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Local perceptions of jaguars (*Panthera onca*) and pumas (*Puma concolor*) in the Iguaçu National Park area, south Brazil

Valéria Amorim Conforti[a,b,1], Fernando Cesar Cascelli de Azevedo[a,c,*]

[a] *Associação Pró-Carnívoros, Brazil*
[b] *Animal and Veterinary Science Department, University of Idaho, Idaho, USA*
[c] *Fish and Wildlife Resources Department, University of Idaho, Idaho, USA*

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Abstract

Jaguars (*Panthera onca*) have been killed by local residents within the boundaries and lands surrounding Iguaçu National Park (INP), Brazil. Both jaguars and pumas (*Puma concolor*) occur in the region, however, livestock predation by pumas has rarely been reported. Our objective was to assess the local perceptions about jaguars and pumas. We identified two major factors that distinguished the perceptions towards the two species: less people feared the puma than the jaguar; and most people believed that jaguars, but not pumas, were released into INP by local authorities. Interestingly, despite those major differences in these perceptions, feelings towards the two species tended to be the same. Perceptions towards jaguars were not influenced by the predation history of the properties, suggesting that the predation impact was not remarkable enough to influence local perceptions towards carnivores. This is apparently the first study on local perceptions towards large carnivores in Brazil.

Keywords: Jaguars; Pumas; Local perceptions; Livestock predation

1. Introduction

The native forest in the state of Paraná in southern Brazil, which once covered almost the entire state, has been dramatically reduced to only about 6%, with 80% of such forest occurring within the boundaries of Iguaçu National Park (INP). The Park is surrounded by private lands, on which the main activities are crop farming and livestock ranching. Intense fragmentation of habitats in the region and the lack of a buffer zone between INP and the surrounding rural properties generate an "island-effect" that isolates the Park from other significant patches of forest. INP houses the last significant population of jaguars (*Panthera onca*) in south Brazil (Crawshaw, 1995), Paraná state. The puma (*Puma concolor*) is one of five other species of wild cats also known to occur in the INP (Crawshaw, 1995).

The close proximity of farmlands to INP has been one of the factors contributing to human–wildlife conflicts in the area. Wild carnivores, mainly jaguars, have been responsible for livestock losses in the region. Between 1995 and 1997, local residents reported that about 30 adult jaguars were killed illegally within the boundaries of the Park, mostly in retaliation for livestock predation (Azevedo and Conforti, 1999). Although rare, livestock predation by pumas also has been reported at INP (Azevedo and Conforti, 1999). Furthermore, the apparent local disappearance of the white-lipped peccary (*Tayassu pecari*), possibly due to overpoaching, coincides with a notable increase of predation on domestic animals in INP (Conforti and Azevedo, 1997). One could speculate that the decrease of the white-lipped peccary population might have affected the jaguars' diet in INP given that peccaries were found to be the most preferred prey taken by jaguars (Crawshaw, 1995).

Neotropical cats, mostly jaguars, have been reported to kill livestock in places where they occur in close contact (Schaller and Crawshaw, 1980; Rabinowitz, 1986; Mondolfi and Hoogesteijn, 1986). However, the attitudes of local people towards the predation problem are poorly understood. Human attitudes towards carnivores

* Corresponding author at: Fish, Wildlife Resources Department, College of Natural Resources, University of Idaho, Moscow, ID 83844-1136, USA. Tel.: +1-208-885-9440; fax: +1-208-885-9080.
E-mail addresses: conf3447@uidaho.edu (V.A. Conforti), azev3517@uidaho.edu (F. Cesar Cascelli de Azevedo).
[1] Present address: Holm Research Center, PO Box 442201, University of Idaho, Moscow, ID 83844-2201, USA.

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tend to be shaped by understanding and knowledge of a particular species, as well as by past and present interactions with that species (Kellert et al., 1996). Where large carnivores prey upon livestock, local people often hold negative attitudes, as reported for snow leopards (*Panthera uncia*) by Oli et al. (1994) and wolves (*Canis lupus*) by Lenihan (1996). To assess the perceptions towards large cats, surveys of local people have been used as tools to gather information about human-cat interactions (Oli et al., 1994). Such studies also have been used as a basis for long-term strategies for conserving large cats and their habitats (Nyhus et al., 1999).

