PEOPLE AND BIG CATS (*PANTHERA ONCA* AND *PUMA CONCOLOR*) OF THE ATLANTIC FOREST, BRAZIL

by

©Mônica Taís Engel

A Thesis submitted to the

School of Graduate Studies

in partial fulfillment of the requirements for the degree of

Master of Sciences

Department of Geography

Memorial University of Newfoundland

May 2016

St. John's, Newfoundland and Labrador

ABSTRACT

Conservation of large felids is not only about collecting ecological information; it is also about understanding people's values, beliefs, attitudes and behaviour. The overarching goal of this thesis is to assess the relationship between people and jaguars and pumas. Specifically by contributing to the understanding of public acceptance of big cats, as well as the forces (cognitive and social) that influence people's acceptability. Self-administered questionnaires (n=326) were applied to rural residents outside two protected areas in the State of Sao Paulo: Intervales and PETAR state parks. Findings showed that the acceptability of killing big cats varied accordingly to attitudinal type (positive and negative). Additionally, acceptability of jaguars and pumas was influenced by existence values, attitudes and park credibility. Human dimensions research helped in understanding the relationship between people and the big cats, highlighting the need, for example, to improve the credibility of the parks in the communities and to decrease the fear of jaguars and pumas.

Dedication

To Soneca, a female jaguar whose GPS signals have been lost.

©B. Beisiegel

ACKNOWLEDGEMENTS

I am grateful to my supervisor Alistair Bath who believed in me at the first moment we met a few years ago and convinced me to come to this cold, windy and wonderful island. Thank you, boss!

My gratitude also goes to Silvio Marchini who showed me the incredible world of human dimensions research while I was still an undergraduate student; and to Carissa Brown for her valuable and insightful feedback on this research.

A special thank you to Jerry Vaske from Colorado State University for accepting to collaborate in this project and help me to understand all the numbers I was generating with my data.

I would like to thank Beatriz Beisiegel for her support in the field, and to the best field assistant I could possibly have, Rafael Bergamaschi.

Many thanks to Alfred Dyck with the language support when I was thinking in Portuguese but writing in English. Thank you Alfred for receiving me in your place and being supportive during my time in Newfoundland and Labrador.

My gratitude also goes to the Geography Department at MUN, in special to Charlie Conway for map design. Thank you to all my colleagues who I had the privilege to meet and share some incredible time with.

A special thank you for all staff and managers from Intervales and PETAR state parks, and to all people involved in the field research. I am also grateful to Chester Zoo for funding this research.

Finally, a special thank you to my family for everything!

Table of contents

List of Tables

List of Figures

Overview

This thesis is organized in four chapters. Chapter *1, Introduction,* provides an overview of specific research focused on human dimension aspects of jaguars (*Panthera onca*) and pumas (*Puma concolor*), the field of human dimensions, and the biological characteristics and distribution of both felid species. In addition, this chapter introduces the research objectives, a description of the study area, and relevance of the study, the conceptual framework, and the data collection methods. The following two chapters comprise two scientific papers: Chapter *2. Attitudes toward jaguars and pumas and the acceptability of killing a Big Cat: An Application of the Potential for Conflict Index$_2$,* and Chapter *3. Predicting acceptance for jaguars and pumas in the Atlantic Forest, Brazil.* The former paper was submitted to Oryx, an internationally recognized peer-reviewed journal focused on international wildlife conservation issues. The latter paper was submitted to the leading journal in human dimensions in wildlife management research, Human Dimensions of Wildlife. Chapter *4, Summary,* integrates the key findings of this research and its contributions to the human dimensions of wildlife discipline and for jaguar and puma conservation. This chapter provides insights on how this research addresses certain gaps in the literature about human-wildlife interactions, particularly in countries where such research is new, and provides direction for further work to ensure long-term conservation of jaguars and pumas in Brazil. The research instrument is presented in the *Appendix.*

Chapter 1. Introduction

1.1 The human dimensions of jaguars and pumas

Historically, jaguars (*Panthera onca*) and pumas (*Puma concolor*) have been hunted and revered throughout their range (Smith, 1976; Nowell & Jackson, 1996; Durán et al., 2010). Both jaguars and pumas are present in the imagination of the people in the Americas, sometimes as beautiful and powerful expressions of nature (Sunquist & Sunquist, 2002), but otherwise as beasts responsible for economic loss and a threat to humans (Zimmermann et al., 2005; Shulz et al., 2014). Culturally and ritualistically, jaguars have an important symbolic role as a representation of power and strength to some ethnic groups in the Americas (Sunquist & Sunquist, 2002; Stone, 2011). For example, in shamanism, the jaguar represents the interaction between mind and soul, and is believed to provide courage, sensuality and power for those seeking their medicine (Stone, 2011). The English common name, *jaguar*, originated from *yawara,* a South American Tupi-Guarani word with several meanings, such as "wild beast that overcomes its prey at a bound," and "eater of us." The jaguar is the symbol on the current Brazilian fifty-real bill and is the flagship species of several conservation initiatives and zoos.

Although not as charismatic as the jaguar, pumas also appear in several folkloric and mythological contexts in the Americas. With more common names than any other animal in the world (Eisenberg, 2014), pumas are called by the Peruvian Quechua Indians as *Yumas* meaning "powerful animals". For the Cherokee in North America, the puma's common name *Klandaghi* means "the lord of the forest" and the

Chickasaw refer to it as the cat of God (Conway, 1995). Despite the mythological values attributed to jaguars and pumas, these big cats also elicit fear and hatred among people, thus having a complex and paradoxical relationship with humans. Big cats, as many other large carnivores are valued for different reasons. For instance, in southeast of Brazil, people value the maned wolf for their body parts (used as medicine) and for the role in nature (Consorte-McCrea, 2013).

The elimination of large carnivores from the wild is one of most significant anthropogenic impacts on nature (Estes et al., 2011). Anthropogenic impacts to big cats are mainly caused by habitat loss, depletion of prey and persecution (Murphy & Macdonald, 2012). Outside protected areas, however, the major threat affecting wild felids is conflicts with livestock and people (Woodroffe & Ginsberg, 1998). Such conflicts have already affected over 75% of the world's felid species and the severity of conflict increases with the animal's body mass (Inskip & Zimmermann, 2009). Although habitat recovery and preservation is required, conservation of big cats depends mainly upon people's ability to accept and coexist with them.

Although insightful research has been conducted to investigate the socioeconomic impact of livestock depredation by jaguars and pumas (e.g., Zimmermann et al., 2005; Shulz et al., 2014), little has been done to uncover the human dimensions of the relationship between people and big cats in Brazil (Marchini, 2010). Previous studies show, however, that perceptions toward jaguars and pumas are not the same throughout their range, but are usually rooted in the context of fear, social identity, and economic impacts (e.g., Zimmermann et al., 2005; Palmeira & Barella, 2007; Marchini & Macdonald, 2012; Amit et al., 2013). For example, in Costa Rica, ranchers' perceptions toward jaguar and puma attacks on

livestock were negative and the economic impact overestimated (Amit et al., 2013). In contrast, cattle ranchers in Guatemala held positive attitudes toward big cats (Soto-Shoender & Main, 2013). In the northern Pantanal, 64% (n=32) of ranchers did not tolerate jaguars on their farms, arguing that they were a threat to cattle (82%) and to humans (34%) (Zimmermann et al., 2005). From the surroundings of Intervales State Park and Alto Ribeira State Park – PETAR in Brazil, 54% (n=15) of rural residents held negative attitudes, suggesting the extermination of jaguars from the region as a solution to the conflict with livestock (Palmeira & Barella, 2007). In places where both jaguars and pumas coexist, the perception of threat also differs between the two species. Pumas were seen as more dangerous to humans than jaguars in El Salvador (Campbell & Alvarado, 2011), whereas in southern Brazil, fewer people feared pumas than they did jaguars (Conforti & Azevedo, 2003). This research was designed with the ultimate goal to contribute to the understanding of the relationship between people and jaguars and pumas, to aid in the conservation of these large predators in the wild, and continue the establishment of the human dimensions of wildlife discipline in Brazil.

1.2 Human Dimensions of Wildlife Perspective

The Human Dimension of Wildlife (HDW) concept was formally introduced to the wildlife profession by Hendee in the early 1970s (Manfredo et al., 1998). The main objectives of the discipline are to describe, predict, understand and affect people's perceptions and behaviours toward wildlife and natural resources (Manfredo et al., 1996). HDW uses social information in the field of wildlife management

(Manfredo, 2008), and includes a variety of social science disciplines, such as geography, psychology and sociology (Manfredo et al., 1998).

During the 1970s, the focus of HDW research was on hunting and fishing (Bath, 1998). In the 1980s, new approaches emerged and people's attitudes toward wildlife became a key topic of research (Bath, 1998). The last decade of the 20th century marked another transition in the field, when the social sciences started its battle to find a space in wildlife issues previously dominated by biologically driven assessments and plans (Manfredo et al., 2009). In the late 1990s and early 2000s, new concerns emerged. Social issues such as indigenous rights, poverty, governance, and social justice led to the study of illegal harvesting and trade, co-management of natural resources, and wildlife and human health (Manfredo et al., 2009). Although it is difficult to predict, the challenges for the coming years will likely include the effects of the impact of natural disasters, climate change, habitat fragmentation, urbanization, and invasive species on people's lives (Vaske et al., 2006), and the ever-decreasing space between people and large carnivores.

