $p < .001$) and from scenario 4 ($t(316) = 9.98$, $p < .001$). The mean acceptability of killing a big cat in scenario 2 was also statistically different from scenario 3 ($t(310) = 5.96$, $p < .001$) and from scenario 4 ($t(313) = 10.07$, $p < .001$). Scenario 3 was also significantly different from scenario 4 ($t(308) = 5.14$, $p < .001$).

Fig. 2 Mean acceptance ratings and Potential for Conflict Index₂ (PCI₂) values for overall acceptability of killing a big cat across four scenarios of people–big cat interactions. Different superscript letters (^a, ^b, ^c) above the PCI₂ values represent significant (*d*) difference in consensus ($p < .05$). Different superscript numbers (¹, ², ³) above the PCI₂ values represent significant differences between means ($p < .05$)

The level of consensus was also generally high. PCI₂ values ranged from .10 to .27 (Fig. 2), and were significantly different across some of the scenarios, partially supporting hypothesis 3. As the severity of the interaction between people and the big cats increased, the level of consensus decreased (i.e., PCI₂ values were larger). The level of consensus in scenario 1 did not differ significantly from scenario 2, but the PCI₂ for scenario 1 differed from scenarios 3 and 4. In scenario 2, the level of consensus was significantly different only from 4. In scenario 3, the PCI₂ did not differ from scenario 2 and 4, but PCI₂ did differ from scenario 1.

Acceptability of killing a big cat by attitudes within scenarios

On average, the public held a slightly positive attitude toward the big cats ($M = .51$, $SD \pm .80$). While 64% did not consider that big cats were nuisance animals in the region (strongly disagreed and disagreed), 25% were neutral, and 11% considered them a nuisance. Although 41% did not see big cats as threats to people in the region, 30% thought that they posed a threat to people; 29% were neutral. Sixty-two percent liked the big cats, while 18% were neutral and 19% disliked the big cats. The Cronbach's alpha for the 6-item scale was .80 and suggested that items could be combined into a single index (Vaske 2008).

Killing big cats was on average unacceptable. People that held negative attitudes, however, were more accepting of killing a big cat in all scenarios than those with neutral

or positive attitudes (Table 1). While individuals that held negative attitudes disagreed ($M = -.86$, $SD \pm .92$) in killing a big cat if they saw the tracks of these predators (scenario 1), they were neutral ($M = -.09$, $SD \pm 1.27$) when asked if they should be allowed to kill a big cat if their domestic animals were attacked (scenario 4). Mean responses regarding the acceptability of killing big cats from people with negative attitudes differed significantly from people with neutral or positive attitudes within all scenarios, supporting hypothesis 2 ($p < .05$; Table 1). People with neutral or positive attitudes did not differ statistically in their evaluations for any of the four scenarios. On average, killing big cats was unacceptable for people that were neutral or held positive attitudes in all scenarios. The effect sizes (η) were typical (see Vaske 2008) for all scenarios, range .21–.24 (Table 1).

Irrespective of attitude type, residents demonstrated a high consensus level on their disagreement of killing big cats in scenario 1 (PCI₂ range .09–.11) and scenario 2 (PCI₂ range .09–.19). Killing a big cat in scenarios 3 and 4, however, generated less consensus among individuals with different attitude types. In scenario 3, people with positive attitudes were more likely to agree (PCI₂ = .18) that killing big cats was unacceptable, than people that held negative attitudes (PCI₂ = .31). A similar pattern was observed in scenario 4 with people expressing lower levels of consensus within attitudinal groups (PCI₂ range .22–.33) on the acceptability of killing big cats. There was no difference in consensus (PCI₂ values) between individuals that held positive, neutral, and negative attitudes within scenarios 1, 2, and 4 ($p > .05$; Fig. 3).

Table 1 One-way analysis of variance comparisons between people with negative, neutral, and positive attitudes for four scenarios on people–big cat interactions

Scenarios	Attitudes (M) ¹			F -value	p value	Eta (η)
	Negative	Neutral	Positive			
Scenario 1: see the tracks of a big cat close to my home.	−.86 ^a	−1.16 ^b	−1.35 ^b	7.29	.001	.21
Scenario 2: see the big cat close to my home.	−.71 ^a	−1.24 ^b	−1.33 ^b	.03	<.001	.24
Scenario 3: have a domestic animal (pet and/or livestock) killed by a big cat; killer of cat not specified.	−.39 ^a	−1.08 ^b	−1.05 ^b	8.60	<.001	.23
Scenario 4: have a domestic animal (pet and/or livestock) killed by a big cat; I should be allowed to kill the cat.	−.09 ^a	−.55 ^b	−.75 ^b	7.32	.001	.21