Our objective was to assess local perceptions towards jaguars and pumas and to collect information on suggestions for solving the livestock predation problem. Due to reported livestock losses by wild carnivores at INP, we hypothesized that the rural population residing throughout the boundaries of INP held negative perceptions towards jaguars and pumas. We also predicted that this population was not aware of the ecological role of carnivores and held a negative attitude towards these species in the event of predation incidents.

2. Methods

2.1. Study area

Iguaçu National Park covers 185,262 ha of subtropical forest. It is located in the southwest of Paraná state, in the south of Brazil (25°05′S–25°41′S, 53°40′W–54°38′W) along the international boundary between Brazil and Argentina. Together, INP and Parque Nacional Iguazú, across the border, in Argentina, preserve a total of about 240,000 ha of subtropical forest separated by the Iguaçu River. The proximity to the Argentinean park reduces the "island-effect" in INP, since individuals of some species, including jaguars, can cross the river and use both Parks to establish their home ranges.

Adjacent to INP, livestock are raised in a rudimentary, extensive manner, with no protection against predators (Azevedo and Conforti, 1999). Most herdsmen leave their cattle in pastures that are separated from INP by fences or streams, which are not obstacles to either jaguars or pumas.

In 2000, the 14 towns surrounding INP had a total population of 672,847 inhabitants, with an average of 48,061 inhabitants (range 4126–258,543, $n = 14$). Among these towns, 12 have agriculture, livestock raising and forestry exploitation as the major portion of their economy. Subsistence economy is predominant with the main activity being crop farming while livestock ranching provided a complementary source of food (IBGE, 2000; MMA/IBAMA, 2001).

2.2. Interviews

Nine of the 14 towns that surround INP were selected for the survey based on their locations in order to have interview sites evenly distributed within the Park's boundary. We selected 75 households from a list of 150 properties located in the nine selected towns based on the number of years that residents were living within the boundaries of the Park. Only households with more than 5 years of residence were chosen. In three of the 75 selected households, the residents were absent when we visited the property. Therefore, we conducted 72 interviews. Only one person from each selected household was interviewed. All surveyed people were adults and livestock owners. We collected information on the size of the properties, amount of livestock holdings, history of livestock predation as well as sex and age of respondents. All interviews were conducted personally during April 1999 to August 2000.

To investigate if owners of small, medium, and large properties differed in their perceptions towards jaguars, we classified the respondents into three groups, according to the area of the property (small: <1 km^2; medium: 1–5 km^2; large: >5 km^2). In order to determine whether the amount of livestock holdings could have been an important factor shaping local peoples' opinion towards jaguars and pumas, independently of the size of the properties, we grouped the respondents according to the size of their livestock holdings (small: <50 animals; medium: 50–500 animals; large: >500 animals). We used the most commonly known names and photographs of the species to help people identify jaguars and pumas. Our questionnaire requested information on the perceptions of local people about jaguars, pumas and INP, as well as general aspects related to jaguars and the problem of livestock predation. The responses were recorded on a 3-point scale: 1 = like, 2 = neutral and 3 = dislike (Table 1).

2.3. Statistical analysis

Percentages for each response were calculated based only on those who answered the respective question. Results shown are percentages and 95% confidence intervals. Values are expressed as mean ± SEM. Perceptions towards jaguars and pumas were analyzed using Chi-square analysis. Fisher's exact test was used when comparison groups had less than five respondents. Statistical significance was measured at $P < 0.05$.