HDW research emerged in the United States and for this reason that country has the highest concentration of research and management efforts. According to Scopus Database, since 1982 the USA alone has published at least 157 documents (56.5%) containing *human dimensions of wildlife* as key word. Following in the rank is Canada (27) and Australia (26). In Europe, United Kingdom (20), Germany (10), Spain (7), Norway (4) and Austria (4) are within the top 15 countries publishing HDW work with this specific key word. Despite HDW research has been conducted in South America, it is not until very recently that the first document was published. The three manuscripts having *human dimensions of wildlife* as key word were published by

Dickman and colleagues in 2013 (Dickman et al., 2013), by Engel and colleagues in 2014 (Engel et al., 2014) and by Marchini also in 2014 (Marchini, 2014). Although the numbers presented do not include a variety of other possible key words in the search (e.g. HDW, human-wildlife, people-wildlife interactions) and comes from one database only, these numbers provide an idea of the geographic distribution of the discipline. As observed, South America has just started its contribution to the field of HDW (in the early 2000s), thus indicating that more research and effort are needed to expand the discipline outside of North America and adapt it to different cultural contexts. This human dimension study summarized in this thesis is one of the first of its kind in Brazil, and focuses on the two largest predators in the country, jaguars and pumas.

1.3 Jaguars and pumas: characteristics and distribution

With shortened faces and rounded heads with 28-30 teeth, and claws specialized for holding and handling prey, felids are strong killers among the large carnivores (Macdonald et al., 2012). Felids belong to the family Felidae and order Carnivora. Although the common ancestor of the modern felids appeared sometime between 35-28 million years ago (Werdelin et al., 2012), the dispersion of modern felids only happened approximately 10 million years ago. The colonization and migration of the North American populations to South America, however, happened between 3 and 4 million years ago after the formation of the Isthmus of Panama (Reis et al., 2006). The family Felidae has worldwide distribution and is divided in two subfamilies (Felinae and Pantherinae), 14 genus and 40 species (Wilson & Reeder, 2005).Twelve of these species occur in the New World.

Jaguars and pumas play an important role in regulating ecosystems, as do many other carnivores at the top of the food web. Large carnivores, including jaguars and pumas, have the potential to limit herbivores through predation, and mesocarnivores through intraguild competition (Estes et al., 2001; Crooks, 2002; Ripple & Beschta, 2006; Estes et al., 2011; Ripple et al., 2014). The role that large bodied carnivores, such as jaguars and pumas, have on ecosystems, together with their vulnerability to extinction, makes their conservation urgent and crucial for all life on Earth (Prugh et al., 2009; Ripple et al., 2014).

There are many interest groups also concerned about these big cats, but not for the same reasons of possible extinction, habitat loss and ecosystem function. Livestock owners are concerned about livestock depredation. Local residents often fear being attacked by the large cats. Hence, the biophysical characteristics of the species is seen as positive or negative depending upon perspective, thus lending the jaguar and puma as excellent species to study from a human dimensions perspective. As Prugh et al. (2009) pointed out, the conservation of apex predators will require not only habitat restoration, but also a greater public acceptance of large carnivores, especially among people directly affected by those carnivores. In human occupied landscapes, for instance, human-wildlife conflict often emerges because of the intolerance of the people who are visited by carnivores (Consorte-McCrea, 2011). Such evidence stresses the fact that traditional ecological and conservation-based research of large predators will probably fail without the knowledge provided by the social sciences regarding human behavior toward wildlife and the environment (Ritchie et al., 2012).

1.3.1 Jaguar *Panthera onca* (Linnaeus, 1758)

The jaguar (*P. onca)* is the largest cat of the Americas and the only representative of the Pantheriane subfamily in the New World. Their weight ranges between 61 and 158kg, and their length between 1.10 and 2.07 meters (Reis et al., 2006). Males are typically bigger than females. Jaguars have a robust, compact and muscular body, with short but strong legs (Oliveira & Cassaro, 2005). They present a yellowish colour with rosettes (black spots) on their heads, back, legs and tails, and a white colour on their chest and belly (Reis et al., 2006) (Figure 1.1). Jaguars are solitary, nocturnal and territorial, with home ranges of up to ~150km^2 (smaller for females) (Macdonald et al., 2012). Their prey base is essentially made of medium and large size vertebrates, such as tapir (*Tapirus terrestris*), capybara (*Hydrochoerus hydrochaeris*), peccary (*Pecari tajacu*), wild boar (*Sus scrofa*) and deer (*Mazama sp.*).

Figure 1.1. Male Jaguar (*P. onca*) at Chester Zoo, Chester, UK. Image: M. Engel.

Historically, the jaguar ranged from the south-western United States to the Rio Negro region in Argentina. Today, jaguars are found in only ~46% of their original territory (Figure 1.3-a) (Macdonald et al., 2012). Although it is estimated that 70% of the jaguar range has a high probability for their long-term survival, in the Atlantic Forest the probability of long-term survival of jaguars is low. For this reason, the Atlantic Forest has been identified as an area of most urgent conservation concern (Sanderson et al., 2002). The population of jaguars in the Atlantic Forest is estimated at ~250 mature individuals separated in 8 sub-populations (Beisiegel et al., 2012). Internationally, the jaguar is classified as Near Threatened (IUCN, 2008), but in Brazil jaguars are listed as Critically Endangered (Machado et al., 2005). The major threats affecting jaguars are habitat loss, illegal trade of their body parts, and persecution (IUCN, 2008).

1.3.2 Puma *Puma concolor* (Linnaeus, 1771)

The puma (*P. concolor*) is the second largest felid of the Americas, and belongs to the subfamily Felinae. Throughout their range, puma diet and body size vary with latitude. On average, pumas have a long and skinny body; but, pumas from the north and south of their distribution have a higher body weight than those close to the equator (Muphy & Macdonald, 2012). In Brazil, puma can weigh can range between 22 and 70kg, and their length is between 1.55 and 1.70 meters (Reis et al., 2006). Females are smaller than males. The coat is uniform and brown in color, except for their chest which has a lighter color (Figure 1.2). Like jaguars, pumas are solitary and nocturnal. Their home range sizes vary depending on the availability of prey. In zones with high density of prey, their home range tends to be smaller (IUCN, 2008).

Yet, their home ranges vary between 32 and 1,030km^2 (Nowell & Jackson, 1996), with females having smaller ranges than males. Pumas are sympatric with jaguars, meaning they can share the same habitat and do not interbreed (Sunquist & Sunquist, 2002). Pumas usually prey on small to medium sized prey, such as capybara (*Hydrochoerus hydrochaeris)*, spotted paca (*Cuniculus paca*), South American coati (*Nasua nasua*) and deer (*Mazama sp.*).

Figure 1.2. Puma cub (*P. concolor*) at Gramado Zoo, Gramado, BR. Image: M. Engel.

Pumas have the largest range of any other mammal in the New World, being found from southern Yukon to Tierra del Fuego, and from the Pacific to the Atlantic (Figure 1.3-b). Historically, pumas were found in the eastern parts of USA and Canada, but were eliminated during the last century (Macdonald et al., 2010). Currently, pumas are found in 73% of their historical range. Although pumas are listed as Least Concern according to the IUCN (2008), in Brazil pumas are classified

as Vulnerable (Machado et al., 2005). The major threats affecting pumas are habitat loss and conflict with humans (Reis et al., 2006; IUCN, 2008).

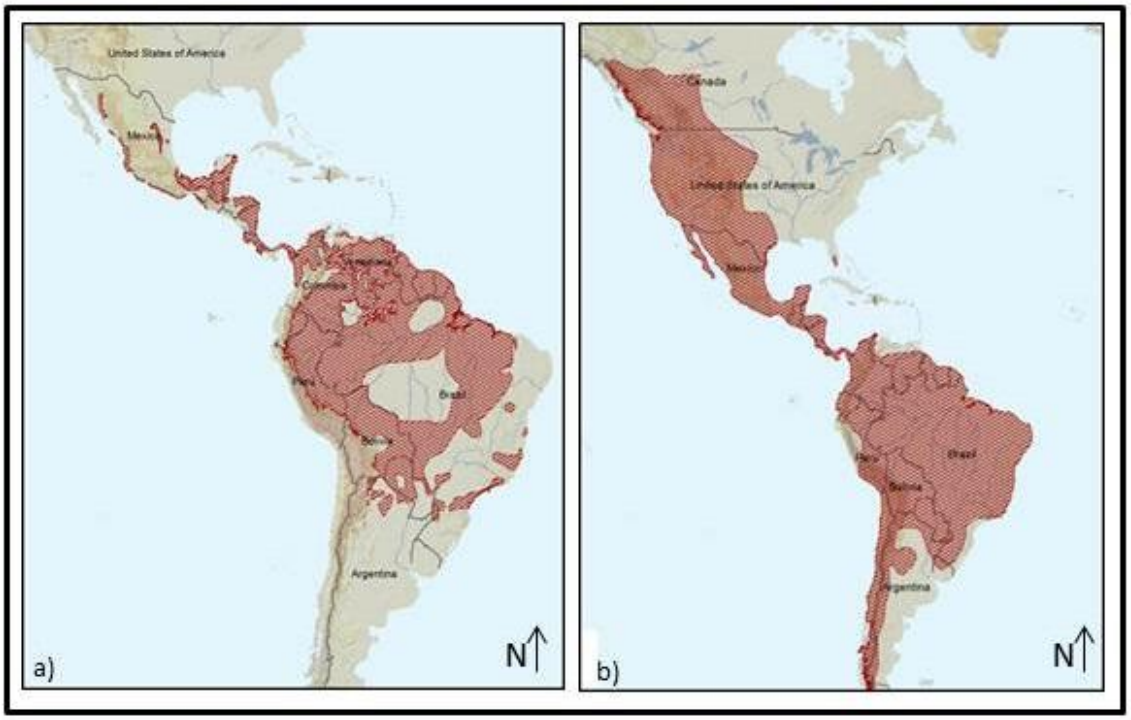

Figure 1.3. (a) Jaguar habitat range map; (b) Puma habitat range map. Adapted from IUCN Red List (2008).