Cell entries are means. Mean with different superscripts differ statistically at $p < .05$ based on the Bonferroni post hoc test (scenarios 1 and 4) or Tamhane post hoc test (scenarios 2 and 3)

Fig. 3 Mean acceptance ratings and Potential for Conflict Index₂ (PCI₂) values for acceptability of killing a big cat by attitudes in four scenarios of people–big cat interactions. Different superscript letters (^a, ^b, ^c) above the PCI₂ values represent significant (d) difference in consensus ($p < .05$)

DISCUSSION

Killing big cats was, on average, unacceptable. As the severity of the interaction increased (i.e., from seeing the tracks of a big cat to having a domestic animal killed), acceptability of killing a big cat increased, and consensus decreased. When people were segmented into subgroups based on their attitudes, individuals with negative attitudes were more accepting of killing big cats in all scenarios. Future information on the drivers of negative attitudes can help managers predict and avoid negative behavior against the big cats.

On average, residents adjacent to PETAR and Intervales State Parks held slightly positive attitudes toward jaguars and pumas. The majority liked the big cats and did not view them as a nuisance. While attacks on humans are rare, jaguars and pumas are commonly seen as threats (e.g., Santos et al. 2008; Soto-Shoender and Main, 2013). Fear of big cats negatively influenced attitudes toward these predators (Engel et al. 2016). Such negative attitudes toward jaguars and pumas were based on perceived risks, not actual risks (Conforti and Azevedo 2003).

Previous research has shown that 54% of residents from two communities adjacent to the parks supported the

elimination of jaguars to solve the problem of livestock depredation (Palmeira and Barella 2007). Our results indicated that the overall public acceptability of killing big cats might be decreasing in the region. Palmeira and Barella (2007), however, investigated the support of killing jaguars and pumas from 27 individuals previously involved in conflict with these predators (livestock depredation). This article included 326 individuals irrespective of their past experience with livestock depredation. Experience with livestock depredation, however, may not predict individuals' acceptance of killing (Conforti and Azevedo 2003), but rather the individuals' negative attitudes and fear toward the species (Altrichter et al. 2006; Jedrzejewski et al. 2011). However, when people value the existence of the wildlife species for future generations, fear may not predict acceptability of killing a big cat (Porfirio et al. 2016).

Seeing the tracks of a big cat (scenario 1), or seeing a big cat close to residences (scenario 2), were not an issue for the respondents, not even for people with negative attitudes. Previous research highlights the sensitivity and complexity of this issue. For example, in some places a puma would not be killed for being close to residential areas (i.e., Manfredo et al. 1998; Thornton and Quinn 2010), while in other places the animal would be killed simply because their tracks have been seen in the forest (Altrichter et al. 2006), or inside the farm boundary (Jedrzejewski et al. 2011), or because people want to avoid future attacks on livestock (Zimmermann et al. 2005). The fact that killing big cats was unacceptable in scenarios 1 and 2 suggests a level of tolerance between people and big cats in the region (see Frank et al. 2015 for discussion of tolerance). This tolerance may be attributable to the positive existence values associated to the species (Engel et al. 2016), and the low levels of encounters. Such evidence is important when considering the implementation of ecological corridors (see Rabinowitz and Zeller 2010).

Recent research has shown that pumas may be dispersing out of their natural habitats into agricultural landscapes (e.g., sugarcane plantations) (Miotto et al. 2010). The growing number of sightings of pumas outside their natural habitat may be explained by human encroachment into natural habitat. As the number of big cats outside protected area boundaries and preserved habitats increases, encounters between people and predators increase. Recognizing situational differences allows managers to anticipate potential people–big cat conflicts and avoid illegal killing.

A significant difference in the mean responses on the overall acceptability of killing big cats was detected between scenario 3 (having a domestic animal attacked) and scenario 4 (having a domestic animal attacked, the respondent could kill the big cat). Given that the severity of the interaction was the same for both scenarios, this finding

suggests that the difference may be the result of the individual control over the kill as in scenario 4. Further research should explore the influence of perceived control on the overall acceptability of killing across the different scenarios. With control over the event, people may be more accepting of killing a big cat in all scenarios, and more likely to perform the behavior. As theorized in the Theory of Planned Behavior (Ajzen 2002), control beliefs give rise to perceived behavioral control, which in combination with other factors (i.e., attitude toward the behavior, subjective norm), leads to the formulation of the intention to perform the behavior (Ajzen 2002). In the Amazon, for example, landowners with a greater sense of control were more likely to intend to kill jaguars (Marchini and Macdonald 2012).