3. Results

Most respondents, 78.08% (CI: 64.63–87.58%), were European descendents (i.e. children, grandchildren, or great-grandchildren of European immigrants). Of the 72

Table 1
Questionnaire used in the survey on local residents near Iguaçu National Park, Brazil, 2000

1. Origin of the family: (Where did your parents, grandparents, and great-grandparents come from?)
( ) Brazil ( ) Italy ( ) Germany ( ) Poland ( ) Other

2. What is your educational level?
( ) Illiterate ( ) Primary school incomplete ( ) Primary school complete
( ) Secondary school incomplete ( ) Secondary school complete
( ) Undergraduate course incomplete ( ) Undergraduate course complete

3. Please, indicate your attitude toward the following:

	Like	Indifferent	Dislike	Do not know
Puma				
Jaguar				
Nature				

4. Have you ever experienced livestock loss due to predation in your property?

5. What is the origin of the jaguars living in this region?
( ) Native ( ) Brought from other places ( ) Some are native, some are brought ( ) Do not know
Comments:_____

6. Who was the responsible for the relocation/releasing of jaguars?

7. What was the objective of the relocation/releasing?

8. Where did you hear about the relocation/releasing?

9. What is the role of jaguars and pumas in the wild?
( ) To control prey population/ to keep the ecological balance
( ) To destroy, subdue or eat other animals
( ) Other: _____
( ) None
( ) Do not know

10. Do you think jaguars would attack humans without being provoked ?

11. Do you think pumas would attack humans without being provoked ?

12. Regarding the predation of livestock by jaguars and pumas, what would you suggest for solving the problem?
( ) Using preventive methods in the property (use predator proof-enclosures during night, use electric fences to surround pastures and/or enclosures, keep herds away from the forest, etc.).
( ) Killing the problem animal(s).
( ) Financial compensation for livestock losses by predators.
( ) Relocating the problem animal(s).
( ) Removing/eradicating all jaguars from INP.
( ) Restructuring the food chain (reintroduction of native species extinct locally).
( ) Other: _____
( ) Do not know

13. Would you be willing to change your husbandry practices in order to minimize predation on your livestock?
( ) Yes ( ) No

14. If so, would you pay for the management changes?
( ) Yes ( ) No
Comments:_____

households interviewed, 63 were men and 9 were women. The average age of the respondents was 45.86 ± 15.32 years (range: 23–76, $n = 72$). The average property size was 2.58 ± 3.87 km^2 (range: 0.03–15.31 km^2, $n = 61$). Eleven households did not report the size of their properties. Livestock holding averaged 278.30 ± 385.27 heads per property (range: 2–2,000, $n = 59$). Thirteen households did not provide the number of animals they owned. The educational level of the respondents was considered low given that only 19.18% (CI: 9.67–31.33%) had completed elementary school.

Prior to evaluating perceptions towards jaguars and pumas, all respondents were asked if they knew each species. Interestingly, all respondents knew the jaguar, while 44.44% (CI: 30.79–57.89%, $n = 32$) did not recognize the puma. Therefore, only the responses of those who recognized the puma were used in the analyses regarding this species.

The majority of local people, 97.06% (CI: 87.46–99.68%), indicated a positive perception toward INP, and cited the quality of the air and water as the main reasons for their perception. When people were asked about their feelings towards jaguars and pumas, most people held positive perceptions towards both species ($\chi^2 = 3.77$, $P = 0.05$, $n = 52$; $\chi^2 = 7.00$, $P = 0.01$, $n = 28$, respectively). From the total number of respondents that knew the puma ($n = 40$), only a minority 7.5% (CI: 5.28–35.42%) did not favor the presence of pumas in INP. Regarding the jaguar, 36.54% (CI: 21.54–52.50%) of the respondents did not favor the presence of jaguars in the Park. Perceptions towards the two carnivores did not depend on the species, i.e. whether the species of interest was the jaguar or the puma ($\chi^2 = 0.0$, $P = 1.00$, $n = 25$). People who held a positive perception towards jaguars tended to hold a positive perception towards pumas and vice-versa. Likewise, those showing a negative perception about one species tended to do so about the other species. Perceptions did not differ according to the sex of the respondents ($\chi^2 = 0.22$, $P = 1.00$, $n = 46$ and $n = 6$ for men and women, respectively).