1.4 Research objectives

The overarching goal of this thesis is to assess the relationship between people and jaguars and pumas in the surroundings of two protected areas in the Brazilian Atlantic Forest. The specific objectives of this research are:

1) To explore public acceptability of killing jaguars and pumas in different scenarios of people-big cat interactions, examining the influence of attitudes toward jaguars and pumas on acceptability, as well as the amount

of consensus on the average acceptability of killing big cats and among individuals with negative, positive and neutral attitudes.

2) To explore public acceptance of jaguars and pumas presence in the target region, evaluating the influence of attitudes, existence value, fear and credibility of the wildlife management agency on the acceptability.

The two objectives are assessed in the scientific manuscripts that follow. For all analyses in this research, the objective was also to test whether there was a difference in the individual's responses between jaguars and pumas. In addition, with the data gathered in this research, the aim is to provide insights for managers and decision makers when, for example, implementing ecological corridors in the Atlantic Forest.

1.5 Study area

The Atlantic Forest is one of the top five hotspots for biodiversity in the world and is arguably the most devastated and threatened forested ecosystem on the planet (Galindo-Leal & Camara, 2003). From an original area of 1.4 million km^2, only ~12% remains preserved in large protected areas or in fragmented small patches (SOS Mata Atlântica/INPE, 2015). In 1988, the Federal Constitution recognized the Atlantic Forest as part of UNESCO's Biosphere Reserve and as a National Heritage Site. Urbanization and the ever growing demand for natural resources and land are the main drivers of deforestation. Approximately 72% of the Brazilian population (~145 million people) live in the Atlantic Forest biome (IBGE, 2014), and despite law enforcement efforts to protect the forest and mitigate illegal logging, it is estimated

that at least 278,000ha of forest were lost between 2000 and 2008 (SOS Mata Atlântica/INPE, 2009). Recent data indicate that between 2012 and 2013 the Atlantic Forest lost an area of 23,948ha, whereas during the period of 2013-2014 deforestation decreased 24% compared to the previous period, yet with a loss of approximately 18,267ha (or the equivalent to 18,000 football fields). The state of Sao Paulo ranked seventh nationally in deforestation of the Atlantic Forest during the period of 2013-2014, being responsible for the deforestation of 61 hectares of forest (SOS Mata Atlântica/INPE, 2015).

The Atlantic Forest *sensu lato* (Brazilian federal law n°11 428/2006) present a high level of endemism and boasts at least 15,782 species of vascular plants (approximately 5% of the total flora in the world), 935 species of birds, 370 species of amphibians, 200 species of reptiles, 270 species of mammals and at least 370 species of fish (Ribeiro et al., 2009). Of the 633 threatened species in Brazil, at least 383 are in the Atlantic Forest. The rich biodiversity of the Atlantic Forest is due to the geological and climatic history of the continent. During the Cenozoic era, deep faults created sharp relief, and in the Pleistocene the forest became fragmented during the coldest and driest periods. When the climate was more favorable, the forest probably occupied larger areas, even connecting with the Amazon Forest (Pinto & Wey de Brito, 2003).

Long isolated from other major rainforests in South America, the Atlantic Forest has diverse and unique vegetation and forest types. The two main ecoregions are: a) the coastal Atlantic forest, located about 50-100 km alongside the coast, and b) the interior Atlantic Forest, which follows along the foothills of the *Serra do Mar* into southern Brazil, Paraguay and Argentina (Galindo-Leal & Camara 2003). This chain

of mountains that compose the coastal landscape (Figure 1.4) is mostly formed by granitic rocks dating back to the Paleozoic Era (Galindo-Leal & Camara 2003). Altitude determines at least three vegetation types in the Atlantic Forest: a) the lowland forest of the coastal plain, b) the mountain forests, and c) the high-altitude grassland or *campo rupestre* (Galindo-Leal & Camara 2003).

Figure 1.4. Serra do Mar landscape. Site: Alto do Ribeira State Park (PETAR). Image: M. Engel.

The study area of the research presented in this thesis is located along the Serra do Mar ecological corridor, southwest of Sao Paulo State, Brazil (Figure 1.5). The climate is tropical humid, with an average temperature ranging between 17 and 22°C, and average rainfall of 1,700 to 2,400mm per year (Ab'Saber, 1970).The target study area encompasses the rural areas of Iporanga (1,890 rural residents) and Ribeirão Grande (5,078 rural residents). Iporanga and Ribeirão Grande are located adjacent to Alto Ribeira State Park (PETAR) (24° 27' 36" S 48° 36' W) and Intervales State Park (24° 15' 55" S 48° 24' 25" W). These two strict protected areas are situated in the

Ribeira Valley (Vale do Ribeira) and are within one of the 182 potential ecological corridors for jaguars identified by Rabinowitz and Zeller (2010). Due to the low rates of mature jaguars in the biome (~250 individuals), this region is classified as "highest priority" for conservation (Sanderson et al., 2002) making it an ideal location for this research.

Figure 1.5. Study area with the Intervales State Park and Alto do Ribeira State Parks in the highlighted box. © C. Conway (Dept. Geography/MUN).

The main economic activities in the region are small scale livestock production and subsistence agriculture. For the past few years, tourism activities have been increasing in the region, especially ecotourism (Carlos Botelho management plan,

2008). Another important component of the regional economy is the increase of pine and eucalyptus plantations.

The target study area was one of the first places to be colonized in the state of Sao Paulo during the 16th century. Ironically, São Paulo is the most industrialized and wealthiest state in the country, yet the study region is one of the poorest parts of the state. Basic services such as education and health, as well as professional incentives for economic improvements are sub-standard, and young people are moving to other places in search of jobs and opportunities.

1.6 Outline of papers

Both manuscripts corresponding to Chapters 2 and 3 are interconnected to accomplish the overarching goal of this research, which is to understand the relationship between people and big cats in the Atlantic Forest. The first objective is to evaluate whether people consider the killing of big cats acceptable or unacceptable across different scenarios of people big-cat interactions. The second objective is to evaluate the extent that people accept sharing the land with these large predators. These two manuscripts provide insights into how local residents adjacent to PETAR and Intervales State Parks live alongside jaguars and pumas. Abstracts corresponding to Chapters 2 and 3 are given below.

Chapter 2 consists of a paper submitted to *Oryx*, with the title: "Attitudes toward jaguars and pumas and the acceptability of killing a Big Cat: An Application of the Potential for Conflict Index$_2$".

Poaching is one of the main threats affecting jaguars (*Panthera onca*) and pumas (*Puma concolor*). We explored the overall acceptability of killing big cats in different scenarios of people-big cats interactions, and the influence of attitudes toward jaguars and pumas on acceptability. The Potential for Conflict Index$_2$ (PCI$_2$) was used to examine the overall amount of consensus on the acceptability of killing big cats, as well as consensus levels among individuals with negative, positive and neutral attitudes. Data were obtained from 326 self-administered questionnaires in areas adjacent to two protected areas in the Brazilian Atlantic Forest: Intervales State Park and Alto Ribeira State Park. Overall, residents in both locations considered killing big cats unacceptable (M = -1.12, SD ± .85). However, individuals who held negative attitudes were more accepting of killing in all scenarios. As the severity of people-big cats interactions increased, the level of consensus decreased. On average, people held slightly positive attitudes toward big cats, as most of the residents slightly liked jaguars and pumas and did not consider them as threats and nuisance to people (M = .51, SD ± .80). From a managerial perspective, findings highlight the range of acceptability of killing big cats, as well as the level of consensus among groups with positive, neutral and negative attitudes. Knowing whether killing a big cat is acceptable or unacceptable by the public in situational specific settings can assist managers to anticipate conflict and avoid illegal killing of big cats.

Chapter 3 consist of a paper submitted to *Human Dimensions of Wildlife,* with the title: "Predicting acceptance for jaguars and pumas in the Atlantic Forest, Brazil".

Jaguars are highly threatened in the Atlantic Forest, especially at the borders of protected areas. We assessed the influence of emotions, attitudes, existence value, and agency credibility on people's willingness to accept jaguars and pumas within a

complex of protected areas. Data were obtained through self-administrated questionnaires (n=326). Results indicated that those with a positive attitude toward big cats (β=.28, p<.001), those who valued the existence of big cats (β =.14, p <.05), those who would feel sorry if jaguars and pumas disappear (β =.21, p<.001), and those who considered the park a credible managing agency (β=.15, p=.005) were more accepting of big cats. Our model provided theoretical and practical insights into large carnivore conservation. For example, given the significance of park credibility, a positive relationship between park authorities and residents is crucial for conservation of big cats.

