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## Attention matters: A preliminary assessment of ranchers' attitudes towards big cats in Costa Rica<sup>☆</sup>

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### ABSTRACT

Good conservation strategies that include direct attention towards the affected people can promote positive attitudes to wildlife and its conservation. We assessed how the attention from wildlife authorities and non-profit institutions affects ranchers' attitudes towards jaguars and pumas in Northern Costa Rica. Our sample was divided into ranchers with livestock predation issues who received institutional attention, ranchers with predation issues who did not receive any attention, and ranchers without livestock predation incidents. The attention received was self-reported by the respondents. We applied a 10-item Likert scaled test used previously to assess attitudes toward big felids in South Africa. We looked for spatial patterns of segregation of attitudes to determine areas that need special attention. Ranchers who receive no institutional attention had the most negative attitude score,  $-1.77$  (IC 95%:  $-4.19 - 0.64$ ). Ranchers with a positive attitude were geographically closer to each other than to the other ranchers ( $S = 0.32$ ). Although preliminary, our findings suggest that institutional attention can be positively related to attitudes held by ranchers toward big cats.

### 1. Introduction

Human coexistence with carnivores can be challenging when there is competition for food (Ripple et al., 2014). This challenge is increasing worldwide due to changes in land use, increasing livestock population and declining populations of natural prey (Distefano, 2005). Various measures have tried to mitigate human-predator conflict, such as direct interventions (lethal removal or translocation of animals) or community interventions like education, ecotourism or local management (Holland et al., 2018). Evaluations of these measures, however, are scarce. The assessment of attitudes, defined as learned predispositions to respond in a consistently favorable or unfavorable manner towards a given object

(Ajzen and Fishbein, 1975), can help to evaluate the efficacy of interventions aimed at reducing conflicts and guide adjustments to improve them (Thorn et al., 2012).

In Northern Costa Rica, where livestock predation by jaguars (*Panthera onca*) and pumas (*Puma concolor*) is an issue, some ranchers receive assistance from wildlife authorities and non-profit institutions such as technical assistance and workshops about preventive measures, but little is known about how these interventions affect attitude towards big cats. In addition, the spatial distribution of such attitudes can inform managers about where to focus their interventions to mitigate livestock predation by carnivores (Carter et al., 2014; Teixeira et al., 2020). We assessed how institutional attention, being technical assistance of

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different types, from wildlife authorities and non-profit institutions affects ranchers' attitudes towards jaguars and pumas, as well as the attitudinal spatial patterns in Northern Costa Rica.

## 2. Methods

### 2.1. Study area

The study area comprises Chorotega and Huetar Norte regions in Northern Costa Rica, an area of great importance for cattle production (Madrigal and Fallas, 2013) and where numerous initiatives of conservation of big cats that address conflict have taken place (Zeller et al., 2013). It is a place of high genetic diversity of jaguars, and it is also important to maintain gene flow throughout the distribution of this species (Wultsch et al., 2016). The often inadequate cattle management in conjunction with landscape features, topography and the presence of protected areas, make losses due to predation a continuous issue in the area (Amit et al., 2013). There are eight protected areas within the regions of study: 1) Wildlife Refuge Caño Negro, 2) Private Reserve Duaru, 3) Miravalles National Park, 4) Volcán Tenorio National Park, 5) Santa Rosa National Park, 6) Rincón de la Vieja National Park, 7) Horizontes Biological Station, 8) Wildlife Refuge Silvestre Maquenque (SINAC, 2021). All together these areas protect a 1711.84 km<sup>2</sup> of diverse ecosystems such as tropical dry forest, tropical moist forest, premontane wet forest and premontane rain forest (Tosi, 1969).

### 2.2. Data collection and analysis

We used a layer of the ranchers in the study area in 2012, provided by the National Service of Animal Health (SENASA). From this layer, we selected the ranches with potential livestock predation vulnerability according to the following criteria: proximity to natural protected areas (8 km buffer zone), presence of streams in the ranch, and vegetation cover (i.e. secondary and old-growth forest) that facilitates felid movements (Boulhosa and Azevedo, 2014; Miller et al., 2015; Rabinowitz and Zeller, 2010). From 1354 ranches with potential vulnerability, we selected a random sample of 90 ranchers, plus 16 ranchers with institutional attention were selected non-randomly.