The mean acceptance of killing big cats was not significantly different between individuals with neutral and positive attitudes, but these two segments differed from those with negative attitudes within all scenarios. The PCI₂ facilitated understanding of the similarities and differences in these attitudinal segments. Hunting is a sensitive topic. Less consensus was observed on the more severe scenarios, which reflected the ambiguity that this topic generates. Consensus among attitudinal segments within each scenario showed no difference, except for scenario 3, where individuals with negative attitudes differed from individuals with positive attitudes. Less consensus was found among people with negative attitudes. Thus, suggesting that even though some people may hold negative attitudes toward a species, they do not necessarily support and/or engage in any behavior that threatens conservation, such as killing (i.e., Liu et al. 2011; Bruskotter and Wilson 2014).

This article represents the first attempt to understand acceptability of killing big cats in the Brazilian Atlantic Forest that applies the PCI₂. We recommend further exploration of acceptability of killing in different scenarios, and within and between other social groups. For example, between landowners whose main source of income is livestock and people with alternative source of income. Finally, we recommend expanding this analysis to other areas of the PEC region, for example, to areas adjacent to Carlos Botelho State Park.

CONCLUSION

The PCI₂ has been used to measure conflict between groups in a variety of contexts. For example, to measure differences in normative tolerance within and between scuba drivers and snorkelers (Vaske et al. 2013), to assess people's acceptability of regulatory policies in private forests (Poudyal et al. 2015), to measure users' opinions toward wild boar management approaches (Frank et al. 2015),

attitudes among livestock breeders toward livestock predation by pumas (Palmeira et al. 2015), and attitudes toward implementation of management actions to reduce fear of brown bears and wolves (Frank et al. 2014). The use of PCI₂ provided a better understanding of both the mean responses and the level of consensus in each sample (Sponarski et al. 2015). PCI₂'s graphic approach allows managers to: (a) determine the similarities and differences among interest groups, (b) enhance communication interventions, and (c) discuss the acceptability of management actions among interest groups (i.e., compensation schemes for livestock losses, alternative sources of income, relocate the predator).

Strategies to mitigate human–big cat conflict have been proposed by the National Action Plan for the conservation of jaguars and pumas (e.g., reintroduction, command and control to decrease hunting pressure on jaguars and on their prey, husbandry improvement, establishment of new protected areas) (Desbiez et al. 2013). The PCI₂ could be used to investigate public's acceptability of these management actions, helping managers to identify potential conflicts among interest groups.