1.7 Relevance of the research

This research project has theoretical and practical significance for the conservation of jaguars and pumas in Brazil, as well as for large carnivores in general. First, this research responds to the direction and recommendations stated by previous research in the context of big cats, such as

i) the need to address people's perceptions of jaguars versus pumas (Marchini, 2010);

ii) the need to provide an overview of conflict with people and/or livestock for each species (Inskip & Zimmermann, 2009);

iii) the need to assess the human dimension of the interactions between humans and big cats (Inskip & Zimmermann, 2009; Joly et al., 2010);

iv) the need to involve the people who live and work in the areas considered by the Jaguar Corridor Initiative (i.e. Ribeira Valley) (Zeller et al., 2013).

Second, this research responds to the request to explore further the use of psychological and cognitive models to understand public acceptance of wildlife (Gigliotti et al., 2000; Bruskotter & Fulton, 2012). Finally, this research contributes to the development of the HDW discipline in Brazil, a novel approach that was newly introduced in the early 2000s. Only recently in 2015 has the field been formally accepted in the academic setting at the University of Sao Paulo.

1.8 Conceptual framework

The theoretical background of this study is grounded in the HDW literature (e.g., Manfredo, 2008; Vaske, 2008; Manfredo et al., 2009; Decker et al., 2012), and is based on the cognitive approach of human behaviour (Fulton et al., 1996; Vaske & Donelly, 1999; Vaske & Manfredo, 2012). More specifically, this study draws upon the relationship between attitudes, emotion (i.e., fear), existence values, acceptability, and social credibility of the management agency as forces capable drive human behaviour towards wildlife. Details on the conceptual framework are described in the following chapters.

1.9 Data collection

Data were collected during the months of May and June 2014 through a structured questionnaire containing closed-ended questions. Previous to the data collection, the questionnaire was pre-tested through a pilot survey to adapt the vocabulary and length of the instrument. The questionnaire consisted of several sections (see Appendix), however, for the purpose of the two objectives of this research, only the following sections were used in the analysis:

- attitudes toward jaguars and pumas, and attitudes toward the park
- existence values
- emotional disposition (fear and sorrow)
- acceptability of killing big cats
- acceptability of big cats
- park's management agency credibility
- likelihood of having a domestic animal attacked by a big cat
- information on past experience with domestic animals' depredation

The questionnaire was administered to rural residents from Iporanga and Ribeirão Grande, with both adults (>18 years old) and youth (15 to 17 years old). All respondents had the option not to participate in the research. Further details about sampling and data analysis are provided in Chapters 2 and 3. The questionnaire presented in the Appendix is the English version, however the version applied in the field was translated into Portuguese.

Co-authorship statement

The author of this thesis has been the primary researcher of this study, including the literature review and the design of the research proposal, the practical aspects of the research, the data collection and analysis, and the manuscript preparation. The co-authors and committee members have contributed to the research project by critically reading and providing feedback on all stages of the study.

For the two manuscripts included in this thesis, the author is the primary and corresponding author. The co-authors provided significant intellectual contributions to each of the articles by critiquing methods (i.e., data collection and analysis), interpreting data, and reviewing the manuscripts. The following paragraphs state the journal each manuscript has been submitted to and the order of the co-authors proceeding the author of this dissertation.

The first manuscript "*Attitudes toward jaguars and pumas and the acceptability of killing a Big Cat: An Application of the Potential for Conflict Index$_{2"}$*, was a collaborative effort with Dr. Jerry J. Vaske (CSU), Dr. Alistair Bath (MUN) and Dr. Silvio Marchini (USP). This paper was submitted to *Oryx*.

The second manuscript "P*redicting acceptance for jaguars and pumas in the Atlantic Forest, Brazil"* was a collaborative effort with Dr. Jerry J. Vaske (CSU), Dr. Alistair Bath (MUN) and Dr. Silvio Marchini (USP). This paper was submitted to *Human Dimensions of Wildlife*.

Chapter 2.

Attitudes toward jaguars and pumas, and the acceptability of killing a big cat: An application of the Potential for Conflict Index$_2$

2.1 Introduction

Habitat loss and poaching are primary threats to wild felids (Zeller, 2007; IUCN, 2008; Loveridge et al., 2010). People kill large bodied felids (e.g., jaguars, pumas) for their skin and bones, to protect themselves and their livestock, to demonstrate bravery, for recreational reasons (Hazzah et al., 2009; Balme et al., 2010; Loveridge et al., 2010; IUCN, 2011), and because these carnivores have large home-ranges that often extend beyond the protected areas' borders (Costal et al., 2005; Inskip & Zimmermann, 2009). Commercial hunting for pelts has historically driven the decline of jaguars in Central and South America. Approximately 15,000 jaguars were killed in the Brazilian Amazon for the fur industry during the 1960s (Smith, 1976). With the implementation of laws (e.g., Brazilian Wildlife Protection Act in 1967, Convention of International Trade of Endangered Species – CITES), however, commercial hunting of jaguars has declined. Yet, despite law enforcement and creation of protected areas, killing jaguars and pumas is still practiced due to livestock depredation, fear and/or social norms (Carvalho & Pezzuti, 2010; Marchini & Macdonal, 2012; Carvalho & Morato, 2013), making persecution the major threat affecting both big cats (Costa et al., 2005).

Social research applied to biodiversity conservation seeks to understand what motivates people to harm wildlife and to promote and engage in conservation (Sandbrook et al., 2013). Results have shown that human behaviour is influenced by many factors, including values, value orientations, norms, and attitudes (Manfredo 2008; Vaske & Donelly, 1999). Of these predictors, attitudes have been the focus of most investigations (Manfredo et al., 2004). Attitudes provide a parsimonious way to describe the thoughts held by a group of people regarding objects (e.g., wildlife species, management option) (Manfredo, 2008). Additionally, understanding similarities and differences in the attitudes of different segments in the population provide insights for developing education and communication campaigns (Decker et al., 2012).

Attitudes reflect an individual's evaluation of an object and include cognitive (beliefs) and affective (e.g., positive or negative) components (Manfredo, 2008; Vaske, 2008). Attitudes are also categorized as implicit or explicit. Implicit attitudes measure automatic and unconscious evaluations; whereas explicit attitudes measure conscious evaluations that an individual is aware of and capable to express (Manfredo, 2008). Human dimensions research has focused on explicit attitudes (Vaske & Manfredo, 2012) and has found that situation and context differences often influence the evaluation (Manfredo et al., 1998). The acceptability of 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 the big cat has killed a pet and / or livestock.

Although studies have examined individuals' attitudes toward pumas (e.g., Manfredo et al., 1998; Thornton & Quinn, 2010) and jaguars (e.g., Palmeira & Barella, 2007; Santos et al., 2008; Marchini & Macdonald, 2012), in depth

information on the influence of attitudes on acceptability of killing big cats is still lacking. This article assessed attitudes toward jaguars and pumas, as well as the influence of attitudes on the acceptability of killing a big cat in different situations of people-big cat interactions.

Acceptability reflects the extent that an individual considers a particular action acceptable or unacceptable (Jacobs et al., 2014), that is, the individual's evaluation of that action (Bruskotter et al., 2009). Given that people do not necessarily share similar evaluations regarding what behaviours are acceptable or unacceptable, lack of consensus (or conflict) arises (Vaske et al., 2010). For example, some people may accept the killing of jaguars and pumas, whereas for others killing may be unacceptable. In this study, the Potential for Conflict Index$_2$ (PCI$_2$) (Vaske et al., 2010) was used to measure consensus regarding the acceptability of killing jaguars / pumas amongst rural people in the neighbourhood of two protected areas in the Atlantic Forest.

2.1.1 Potential for Conflict Index$_2$ – PCI$_2$

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, are statistics that do not have an upper bound, which challenges the interpretation of findings. The Potential for Conflict Index$_2$ (PCI$_2$) was developed to help address these issues (Vaske et al. 2010). Although specifics of the PCI$_2$ are beyond the scope of this article, a detailed description of this statistic and programs for calculating, graphing, and comparing PCI$_2$ values can be found at http://warnercnr.colostate.edu/~jerryv/PCI2/index.htm. The PCI$_2$ ranges from

0 to 1. The least amount of consensus and greatest potential for conflict ($PCI_2 = 1$) 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 PCI_2 of 0 and suggests complete consensus and no potential for conflict.

PCI_2 results can be displayed using graphs. Degree of consensus is illustrated as bubbles where the size of the bubble depicts the magnitude of the PCI_2 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).

With the objective to understand the potential conflict index related to acceptance of killing a big cat, the overall 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 were explored: (a) see the tracks of a jaguar/puma close to home; (b) see a jaguar/puma close to home; and (c) have a domestic animal (pet and/or livestock) killed by a jaguar/puma. We explored the following hypotheses:

H_1 Overall mean acceptance of killing a big cat will vary across the scenarios of human-big cat interaction (i.e., tracks seen, big cat seen, domestic animals

attacked); in that sense, there will be increased acceptability of killing a big cat in the more severe scenarios.

H_2 Mean acceptance of killing a big cat will vary by respondent attitudinal type toward jaguars and pumas (i.e., negative, neutral, and positive) within the scenarios, with people who held negative attitudes being more accepting with killing.