Our survey instrument to assess attitudes towards big felids was a questionnaire based on the items used to determine attitudes towards carnivores in South Africa (Thorn et al., 2012). The questionnaire included items about coexistence with jaguars and pumas, perceived importance of felids, opinion about authorities, attack prevention and opinion about elimination of felids (Appendix 1). The items were answered using a five-point Likert scale (e.g. completely disagree to completely agree); thus, forming a continuum that characterizes the attitude from very negative to very positive. The responses were used to calculate a final attitude score for each respondent. As attitude is a latent variable, to validate its use in the linear model, we conducted a confirmatory factor analysis with Lavaan package from R (R Core Team, 2022; Rosseel, 2012). The reliability test was Cronbach's  $\alpha$ . An alpha ranging from 0.65 to 0.80 can be considered adequate for a scale used in human dimensions research (Vaske et al., 2017). Furthermore, the attitude score distribution was assessed through the Shapiro-Wilk test.

We asked the respondents whether they had received institutional attention, and a brief description of it. The institutions working in the area at that moment were Gente y Fauna, Las Pumas (both Civil Associations); Proyecto Jaguar (Academic research group), and UACfel (Government institution). We did not include the institution identity in our analyses. We divided the respondents into three groups: a) no attention; No institutional attention was received after predation incident, b) with attention: Institutional attention was present, either as a simple response (only interviews or oral advice) or as a complete response from institution (technical assistance process, workshops about preventive measures), c) without predation events in their ranches. To assess the effect of the level of institutional attention given we used a

**Table 1**

Percentage of respondents per item in the questionnaire about attitudes towards felids in Costa Rica.

Item	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Big cats and livestock can coexist without conflict	3.8	27.4	2.8	54.7	11.3
Big cats are dangerous to people	20.8	42.5	3.8	28.3	4.7
It would be fine if big cats disappeared completely	3.8	14.2	5.7	50.9	25.5
Felid attacks to livestock can be prevented	14.2	58.5	2.8	21.7	2.8
Authorities are helping to solve the conflict with big cats	1.9	17.0	16.0	50.0	15.1
Big cats should only exist inside the natural reserves	18.9	54.7	1.9	22.6	1.9
Big cats are important for the forest	32.1	58.5	5.7	3.8	0.0
Big cats cause economic losses	20.8	45.3	4.7	26.4	2.8
Killing felids is simpler than applying preventive measures	3.8	32.1	7.5	50.0	6.6
If livestock losses are few, they can be tolerated	7.5	69.8	3.8	15.1	3.8

generalized linear model with attention as independent variable and attitude towards felids score as response.

We calculated the spatial pattern of attitudes through the measure of segregation (Dixon, 2002) using ecespa package (De la Cruz, 2008) for R language (R Core Team, 2022). We tested spatial segregation for several attitudes by analyzing the counts of the nearest neighbor contingency table for a marked point pattern (Dixon, 2002).

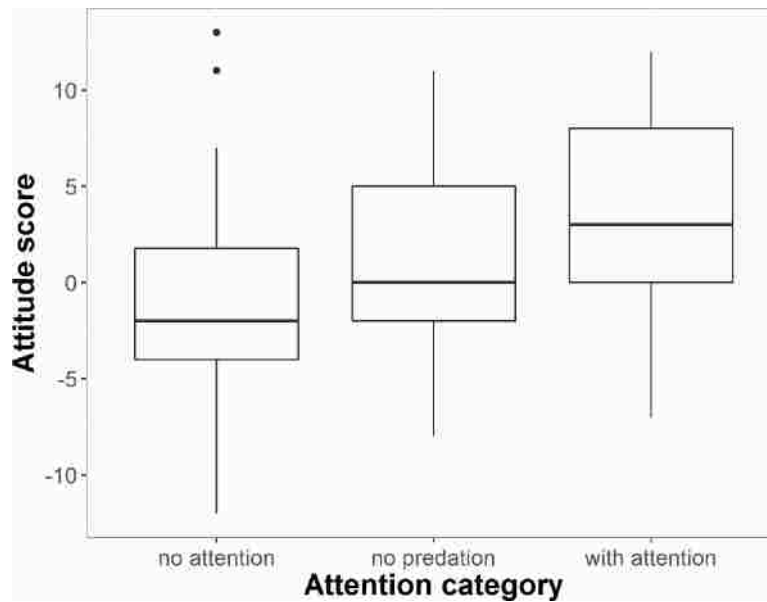
## 3. Results

### 3.1. Scale reliability and validity

The Standardized Root Mean Square Residual (SRMR) of the confirmatory factor analysis for the psychometric test was 0.75. This enabled us to use the attitude score in our models. The Cronbach's  $\alpha$  of the test was 0.72. The possible scores of attitudes could go from -20 (extremely negative attitude) to 20 (extremely positive attitude). The data distribution was normal ( $W = 0.98$ ,  $p$ -value = 0.12).