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REFERENCES

- Ajzen, I. 2002. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology* 32: 665–683.
- Altrichter, M., G. Boaglio, and P. Perovic. 2006. The decline of jaguars *Panthera onca* in the Argentine Chaco. *Oryx* 40: 302–309.
- Bruskotter, J.T., J.J. Vaske, and R.H. Schmidt. 2009. Social and cognitive correlates of Utah residents' acceptance of the lethal control of wolves. *Human Dimensions of Wildlife* 14: 119–132.
- Bruskotter, J.T., and R.S. Wilson. 2014. Determining where the wild things will be: Using psychological theory to find tolerance for large carnivores. *Conservation Letters* 7: 158–165.
- Carvalho Jr., E.A.R., and J.C.B. Pezzuti. 2010. Hunting of jaguars and pumas in the Tapajos-Arapiuns Extractive Reserve, Brazilian Amazonia. *Oryx* 44: 610–612.
- Carvalho Jr., E.A.R., and R.G. Morato. 2013. Factors affecting big cat hunting in Brazilian protected areas. *Tropical Conservation Science* 6: 303–310.
- Cella, E.M., E.C.M. Parsons, and L.L. Rockwood. 2016. Non-governmental organizations and governmental agencies lead in cultivating sea turtle conservation attitudes. *Human Dimensions of Wildlife* 21: 391–402.
- Conforti, V.A., and F.C.C. Azevedo. 2003. Local perceptions of jaguars (*Panthera onca*) and pumas (*Puma concolor*) in the Iguazu National Park area, south Brazil. *Biological Conservation* 111: 215–221.
- Costa, L.P., Y.L.R. Leite, S.L. Mendes, and A.D. Ditchfield. 2005. Mammal conservation in Brazil. *Conservation Biology* 19: 672–679.
- Cronbach, L.J., and R.J. Schavelson. 2003. My current thoughts on coefficient alpha and successor procedures. *Education and Psychological Measurements* 64: 391–418.
- Dickman, A., S. Marchini, and M.J. Manfredo. 2013. The human dimensions in addressing conflict with large carnivores. In *Key topics in conservation biology*, 2nd ed, ed. D.W. Macdonald, and K.J. Willis, 110–126. West Sussex: Wiley.
- Desbiez, A., R.C. Paula, and S. Cavalcanti. 2013. *Action Plan for jaguar conservation in Brazil: Population viability analyses and environmental adequability*. *Endangered species series*. Brasília: ICMBio. (in Portuguese).
- Engel, M.T., J.J. Vaske, A.J. Bath, and S. Marchini. 2016. Predicting acceptability of jaguars and pumas in the Atlantic Forest, Brazil. *Human Dimensions of Wildlife* 21: 427–444.
- Frank, B., A. Monaco, and A.J. Bath. 2015. Beyond standard wildlife management: a pathway to encompass human dimension findings in wild boar management. *European Journal of Wildlife Research* 61: 723–730.
- Frank, J., M. Johansson, and A. Flykt. 2014. Public attitude towards the implementation of management actions aimed at reducing human fear of brown bears and wolves. *Wildlife Biology* 21: 122–130.
- Hiller, T.L., J.E. McFadden-Hiller, S.R. Jenkins, J.L. Belant, and A.J. Tyre. 2015. Demography, prey abundance, and management affect number of cougar mortalities associated with livestock conflicts. *The Journal of Wildlife Management* 79: 978–988.
- IUCN. 2008. *Panthera onca*. The IUCN Red List of Threatened Species v. 2015.1. www.iucnredlist.org. Accessed 06 June 2015.
- Jacobs, M.H., J.J. Vaske, and S. Dubois. 2014. More than fear: Role of emotions in acceptability of lethal control of wolves. *European Journal of Wildlife Research* 60: 589–598.
- Jedrzejewski, W., M. Abarca, A. Viloria, H. Cerda, D. Lew, H. Takiff, E. Abadia, P. Velozo, et al. 2011. Jaguar conservation in Venezuela against the backdrop of current knowledge on its biology and evolution. *Interciencia* 36: 954–966.
- Krymkowski, D.H., R.E. Manning, and W.A. Valliere. 2009. Norm crystallization: Measurement and comparative analysis. *Leisure Sciences* 31: 403–416.
- Liu, F., W.J. McShea, D.L. Garshelis, X. Zhu, D. Wang, and L. Shao. 2011. Human-wildlife conflicts influence attitudes but not necessarily behaviours: factors driving the poaching of bears in China. *Biological Conservation* 144: 538–547.
- Loveridge, A.J., S.W. Wang, L.G. Frank, and J. Seidensticker. 2010. People and wild felids: Conservation of cats and management of conflicts. In *Biology and conservation of wild felids*, ed. D.W. Macdonald, and A.J. Loveridge, 161–196. Oxford: Oxford University Press.
- Machado, A.B.M., G.M. Drummond, and A.P. Paglia. 2008. *Red book of the endangered Brazilian fauna*. Brasília: MMA/Fundação Biodiversitas (in Portuguese).
- Manfredo, M.J., H.C. Zinn, L. Sikorowski, and J. Jones. 1998. Public acceptance of mountain lion management: A case study of Denver, Colorado, and nearby foothills areas. *Wildlife Society Bulletin* 26: 964–970.
- Manfredo, M.J., T.L. Teel, and A.D. Bright. 2004. Application of the concepts of values and attitudes in human dimensions of natural resources research. In *Society and natural resources: A summary of knowledge*, ed. M.J. Manfredo, J.J. Vaske, B.L. Bruyere, D.R. Field, and P.J. Brown, 271–282. Jefferson: Modern Litho.
- Manfredo, M.J. 2008. *Who cares about wildlife? Social science concepts for exploring human-wildlife relationships and conservation issues*. New York: Springer.