Our results show that local perceptions towards jaguars did not depend on the size of the property ($\chi^2 = 0.59$, $P = 0.74$, $n = 42$). However, when the respondents were grouped according to the number of livestock holdings, perception towards jaguars depended on the size of the herd ($\chi^2 = 9.21$, $P = 0.01$, $n = 44$). Those having medium-sized herds tended to be positive towards jaguars ($\chi^2 = 9.00$, $P = 0.00$, $n = 16$), whereas owners of small and large herds showed no tendency ($\chi^2 = 0.80$, $P = 0.37$, $n = 20$; $\chi^2 = 2.00$, $P = 0.16$, $n = 8$; respectively). When opinions of respondents that experienced predation problems were compared with those without previous predation incidents, no differences were observed ($\chi^2 = 0.20$, $P = 0.66$, $n = 52$). When people were asked about the risk of being attacked by a puma, the majority of the respondents did not view the puma as a dangerous animal to humans ($\chi^2 = 18.69$, $P = 0.00$, $n = 39$). However, the proportion of people who viewed the jaguar as a threat to humans was similar to that of people who did not ($\chi^2 = 0.13$, $P = 0.71$, $n = 67$).

The origin of jaguars, but not pumas, living in INP generates controversy among the residents. Most people, 68.49% (CI: 54.35–79.76%), believed jaguars had been brought from other regions and released into INP. Of those that shared this belief and provided an answer regarding the responsible for the release, 68.75% (CI: 46.23–84.82%) blamed the Brazilian Environment Agency (IBAMA). According to 66.66% (CI: 44.53–82.05%) of those respondents who believed jaguars had been released in INP, the released individuals were former captive animals of zoos that could no longer keep them. When asked about the source of this information, 56.09% (CI: 36.80–72.79%) said they heard stories during informal conversation with neighbors, and 26.83% (CI: 11.45–45.59%) said they heard it through the media.

Most local people were not aware of the ecological importance of carnivores in INP or natural ecosystems. Twenty-four percent (CI: 12.12–38.17%) of respondents believed jaguars and pumas have no role in the wild, while 30.98% (CI: 17.65–45.74%) did not know if they played any role in the wild. A negative view of jaguars and pumas was held by 23.94% (CI: 11.12–38.17%) of respondents, who believed those carnivores destroy other animals. Only 21.13% (CI: 10.03–35.03%) recognized those species as having an important role in the wild by controlling prey populations.

When asked about potential solutions for reducing predation by jaguars on domestic animals, 39.73% (CI: 25.77–53.91%) of respondents suggested implementation of preventive methods in the farmlands to minimize attacks on livestock. Relocation of problem animals was another suggestion (35.62%, CI: 22.21–49.77%). The majority of respondents, 71.43% (CI: 55.14–83.56%) was willing to change their husbandry practices to minimize predation incidents, especially if they could get financial support from environmental institutions.

4. Discussion

Wild carnivores commonly generate negative attitudes among rural residents in many regions of the world where they prey upon domestic animals (Oli, 1994; Oli et al., 1994; Mech, 1995, Lenihan, 1996). Besides generating negative attitudes, predators such as jaguars and pumas are blamed for monetary losses due to depredation on livestock (Crawshaw, 1995; Dalponte, 2002 Mazzolli et al., 2002; Saenz and Carrillo, 2002).

Oli et al. (1994) reported that most local residents living in or adjacent to the snow leopard habitat wanted the species eradicated to stop livestock damage. At INP, the conflict between humans and large carnivores culminated in the killing of several jaguars by local residents in response to livestock predation between 1995 and 1997 (Conforti and Azevedo, 1997). Jaguars and pumas coexist in INP and both are responsible for predation on domestic animals (Azevedo and Conforti, 1999). Livestock losses due to pumas are rare and normally misinterpreted as jaguar attacks by the local people (Azevedo and Conforti, 1999). Despite the livestock

predation incidents at INP, our survey showed that those residents holding a negative attitude towards jaguars (26.4%) did not represent the majority of the respondents. In this regard, one could speculate that the killing of jaguars might be due to a minority of residents.