### 3.2. Attitudes towards big cats

From 106 respondents, there were 71 (67%) ranchers with livestock predation events and 35 (33%) without livestock predation. From the 71 ranchers with livestock predation, 37 (35%) had no institutional attention, and 34 (32%) did, being oral advice or technical support. The average score for attitude towards felids was 0.75 (close to neutral), ranging from -12 (negative) to 13 (positive). The 46.2% (49) of respondents had a positive attitude score, 42.5% (45) had a negative score, and 11.3% (12) had a neutral score. Most respondents said that big cats were dangerous to people (63.3%, 67 in total) and that they should exist only within reserves (Table 1). However, 90.6% (96) of respondents answered that big cats were important to the forest, where 32.1% (34)

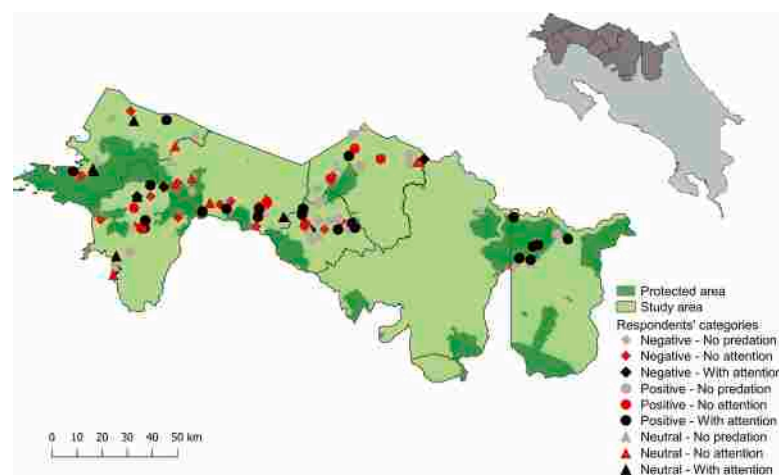


**Fig. 1.** Box plot of the scores of attitudes per group of ranchers: a) No predation: no predation incidents on the ranch, b) No attention: Predation incidents occurred, there was no attention from any institution, c) Predation incidents occurred, there was attention given (e.g. oral advice or workshops).

**Table 2**

Nearest-neighbor count and related statistics for negative, positive, and neutral attitudes toward big cats in Northern Costa Rica. “From” is the label of the point and “To” is the label of the nearest neighbor. S is the segregation index. Z is the z-score for testing whether the observed count equals the expected count. We used 5000 simulations for the randomization approximation of the p-values.

From	To	Observed count	Expected count	S	Z	p-value Normal	Random
Negative	Negative	8	12	-0.24	-1.2	0.22	0.18
Negative	Positive	14	13.71	0.01	0.1	0.92	0.87
Negative	Neutral	14	10.29	0.20	1.4	0.17	0.15
Positive	Negative	10	13.71	-0.19	-1.2	0.22	0.20
Positive	Positive	22	14.86	0.32	2.1	0.04	0.05
Positive	Neutral	8	11.43	-0.20	-1.2	0.23	0.22
Neutral	Negative	11	10.29	0.05	0.3	0.79	0.72
Neutral	Positive	10	11.43	-0.09	-0.5	0.60	0.60
Neutral	Neutral	9	8.29	0.05	0.3	0.80	0.72



**Fig. 2.** Spatial distribution of attitude and attention categories in Northern Costa Rica.

**Table 3**

Results of  $\chi^2$  tests for attitude toward big cats in Northern Costa Rica. P. asymptotic is the p-value from the asymptotic  $\chi^2$  distribution with the appropriate degrees of freedom for each test.

Test	df	$\chi^2$	P. asymptotic	P. random
Overall segregation	6	6.87	0.33	0.34
Negative	2	2.24	0.33	0.3373
Positive	2	4.22	0.12	0.1265
Neutral	2	0.28	0.87	0.8816

strongly agreed, and 58.5% (62) agreed.