H_3 Consensus (PCI_2) regarding the overall acceptance of killing a big cat will vary by the severity of the human-big cat interaction (i.e., tracks seen, big cat seen, domestic animals attacked).

H_4 Consensus (PCI_2) regarding acceptance of killing a big cat will vary by attitudinal type (i.e., negative, neutral, and positive) within the scenarios.

2.2 Study Area

The Atlantic Forest is one of 25 recognized hotspots for biodiversity in the world, and because of urban expansion, illegal logging, animal and plant poaching, and the introduction of alien species, it is arguably the most threatened forest ecosystem on the planet (Myers et al., 2000; Galindo-Leal & Câmara, 2003; Ribeiro et al., 2009). The study area encompassed areas adjacent to two protected areas located along the Serra do Mar ecological corridor in the southwest of Sao Paulo State, Brazil: Intervales State Park and Alto Ribeira State Park (PETAR) (Figure 2.1). Intervales State Park (41,700 ha), with headquarters located in Ribeirao Grande, was established in 1995. PETAR (35,772 ha), located in the municipalities of Iporanga and Apiaí, was

established in 1958. These two protected areas are part of the core zone of the Atlantic Forest Biosphere Reserve, and recognized by UNESCO as a World Natural Heritage Site. Together with other protected areas, this zone represents the largest preserved fragment of the Atlantic Forest; the Serra de Paranapiacaba Corridor.

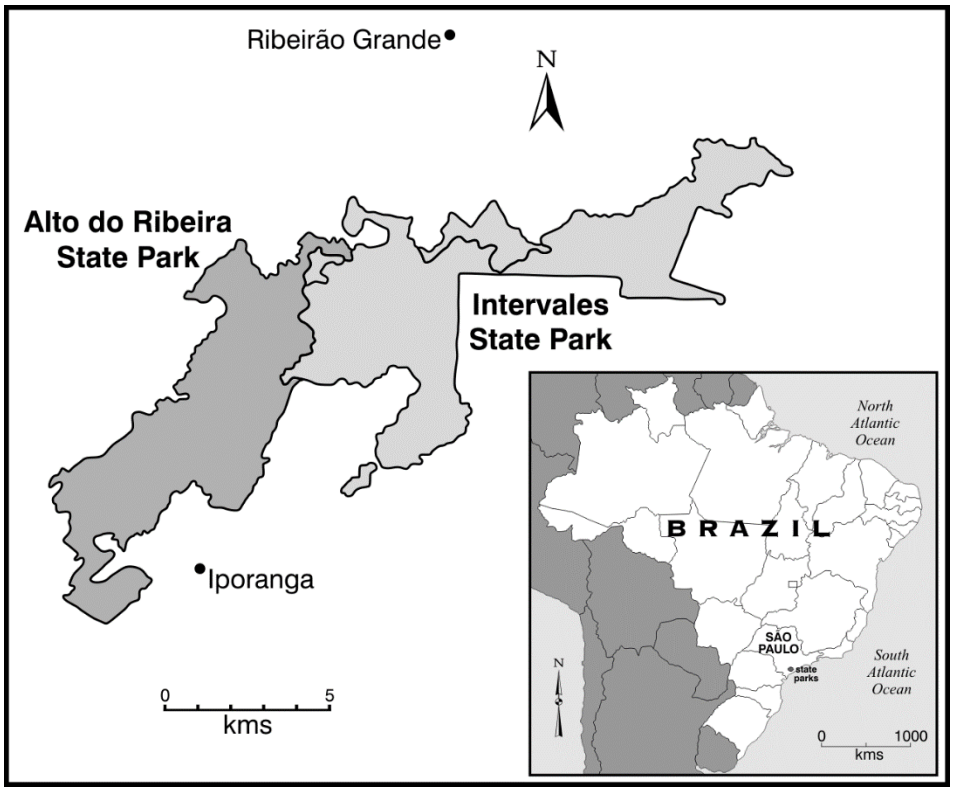

Figure 2.1. Study area highlighting the municipalities of Iporanga and Ribeirão Grande adjacent to Alto do Ribeira State Park (dark grey) and Intervales State Park (light grey). © C. Conway (Dept. Geography/MUN)

The study area is 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), in Brazil both species are Vulnerable (Machado et al., 2008). In the surroundings of Intervales

and PETAR State Parks, the target study area includes the municipalities of Ribeirão Grande and Iporanga. Given that the probability of encounters with jaguars and pumas are higher in the rural areas, focused of this study was on those locations.

2.3 Methods

2.3.1 Data Collection

Data were collected during the months of May and June 2014, through 326 self-administered questionnaires. Only people above 15 years old were sampled. To reach areas where the access by road was difficult (e.g., some areas were only accessible by foot or small boat), 490 structured questionnaires were sent out via rural elementary schools in the study area. The definition of rural residents relates to the geographical place of residence. To confirm this location, respondents were for their place of residence (i.e. rural or urban area). A cover letter explaining the purpose of the study and requesting the participation of one member of the family (mother, father or guardian) was sent out along with the questionnaires. Questionnaires were returned via the school children within 10 days. In addition, high school students completed the questionnaires in the classroom. Two high schools were randomly selected, and all the students with ages between 15-17 years present in the classrooms were asked to answer the questionnaire. Before the questionnaire was distributed, the purpose of the study was explained and the students were invited to participation in the research. All of the respondents had the option to not participate in the study. A total of 326 completed questionnaires were collected, 139 from high school students (response rate=65%), and 187 from people where the questionnaires were sent (response

rate=38%). Since there was no significant difference in the responses between youth (15-17 years) and adults (>18 years), responses were aggregated in the analyses.

To assess acceptability of killing jaguars and pumas, respondents were asked to evaluate the extent they would agree or disagree with the killing of big cats in three different scenarios: (a) seeing the tracks of a jaguar/puma close to their home; (b seeing a jaguar/puma close to their home; and c) having a domestic animal (pet and/or livestock) killed by a jaguar/puma. These questions did not specify who would kill the predator. To assess whether the responses would change for scenario 3 when the person has the control to kill, we asked people to evaluate the extent they agree or disagree with the following sentence: "If a jaguar/puma attacks my domestic animals, I should be allowed to kill the predator". For the purpose of the analyses, this was considered as a fourth scenario. Separate questions were asked for jaguars and pumas. Reponses ranged from 1 to 5, but were recoded to (-2) "strongly disagree", (-1) "disagree", (0) "neutral", (+1) "agree", and (+2) "strongly agree" for analysis.

Attitudes toward jaguars and pumas were assessed through 6 items: a) "Jaguars are nuisance animals in the region"; b) "Pumas are nuisance animals in the region", c) "Jaguars pose a threat to people in the region", d) "Pumas pose a threat to people in the region", e) I like/dislike jaguars, and f) I like/dislike pumas. Responses for items 1-4 were (-2) "strongly agree", (-1) "agree", (0) "neutral", (+1) "disagree", (+2) "strongly disagree" (recoded from 1-5). Responses for items 5-6 were (-2) "strongly dislike", (-1) "dislike", (0) "neutral", (+1) "like", (+2) "strongly like". From a managerial perspective, negative mean scores represent negative attitudes (i.e., agree that big cats are nuisance), and positive mean scores represent positive attitudes toward these species (i.e., disagree that big cats are nuisance).

2.3.2. 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. We therefore grouped these two species together, and describe the results in terms of "big cats". Cronbach's alpha (Cronbach, 1951, Cronbach & Shavelson, 2004) was used to estimate the internal consistency of the attitudinal scale (6 items). We used one-way analysis of variance (ANOVA) to compare mean responses of people holding negative, neutral, and positive attitudes toward big cats within each scenario. If homogeneity could be assumed, we used Bonferroni *post hoc* tests to determine significant differences among the three attitude types. If heterogeneity of variance was detected, we used Tamhane *post hoc* test, which accounts for pairwise comparisons test based on a *t*-test applied when the variance is unequal (Vaske, 2008). To examine differences in consensus among negative, neutral, and positive attitudes, as well as among the overall acceptability of killing a big cat, we used the PCI_2 difference test (Vaske et al., 2010).

2.4 Results

2.4.1 Overall acceptability of killing a big cat across scenarios

On average, people disagreed with killing a big cat in scenario 1 (tracks seen) (M = -1.24, SD = 0.89). Four-fifths (83%) considered the killing of a big cat in

scenario 1 unacceptable. Twelve percent (*n*=38) of the respondents were neutral, and 5% (*n*=17) accepted killing a big cat. On average, people also disagreed with killing big cats in scenario 2 (big cat seen) (*M* = -1.21, *SD* = 0.96). Although 83% (*n*= 265) of the respondents considered the killing unacceptable even if they saw a big cat close to their homes, 10% (*n*= 32) were neutral, and 7% (*n*= 22) accepted the killing of big cats. In scenario 3 (domestic animal killed), people, on average, disagreed with killing big cats (*M* = -0.94, *SD* = 1.10). For the majority of the respondents (72%), killing a big cat was unacceptable; killing a big cat was acceptable for 13% of the respondents. In scenario 4 (the individual has control of killing the predator if a domestic animal is attacked by a big cat), people were slightly less unacceptable with killing big cats (*M* = -0.62, *SD* = 1.20). Although 60% (*n* = 190) of the respondents considered the killing of big cats unacceptable in this scenario, 19% (*n*=61) indicated the behaviour was acceptable and 21% (*n*= 68) were neutral.