In this study, we identified two major factors that distinguished the local perceptions towards jaguars and pumas: fewer people feared pumas than jaguars; and most people believed jaguars, but not pumas, were released into INP by local authorities. Additionally, our previous research in INP region showed jaguars were blamed by local people for all cases of livestock predation (Azevedo and Conforti, 1999). Interestingly, despite these major differences in the perceptions about jaguars and pumas, feelings towards the two species tended to be the same.

Although most individuals (52.2%) viewed jaguars as a risk to human lives, there is no reliable report of an unprovoked attack by a jaguar on a human (Almeida, 1990). Unlike tigers, lions, and leopards, which have been historically related to man-eating incidents (Perry, 1970; Guggisberg, 1975; McDougal, 1987; Bailey, 1993), jaguars have not been reported to be involved in unprovoked attacks on humans. Cases of men killed by jaguars were almost invariably in a poaching situation, where cats were being actively pursued or otherwise harassed (Almeida, 1990). Due to the lack of reliable reports of such attacks by jaguars, it is unlikely that negative perceptions about jaguars are based on the real risk the species may represent to people, but rather the perceived risk. On the other hand, although pumas have been responsible for mauling and even killing humans in other regions (Beier, 1991; Foerster, 1996), more people expressed fear towards jaguars than towards pumas. Interestingly, the knowledge about the puma is low among local people, with many local residents being unaware of its existence. Pumas appear to have been culturally eclipsed by other large carnivores because of their behavior and ecology (Kellert et al., 1996). Maehr (1997) described the Florida panther (*P. concolor*) as "a phantom to human observers" due to its elusive habits and the difficulty of sighting one in the wild.

The low educational level might have influenced the local perceptions of jaguars and pumas in many aspects, especially in regard to the importance of these species in the wild. As reported by Bath (1987) in a survey about perceptions towards wolves, there was a relationship between knowledge of the species and perceptions. In our study, most people were not aware of the role of jaguars or pumas in the wild.

The belief that jaguars were relocated to INP from other areas might also be related to the low educational level. Most respondents living adjacent to INP believe jaguars had been relocated to INP, and some (data not shown) thought native jaguars did not prey upon livestock, "only jaguars raised in captivity." One source of this belief was TV reports, which showed trapped, radio-collared jaguars being released into the forest as part of a jaguar research project. However, local people did not understand that these jaguars were captured in INP. They believed these jaguars had been brought into INP. Other respondents mentioned TV reports about a local zoo that could not afford to maintain its jaguars and concluded that those jaguars were being released into INP. It is important to mention there was no official report of jaguars being released into the park.

Environmental education is an important tool for transforming attitudes towards wildlife. In the case of large carnivores in INP, it could be highly efficient if directed at children. A continuing environmental education program, specifically focused on target groups, is fundamental to getting jaguars and pumas widely accepted as native animals that need to be preserved. Obviously, understanding of the role of large carnivores in the wild is not sufficient to solve current conflicts. Adult residents have deeply rooted attitudes towards wildlife, often characterized by an exploitative view of nature.

Carnivores often are hated by people who fail to recognize the predator-prey relationship and its importance to predator survival (Mech, 1970). Similarly, we believe it is unlikely that residents, particularly uneducated adults holding negative perceptions towards jaguars and pumas, could be changed merely through educational programs. Rather, the attitudes of local people towards these species would more likely undergo a positive change if they could obtain economic profit by getting enrolled in activities involving conservation of wild carnivores, such as ecotourism.

Most wildlife preservation efforts fail to consider peoples' perceptions towards a species and to communicate the benefits that come from protecting these species, including values usually forgotten, such as cultural, moral, aesthetic and recreational (Kellert, 1985). When a species is appreciated as a symbol of wilderness, this aesthetic value may be enough to establish positive attitudes towards the species, whether it is considered to have other values or not (Mech, 1970).