### 3.3. Institutional attention and attitudes

When comparing attitude towards felids by the attention in the linear model, the group without predation incidents was used as intercept, where the average score of the psychometric test was 0.5 (CI 95%: -1.11 - 2.29) points. The group without institutional attention had the most negative attitude score, being on average -1.77 (CI 95%: -6.2 - 0.4) points below the group without predation incidents (Fig. 1). On the other hand, the group with institutional attention had the highest attitude score, being, on average 2.92 (CI 95%: 0.3 - 5.5) points above the group of ranchers without predation incidents.

### 3.4. Spatial segregation of attitudes

A total of 39 (36.8%) individuals had a negative attitude toward felids, 26 (24.5%) had neutral attitude, and 41 (38.7%) had positive attitude. The observed number of nearest neighbors with positive attitudes exceeds the expected (Table 2). In contrast, the observed neighbors with negative attitude are below the expected. The segregation indices are positive for most of the combinations (Table 2). The highest value of segregation is 0.32, from positive attitude neighbors. The spatial distribution of attitudes is homogeneous (Fig. 2). Attitude categories are not segregated. However, the number of respondents with positive attitude as nearest neighbors exceeds the number expected under random labelling (Table 3).

## 4. Discussion

Social interventions should always be accompanied by an evaluation of outcomes. Evaluations could reveal optimal solutions as well as help identifying what is taking us closer to our conservation goals (Cavalier et al., 2021). Besides, interventions could have negative or no effects at all, and this has to be acknowledged in order to redefine conservation efforts (Titus and Jachowski, 2021). Attitudes could be used to assess the outcomes of interventions as they are important indicators of willingness to coexist with wildlife. However, some other important behavior determinants of behavior are values and norms (Knox et al., 2019; Straka et al., 2016), which should be considered when trying to prevent or diminish carnivore killing. Future research should also focus on including more of these variables to improve evaluations on interventions.

Regarding attitude scores, we found a practically even distribution in our sample of respondents with negative or positive scores. Negative attitude scores were associated with fear, which can be common in spite of the lack of actual attacks on people (Knox et al., 2019; Teixeira et al., 2020). On the other hand, positive attitudes were associated with the role carnivores have in the forest, thus future interventions could highlight the benefits that these species bring (Ardiantiono et al., 2021; Expósito-Granados et al., 2019).

### 4.1. Institutional attention and attitudes

Attitudes towards felids were more positive among the ranchers who

received attention from wildlife authorities and non-profit institutions than the attitudes of ranchers who did not receive attention. Conversely, the group of ranchers who did not receive institutional attention was the most negative towards felids (lowest attitude score). However, the presence or absence of institutional attention was not empirically verified and is as reported by ranchers. The reflected negative attitudes could have existed prior the predation incidents. In any case, a proper evaluation of each intervention taken should be a goal in order to keep track on any outcomes and involve the local population (Cavalier et al., 2021). Previous research demonstrates the positive role of social trust in wildlife management agencies in determining tolerance to predators (Bruskotter and Wilson, 2014).

### 4.2. Spatial segregation of attitudes

Attitudes toward wildlife are seldom uniform across space because factors affecting attitudes, such as interactions with wildlife, are spatially heterogeneous (Carter et al., 2014). There is an equivalent mixture between negative and positive attitudes in the area. This could be due to our broad scale. Literal neighbors could share the same attitudes toward felids, and it may be important to sample attitudes at a local scale. Furthermore, the attention from institutions is not provided to everybody in the area. Given that interventions are focused on communities or small areas, our random sampling is showing the broad scale picture. Understanding the spatial distribution of attitudes at a smaller scale could also help to monitor the outcomes of interventions. This kind of result would be favorable if the positive values around the species and the people with a positive attitude are included in the interventions to reach those persons with negative attitudes (Inskip et al., 2016).

In sum, although preliminary, our findings suggest that institutional attention itself - regardless of the specific interventions conducted by the institution - can have a positive effect on ranchers' attitudes towards jaguars and pumas in Costa Rica. As previously found for other areas, our results corroborate the - sometimes underestimated - importance of institutions in shaping human-wildlife relationships.

## Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Margarita Gil-Fernandez reports financial support was provided by US Fish and Wildlife Service. Margarita Gil-Fernandez reports financial support was provided by Idea Wild. Eduardo Carrillo reports financial support was provided by National University of Costa Rica.

## Data availability

Data will be made available on request.

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