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, d = -.02). However, the mean response to scenario 1 was significantly different from scenario 3 (t (311) = 5.51, p < .001, d= -.30) and scenario 4 (t (316) = 9.98, p < .001, d = -.60). The mean acceptability of killing a big cat in scenario 2 was significantly different from scenario 3 (t (310) = 5.96, p < .001, d = -.37) and 4 (t (313) = 10.07, p < .001, d = -.57). Mean response to scenario 3 was significantly different from scenario 4 (t (308) = 5.14, p < .001, d = -.30).

Overall, people did not agree with killing a big cat (*M*=-1.12, *SD* ± .85). Although 12% accepted killing of big cats irrespectively of the scenario, 74% disagreed with killing and 14% were neutral. However, there were significant

differences in the overall mean acceptability of killing a big cat across some of the scenarios, supporting hypotheses 1. The level of consensus was generally high. PCI_2 values ranged from .10 to .27 (Figure 2.2), and were significantly different across some of the scenarios, supporting hypotheses 3. As the severity of the interaction between people and the big cats increased, the level of consensus decreased (i.e., PCI_2 values are higher). The level of consensus in scenario 1 did not differ significantly from scenario 2, but it differed from scenario 3 and 4. In scenario 2, the level of consensus was significantly different only from 4; and in scenario 3, the PCI_2 did not differ from scenario 2 and 4, but it differed from scenario 1.

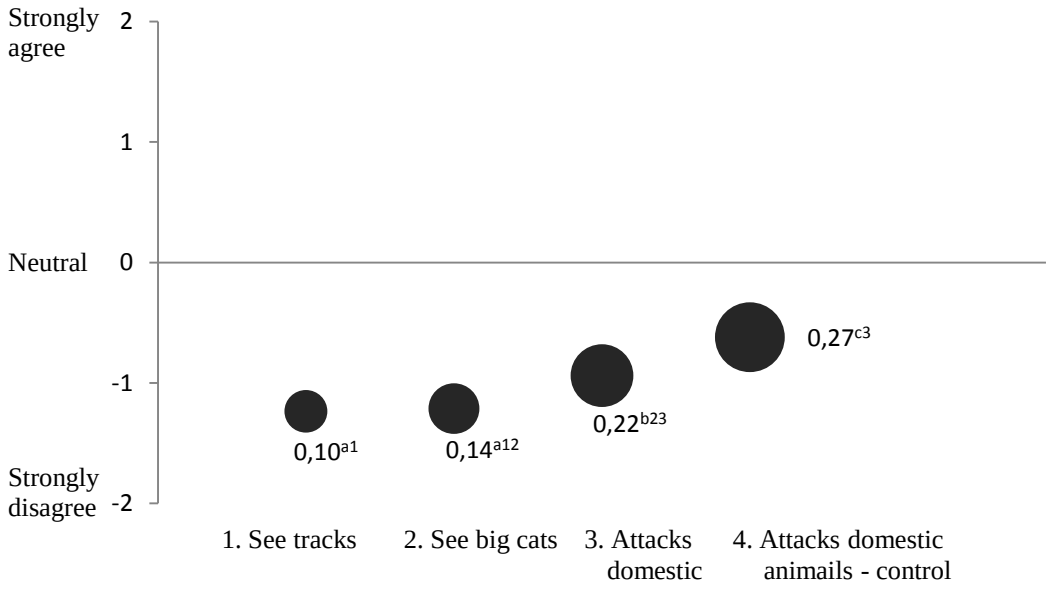

Figure 2.2.Mean acceptance ratings and Potential for Conflict Index$_2$ (PCI_2) values for overall acceptability of killing a big cat across four scenarios of people-big cats interactions: 1) see the tracks of a jaguar/puma close to my home; 2) see a big cat close to my home; 3) have a domestic animal (pet and/or livestock) killed by a big cat; and 4) have a domestic animal killed by a big cat, the individual should be allowed to kill the predator. Superscript letters ($^{a, b, c}$) above the PCI_2 values represent significance (*d*) in consensus ($p<.05$) across the 4 scenarios, and superscript numbers ($^{1, 2, 3}$) above the PCI_2 values represent significance between means.

2.4.2 Acceptability of killing a big cat by attitudes within scenarios

The attitude scale contained six positive and negative statements about jaguars and pumas (i.e. jaguars/pumas are a nuisance, jaguars/pumas pose a threat to people, and like/dislike jaguars/pumas). The Cronbach's alpha for the scale was .80, implying that the scale was 80% reliable (Vaske, 2008). On average, the respondents held a slightly positive attitude toward jaguars and pumas, since they liked the big cats and tended to disagree that these predators pose a threat to people in the region and were nuisance animals (M = .51, SD ± .80). Given that there was no significant difference in public attitudes between jaguars and pumas, responses were grouped into three new variables: a) big cats are nuisance, b) big cats pose a threat, and c) like/dislike big cats. Although 64% (n=206) did not consider (strongly disagreed and disagreed) that big cats were nuisance animals in the region, 25% (n=80) were neutral, and 11% (n=34) considered them a nuisance. Although 41% (n=129) did not see big cats as threats to people in the region, 30% (n=96) thought that they posed a threat to people; 29% (n=92) were neutral. Sixty-two percent (n=198) liked the big cats, while 18% (n=60) were neutral and 19% (n=61) disliked big cats.

Killing big cats was on average unacceptable. However, people who held negative attitudes were more accepting of killing a big cat in all scenarios. Although individuals who held negative attitudes disagreed (M = -.86, SD ± .92) with killing a big cat if they saw the tracks of these predators (scenario 1), they were neutral (M = -.09, SD± 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 positive attitudes within all scenarios, supporting hypothesis 2 (p<.05; Table 1).

On average, killing big cats was unacceptable for people who held positive attitudes in all scenarios. Despite mean responses from individuals who held negative attitudes were significantly different from individuals who held positive attitudes, there was no difference in the acceptance of killing big cats between individuals with positive attitudes and individuals with neutral attitudes in all scenarios. Mean acceptability of killing big cats from individuals who were neutral in their attitudes differed significantly from individuals with negative attitudes on scenarios 2 (big cat seen) and 3 (have a domestic animal attacked). According to Vaske et al. (2002), the effect size (η) was typical for all scenarios (Table 2.1).

Table 2.1. 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*)			*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[ab]	-1.35[b]	7.29	.001	.21
Scenario 2: see the big cat close to my home.	-.71[b]	-1.24[a]	-1.33[a]	.03	<.001	.24
Scenario 3: have a domestic animal (pet and/or livestock) killed by a big cat.	-.39[b]	-1.08[a]	-1.05[a]	8.60	<.001	.23
Scenario 4: If a jaguar/puma attack my domestic animals, I should be allowed to kill the predator.	-.09[b]	-.55[ab]	-.75[a]	7.32	.001	.21

The superscript letters ([ab]) represent significance between means based on the Bonferroni *post hoc* test for scenarios 1 and 4; and Tamhame *post hoc* test for scenarios 2 and 3.

Irrespectively of attitude type, residents demonstrated a high consensus level on their disagreement of killing big cats in scenario 1 (PCI_2 range = .09 - .11) and scenario 2 (PCI_2 range = .09 - .19). Killing a big cat in scenarios 3 and 4, however, generated lower level of consensus among individuals with different attitude types. Although in scenario 3 people who held positive attitudes had higher level of consensus (PCI_2 = .18) with not accepting the killing of big cats, people who held negative attitudes had lower level of consensus (PCI_2 = .31). A similar pattern to scenario 3 was also observed in scenario 4 with people expressing lower levels of consensus within attitudinal groups (PCI_2 range = .22 - .33) with the acceptability of killing big cats. There was no difference in consensus (PCI_2 values) between individuals who held positive, neutral and negative attitudes within scenarios 1, 2 and 4 (p>.05; Figure 2.3). However, there was significant difference in the level of consensus in scenario 3 between people with positive attitudes (PCI_2=.18) and people with negative attitudes (PCI_2=.31).