- Manning, R.E. 2011. *Studies in outdoor recreation: Search and research for satisfaction*. Corvallis: Oregon State University Press.
- Marchini, S., and D.W. Macdonald. 2012. Predicting ranchers' intention to kill jaguars: Case studies in Amazonia and Pantanal. *Biological Conservation* 147: 213–221.
- Matoso, A.Q., K. Pisciotto, M.I.A. de Barros, J.L.C. Maia, and S.F. Lorejan. 2008. Carlos Botelho management Plan, Sao Paulo.
- Miotto, R.A., M. Cervini, R.A. Begotti, and P.M. Galetti Jr. 2010. Monitoring a puma (*Puma concolor*) population in a fragmented landscape in Southeast Brazil. *Biotropica* 44: 98–104.
- Palmeira, F.B.L., and W. Barella. 2007. Conflicts caused by domestic animals attacked by large felids in quilombolas communities in the Atlantic Forest. *Biota Neotropica* 7: 120–128. (in Portuguese, English summary).
- Palmeira, F.B.L., C.T. Trinca, and C.M. Haddadd. 2015. Livestock predation by Puma (*Puma concolor*) in the highlands of a southeastern Brazilian Atlantic Forest. *Environmental Management* 56: 903–915.
- Paviolo, A., C. de Angelo, K.M.P.M.B. Ferraz, R.G. Morato, J.M. Pardo, A.C. Srbek-Araujo, B.M. Beisiegel, F. Lima, et al. 2016. A biodiversity hotspot losing its top predator: The challenge of jaguar conservation in the Atlantic Forest of South America. *Science* 6: 3714.
- Porfiro, G., P. Sarmiento, S. Leal, and C. Fonseca. 2016. How is the jaguar *Panthera onca* perceived by local communities along the Paraguai river in the Brazilian Pantanal? *Oryx* 50: 163–168.
- Poudyal, N.C., R.L. Moore, and T.M. Young. 2015. Public attitudes toward regulatory and incentive approaches to private forests: An assessment and comparison of resident Segments in Georgia, USA. *Forestry Science* 61: 1088–1096.
- Rabinowitz, A., and K. Zeller. 2010. A range-wide model of landscape connectivity and conservation for the jaguar, *Panthera onca*. *Biological Conservation* 143: 939–945.
- Ribeiro, M.C., J.P. Metzger, A.C. Martensen, F.J. Ponzoni, and M.M. Hirota. 2009. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. *Biological Conservation* 142: 1141–1153.
- Robinson, H.S., R. Desimone, C. Hartway, J.A. Gude, M.J. Thompson, M.S. Mitchell, and M. Hebblewhite. 2014. A test of the compensatory mortality hypotheses in mountain lions: A management experiment in West-Central Montana. *The Journal of Wildlife Management* 78: 791–807.
- Sanderson, E.W., K.H. Redford, C.L.B. Chetkiewicz, R.A. Medellin, A.R. Rabinowitz, J.G. Robinson, and A.A. Taber. 2002. Planning to save a species: The Jaguars as a model. *Conservation Biology* 16: 58–72.
- Santos, F.R., A.T.A. Jácomo, and L. Silveira. 2008. Humans and jaguars in five Brazilian biomes: Same country, different perceptions. *CAT News* 4: 21–25.
- Soto-Shoender, J.R., and M.B. Main. 2013. Differences in stakeholder perceptions of the jaguars (*Panthera onca*), and puma (*Puma concolor*) in the tropical lowlands of Guatemala. *Oryx* 47: 109–112.
- Sponarski, C.C., J.J. Vaske, and A.J. Bath. 2015. Differences in management action acceptability for coyotes in a National Park. *Wildlife Society Bulletin* 9999: 1–9.
- Thornton, C., and M.S. Quinn. 2010. Risk perceptions and attitudes toward Cougars in the Southern Foothills of Alberta. *Human Dimensions of Wildlife* 15: 359–372.
- Vaske, J.J. 2008. *Survey research and analysis: Applications in parks, recreation and human dimensions*. State College: Venture Publishing.
- Vaske, J.J., J. Beaman, H. Barreto, and L.B. Shelby. 2010. An extension and further validation of the Potential for Conflict Index. *Leisure Sciences* 32: 240–254.
- Vaske, J.J., and M.J. Manfredi. 2012. Social psychological considerations in wildlife management. In *Human dimension of wildlife management*, ed. D.J. Decker, S.J. Riley, and W.F. Siemer, 43–57. Baltimore: The Johns Hopkins University Press.
- Vaske, J.J., L.M. Heesemann, D.K. Loomis, and S.C. Cottrell. 2013. Measuring variability in encounter norms among scuba divers and snorkelers: An application of the Potential for Conflict Index₂. *Tourism in Marine Environments* 9: 69–80.
- Woodroffe, R., and J.R. Ginsberg. 1998. Edge effects and the extinction of populations inside protected areas. *Science* 280: 2126–2128.
- Zeller, K. 2007. *Jaguars in the new millennium data set update: The state of the jaguar in 2006*. USA: Wildlife Conservation Society.
- Zimmermann, A., M.J. Walpole, and N. Leader-Williams. 2005. Cattle ranchers' attitudes to conflicts with jaguar (*Panthera onca*) in the Pantanal of Brazil. *Oryx* 39: 406–412.

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