The livestock predation impact needs to be considered in regards to local perceptions about carnivores given that it can potentially affect local attitudes towards predators. Jaguars were blamed by the ranchers for all livestock predation incidents in the region, even though some livestock predation by pumas did occur at INP. As reported by Azevedo and Conforti (1999), out of 39 reported attacks, 38 were by jaguars and only one by a puma, were observed in 11 of 42 properties surrounding INP visited from January 1998 to April 1999. This low rate of livestock predation by pumas could be a factor influencing the respondents' perceptions towards this species. Despite the high number of livestock predation by jaguars, our results show that most people did not

have negative perceptions of jaguars. Moreover, perceptions towards jaguars were not influenced by the predation history of the property. It could be inferred, therefore, that personal experience with livestock losses due to predation was not remarkable enough to influence their perceptions towards these carnivores. This is in agreement with our data on predation impact (Azevedo and Conforti, 1999), which suggested that the impact might not be too significant. A previous study with 42 rural properties surrounding INP revealed that 11 properties (28.2%) had predation incidents (average size of the properties: 2.58 ± 3.63 km^2; total area approximately 108 km^2). The total economic loss in one year considering all properties did not exceed US $3000. The average loss to predation did not exceed 2.64 ± 1.56 animals (range: 1–6 animals) per property, which represented 0.40% of the total livestock holdings. This impact is low when compared to another jaguar predation study in Brazil (Dalponte, in press), which reported an annual livestock loss due to jaguar predation of US $28,500 on two ranches (total area: 390 km^2), representing 0.84% of the total livestock holdings. We did not observe a relationship between perceptions towards jaguars and size of property. Furthermore, we observed that the majority of owners of medium-sized, but not small and large-sized herds, were positive towards jaguars. The reason for this difference is unknown and should be addressed by further studies.

It is reasonable to associate the incidence of livestock predation in INP region to the local management of herds, which is characterized by extensive husbandry with no specific protection against predators. As suggested by Oli et al. (1994), in a study on livestock losses by snow leopards in Nepal, livestock predation seems to be widespread in areas where extensive livestock husbandry is practiced. Preventive methods should be implemented to minimize predation incidents in INP region. Moreover, cooperation between government, non-governmental organizations, and ranchers could contribute to the success of a preventive program given that participation of ranchers in planning the program would enhance their willingness to change husbandry practices. Involvement of governmental and non-governmental institutions could give the financial support required for implementation of preventive programs.

Monetary compensation for depredation has been used as means of placating the large carnivore-rancher conflict (Keiter and Locke, 1996). Reimbursement for livestock predation could reduce the killing of jaguars by ranchers in INP region. However, monetary compensation could not only be costly but could fail to address the causes of depredation (Jackson et al., 1994). In this study, most suggestions for solving the predation problem focused on the implementation of preventive methods in the farms (39.7%) rather than reimbursement (5.5%). Michelle and Smirnov (1999) suggested that both an adequate natural prey base and a compensation system for livestock losses would solve the human-tiger conflict in eastern Russia. In the case of jaguars in INP, the reintroduction of white-lipped peccaries may be a reasonable step in solving the predation conflict. However, a successful reintroduction of peccaries in the Park would require funding, extensive work on monitoring the reintroduced animals and their impact on the ecosystem, and effective poaching control in INP; otherwise, the reintroduced animals would more likely end up as food for poachers than for jaguars. On the other hand, if implemented, a compensation system would need to be selectively applied to those farmers that had made attempts to prevent predation. Otherwise, the compensation scheme would be an additional factor to facilitate and perpetuate predation incidence by discouraging farmers to employ husbandry practices that could protect their livestock.

In conclusion, we believe that the implementation of appropriate long-term educational programs targeting the local people would be one of the most valuable steps for increasing their knowledge about carnivores and, consequently, the acceptance of all native species as local resources that must be preserved. However, educational programs alone would not be sufficient for solving predation conflicts that end with the killing of jaguars. Research on more appropriate means of reducing livestock losses by carnivores is needed.

Since INP has been a place for profitable activities of several private companies, we suggest that the environmental agency of the government responsible for the Park should seek support from those private companies in order to create a funding program that could help provide financial and technical support for those suffering economic losses due to wild carnivores. Moreover, effective programs against poaching must be implemented if jaguars are to be preserved at INP.

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