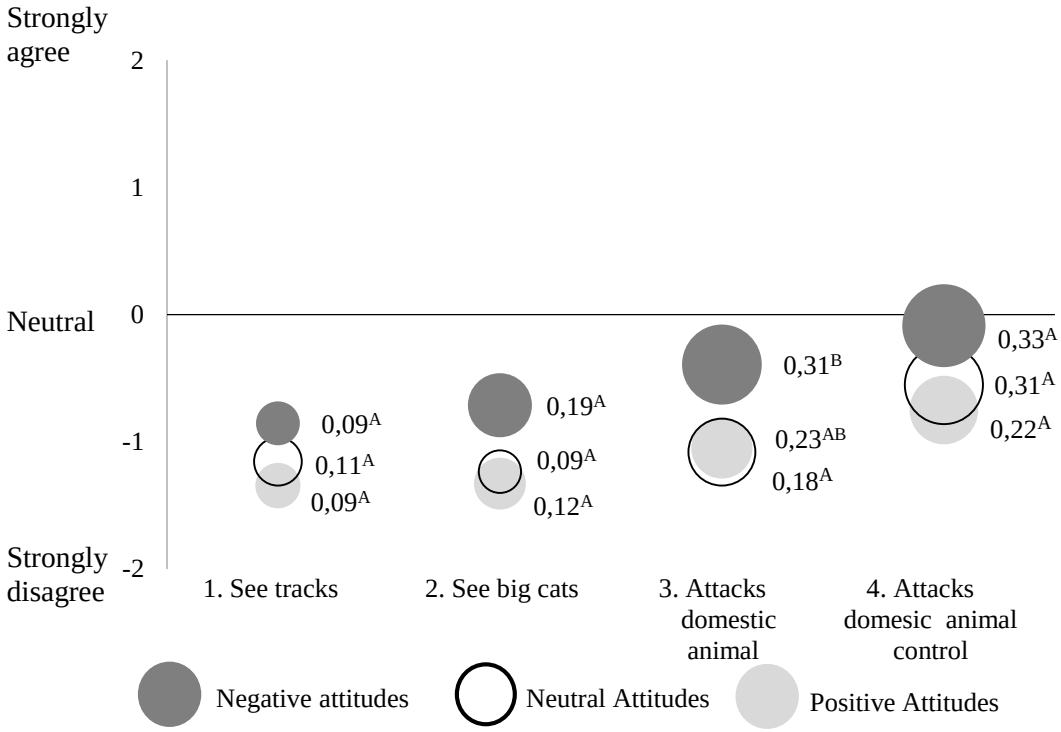

Figure 2.3. Potential for Conflict Index$_2$ (PCI_2) values for acceptability of killing a big cat by attitudes in four scenarios of people-big cats interactions: 1) see the tracks of big cats close to my home; 2) see the big cats close to my home; 3) have a domestic animal (pet and/or livestock) killed by big cats; and 4) have a domestic animal killed by big cats, I should be allowed to kill the predator. Superscript letters (^{AB}) above the PCI_2 values represent significance (*d*) in consensus ($p<.05$) between three groups (negative, neutral and positive attitudes).

2.5 Discussion

This study demonstrated that the local rural residents surveyed adjacent to PETAR and Intervales State Parks held slightly positive attitudes toward jaguars and pumas. The majority liked jaguars and pumas and did not consider the big cats as nuisance animals. Despite that less than half of respondents disagreed that big cats posed a threat to people in the region, the proportion of people who agreed that jaguars and pumas posed a threat to humans was similar to that of people who were neutral in their responses. Although attacks on humans are rare, jaguars and pumas are

commonly seen as threats to people (Conforti & Azevedo, 2003; Palmeira & Barella, 2007; Santos et al., 2008). Fear of jaguars and pumas influences public attitudes toward these predators (Engel et al., under review.). The documented belief that jaguars and pumas pose a threat to humans may be the result of fear from these predators. It is unlikely, however, that negative attitudes toward jaguars and pumas are based on the real risk these species may pose to people, but rather the perceived risk (Conforti & Azevedo, 2003). Further investigations is needed to explore the associations between fear, attitudes and beliefs that big cats are a threat to people.

Killing big cats was, on average, unacceptable. Yet, the overall acceptability of killing jaguars and pumas varied significantly across different scenarios of people-big cat interactions. As the severity of the interaction increased (i.e., from seeing the tracks of a big cat to having a domestic animal killed by a big cat), acceptability of killing a big cat increased. Additionally, as the severity of the interactions increased, consensus regarding the acceptability of killing the big cat decreased. Although killing a big cat was, on average, unacceptable, when people were segmented in subgroups based on their attitudes toward jaguars and pumas (negative, neutral, positive), individuals who held negative attitudes were less unaccepting of killing big cats. Previous research has shown that 54% (n = 15) of residents from two communities adjacent to Intervales State Park and PETAR State Park supported the elimination of jaguars as a management strategy to solve the problem of livestock predation (Palmeira & Barella, 2007). These authors explored individual's opinion about strategies to mitigate livestock predation (i.e. lethal control) from people previously involved in livestock loss. Although, it is important to note that past experience with livestock depredation are not always the predictor of individuals' acceptance of killing

(Conforti & Azevedo, 2003). Results from Palmeira and Barella (2007) also showed that residents held negative attitudes toward big cats. Although the questions used to assess attitudes were not the same from Palmeira & Barella (2007), the results found in this study could be associated to the previous finding in the sense that people holding negative attitudes could be more prone to accept and support the elimination of big cats to mitigate livestock predation.

Seeing the tracks of a big cat (scenario 1), or seeing a big cat close to residences (scenario 2), were not significant issues for the local residents surveyed. Even for people with negative attitudes toward jaguars and pumas, killing a big cat was unacceptable in these situations. This result is particularly important when considering the implementation of ecological corridors for the region (Rabinowitz & Zeller, 2010). Recent research has shown that pumas may be dispersing out of their natural habitats and into agricultural landscapes (e.g. sugar-cane plantations) (Miotto et al., 2010). As the number of big cats outside protected areas boundaries and preserved habitats increase, encounters between people and predators can increase. Recognizing situational differences allows managers to anticipate potential conflicts between people and big cats, and avoid illegal killing.

A significant difference in the mean overall acceptability of killing big cats was detected between scenario 3 (having a domestic animal attacked) and scenario 4 (having a domestic animal attacked, with personal control to kill the predator). Considering that the severity of the interaction was the same for both scenarios, this finding suggests that the difference in the overall acceptability of killing may be the result of the individual control over the event (i.e., kill) as it is in scenario 4. With control over the event (i.e., kill) people may be more accepting of killing a big cat in

all scenarios, and therefore more likely to perform the behaviour. Being allowed to kill the predator, however, is different from intending to kill and perform the behavior of killing the predator. According to Ajzen (2002), control beliefs give rise to perceived behavioral control, which in combination to other factors (i.e. attitude towards the behaviour, and subjective norm), lead to the formulation of the intention to perform a given behaviour. In the Amazon deforestation frontier, for example, landowners with a greater sense of control were more likely to intend to kill jaguars (Marchini & Macdonad, 2012). Given that the objective of the present research was not to predict behaviour, but rather assess acceptability of killing, it is recommended further investigation of behavioural intention to kill the predators, especially among individuals who hold negative attitudes toward jaguars and pumas. In addition, because the question asked in scenario 4 referred, ultimately, to the prohibition of hunting, the responses given could also be expressing the individual's feelings about the lack of control itself. In other words, the feelings may be related to the Brazilian hunting law. Although prohibited by law, hunting regulations provoke debate among people who agree and disagree with such regulations. In-depth analyses of people's perceptions, attitudes and acceptability toward hunting regulations would add valuable information to the understanding of the human dimensions of big cats in the Brazilian Atlantic Forest.

Except for scenario 2 (big cats seen) and scenario 3 (domestic animal killed by a big cat), the mean acceptance of killing big cats was not significantly different between individuals with neutral and negative attitudes within the scenarios. In addition, the mean acceptance of killing big cats was not significantly different between individuals with neutral and positive attitudes within all scenarios. Yet, the

mean acceptance of killing big cats was significantly different between the two groups that held positive and negative attitudes in all scenarios. These findings suggest that from a management perspective, communication campaigns and persuasive messages should focus on those with extreme negative attitudes, although extreme attitudes are more resistant to social influence (Pomerantz et al., 1995). However, understanding the drivers of this minority who have the potential to threaten the survival of jaguars and pumas is important as extreme attitudes tend to be consistent with behaviour (Sotirovic, 2004).

Apart from cognitive variables, perceptions toward jaguars can also be dependent on the number of livestock holdings (Conforti & Azevedo, 2003). In the surroundings of Iguaçu National Park, people with medium-size herds (50 – 500 animals) tend to be positive towards jaguars, whereas owners of small (<50 animals) and large (>500 animals) herds showed no tendency to negative perceptions (Conforti & Azevedo, 2003). The reason for this difference is unknown (Conforti & Azevedo, 2003), but given that acceptability of killing increased if a domestic animal was to be attacked by a jaguar or puma, further research should assess the effect of the size of herd on people's attitudes, fear and acceptability of killing.

The PCI_2 facilitated understanding similarities and differences in these attitudinal segments (i.e., positive, neutral, negative). The findings supported both hypotheses 3 (consensus regarding acceptance of killing a big cat will vary by the severity of the interaction) and hypotheses 4 (consensus will vary by attitudinal type). Hunting and killing wildlife is a sensitive topic, especially in countries where hunting is forbidden by law, as in Brazil. Less consensus was observed for the more severe scenarios, which reflected the ambiguity that this topic generates. Consensus among

attitudinal types within each scenario showed no difference, except for scenario 3, where individuals with negative attitudes differed significantly from individuals with positive attitudes. Furthermore, individuals who considered jaguars and pumas a threat to people, nuisance animals, and did not like them demonstrated more disagreement on their acceptability ratings for scenario 3. Although it may be contradictory, this finding supports the idea that even though some people may hold negative attitudes toward a species, they do not necessarily support and / or engage in negative behaviour that threatens its conservation, such as killing (Bruskotter & Wilson, 2014).

From a managerial and methodological perspectives, the use of PCI_2 provided a better understanding of both the mean responses and the level of consensus in each sample, as well as enhanced the interpretations of the results (Sponarski et al., 2015). However, to better understand the levels of acceptance of killing a big cat across different scenarios of interactions with people, future research should include scenarios of having domestic animals killed more than once. For wildlife managers, understanding the range of acceptance is crucial to avoid conflict with big cats.

2.6 Bibliography

Ajzen, I. (2002). Perceived behavioural control, self-efficacy, locus of control, and the Theory of Planned Behaviour. *Journal of Applied Social Psychology*, 32(4): 665 – 683.

Balme, G.A., Hunter, L.T.B., Goodman, P., Ferguson, H., Craigie, J., & Slotow, R. (2010). An adaptive management approach to trophy hunting of leopards (*Pantehrapardus):* a case study from KwaZulu-Natal, South Africa. Pages 341-352, in D.W. Macdonald, and A.J Lowerdige editors. *Biology and conservation of wild felids*. Oxford: Oxford University Press.

Bruskotter, J.T., & Wilson, R.S. (2014). Determining where the wild things will be: using psychological theory to find tolerance for large carnivores. *Conservation Letters*, 7(3): 158-165.

Carvalho, E.A.R. Jr., & Pezzuti, J.C.B. (2010). Hunting of jaguars and pumas in the Tapajos-Arapiuns Extractive Reserve, Brazilian Amazonia. *Oryx*, 44(4): 610-612.

Carvalho, E.A.R. Jr., & Morato, R.G. (2013). Factors affecting big cat hunting in Brazilian protected areas. *Tropical Conservation Science*, 6(2): 303-310.

Conforti, V.A., & Azevedo, F.C.C. (2003). Local perceptions of jaguars (*Panthera onca*) and pumas (*Puma concolor*) in the Iguaçu National Park area, south Brazil. *Biological Conseervation*, 111:215-221.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3): 297-334.

Cronbach, L.J., & Schavelson, R.J. (2003). My current thoughts on coefficient alpha and successor procedures. *Education and Psychological Measurements,* 64(3): 391-418.

Decker, D.J., Riley, S.J., & Siemer, W.F. (2012) Human Dimension of Wildlife Management. Pages 3-14, D.J. Decker, S.J. Riley, & W.F. Siemer editors. *Human Dimension of Wildlife Management*. The Johns Hopkins University Press, Baltimore, USA.

Galindo-Leal, C., & Câmara, I.G. (2003). Atlantic forest hotspots status: an overview. Pages 3-11, in Galindo-Leal and I.G. Câmara editors. *The Atlantic Forest of South America: biodiversity status, threats, and outlook*. Science and Island Press, Washington, USA.

Hazzah, L., Mulder, M.B., & Frank, L. (2009) Lions and Warriors: Social factors underlying declining African lion populations and the effect of incentive-based management in Kenya. *Biological Conservation,* 142: 2428-2437.

IUCN (2008). *Panthera onca. The IUCN Red List of Threatened Species v*. 2015.1.<www.iucnredlist.org>. [accessed06 June 2015].

IUCN (2011). *Panthera tigris. The IUCN Red List of Threatened Species v*. 2015.1.<www.iucnredlist.org>. [accessed06 June 2015].

Jacobs, M.H., Vaske, J.J., & Dubois, S. (2014). More than fear: role of emotions in acceptability of lethal control of wolves. *Europe Journal of Wildlife Research,* 60: 589-598.

Kleiven, J., Bjerke, T., & Kaltenborn, B.P. (2004). Factors influencing the social acceptability of large carnivore behaviours. *Biodiversity and Conservation*, 13:1647-1658.

Kretser, H.E., Curtis, P.D., & Knuth, B.A. (2009). Landscape, social, and spatial influences on perceptions of human-black bear interactions in the Adirondack Park, NY. *Human Dimensions of Wildlife*, 14: 393-406.

Krymkowski, D. H., Manning, R. E., & Valliere, W. A. (2009). Norm crystallization: Measurement and comparative analysis. *Leisure Sciences, 31*, 403-416.

Loveridge, A.J., Wang, S.W., Frank, L.G., & Seidensticker, J. (2010). People and wild felids: conservation of cats and management of conflicts. Pages 161-196, in in D.W. Macdonald, and A.J Lowerdige editors. *Biology and conservation of wild felids*. Oxford: Oxford University Press.

Machado, A.B.M., Drummond, G.M., & Paglia A.P. (2008). *Livro vermelho da fauna brasileira ameaçada de extinção*. MMA/ Fundação Biodiversitas, Brasilia, BR.

Manfredo, M. J., Zinn, H. C., Sikorowski, L., & Jones, J. (1998) Public acceptance of mountain lion management: A case study of Denver, Colorado, and nearby foothills areas. *Wildlife Society Bulletin*, 26(4), 964–970.

Manfredo, M.J., Yuan, S., & Bright, A.D. (2004). Application of the concepts of values and attitudes in human dimensions of natural resources research. In M.J. Manfredo, J.J. Vaske, D. Field, & P.J. Brown editotrs. *Society and natural resources: A summary of knowledge prepared for the 10th International Symposium on Society and Natural Resources*. Modern Litho, Jefferson, MO, USA.

Manfredo, M.J. (2008). *Who cares about wildlife? Social science concepts for exploring human-wildlife relationships and conservation issues*. Springer, Fort Collins, CO, USA.

Manning, R. E. (2011). *Studies in outdoor recreation: Search and research for satisfaction*. 3rd Edition. Corvallis, OR: Oregon State University Press.

Marchini, S., & Macdonald, D.W. (2012). Predicting ranchers' intention to kill jaguars: case studies in Amazonia and Pantanal. *Biological Conservation,* 147(1): 213-221.

Miotto, R.A., Cervini, M., Begotti, R.A., & Galetti Jr., P.M. (2010). Monitoring a puma (*Puma concolor)* population in a fragmented landscape in Southeast Brazil. *Biotropica,* 44(1): 98-104.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Fonseca, G.A.B.da, & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403: 853-858.

Palmeira, F.B.L, & Barella, W. (2007). Conflitos causados pela predação de rebanhos domésticos por grandes felinos em comunidades quilombolas na Mata Atlântica. *Biota Neotropica*, 7(1): 120-128.

Pomerantz, E. M., Chaiken, S., & Tordesillas, R. S. (1995). Attitude strength and resistance process. *Journal of Personality and Social Psychology,* 69: 408–420.

Rabinowitz, A. & Zeller, K. (2010). A range-wide model of landscape connectivity and conservation for the jaguar, *Panthera onca*. *Biological Conservation,* 143(4): 939-945.

Ribeiro, M. C., Metzger, J. P., Martensen, A. C., Ponzoni, F. J. &Hirota, M. M. (2009). The Brazilian Atlantic Forest: How much is left, and how is the remaining

forest distributed? Implications for conservation. *Biological Conservation,* 142:1141-1153.

Sandbrook, C., Adams, W.M., Büscher, B., &Vira, B. (2013). Social research and biodiversity conservation. *Conservation Biology,* 0(0): 1-4.

Sanderson, E.W., Redford, K.H., Chetkiewicz, C.L.B., Medellin, R.A., Rabinowitz, A.R., Robinson, J.G, & Taber. A.A. (2002). Planning to save a species: the Jaguars as a model. *Conservation Biology* 16(1):58-72.

Santos, F.R., Jácomo, A.T.A., & Silveira, L. (2008). Humans and jaguars in five Brazilian biomes: same country, different perceptions. *CAT News*, 4:21- 25.

Smith, N.J.H. (1976). Spotted cats and the Amazon skin trade. *Oryx*, 13: 362–371.

Sotirovic, M. (2004). Effects of media use on complexity and extremity of attitudes toward the death penalty and prisoner's rehabilitation. *Medipsychology,* 3: 1-24.

Sponarski, C.C., Vaske, J.J., & Bath, A.J. (2015). Differences in management action acceptability for coyotes in a National Park. *Wildlife Society Bulletin*, 9999: 1-9.

Thornton, C., & Quinn, M.S. (2010). Risk Perceptions and Attitudes toward Cougars in the Southern Foothills of Alberta. *Human Dimensions of Wildlife*, 15: 359-372.

Vaske, J.J., & Donnely, M.P. (1999). A value-attitude-behavior model predicting wildland preservation voting intentions. *Society and Natural Resources*, 12: 523-537.

Vaske, J.J., Gliner, J.A., & Morgan, G.A. (2002). Communicating judgments about practical significance: effect size, confidence intervals and odds ratios. *Human Dimensions of Wildlife,* 7: 287-300.

Vaske, J.J. (2008). S*urvey Research and Analysis: Applications in Parks, Recreation and Human Dimensions*. Venture Publishing, Pennsylvania, USA.

Vaske, J.J, & Manfredo, M.J. (2012). Social Psychological Considerations in Wildlife Management. Pges 43-57, in D.J. Decker, S.J. Riley, & W.F. Siemer editors. *Human Dimension of Wildlife Management*. The Johns Hopkins University Press, Baltimore, USA.

Vaske, J.J., Beaman, J., Barreto, H., & Shelby, L.B. (2010). An extension and further validation of the Potential for Conflict Index. *Leisure Sciences*, 32: 240-254.

Zeller, K. (2007). *Jaguars in the new millennium data set update: the state of the jaguar in 2006.* Wildlife Conservation Society, USA.

Chapter 3.

Predicting acceptability of jaguars and pumas in the Atlantic Forest, Brazil

3.1 Introduction

Anthropogenic mortality of large carnivores has resulted in the decline of several species around the globe (e.g. Chapron et al., 2008; Marker, Dickman, Mills, & Macdonald, 2010; Zeller, 2007), affected their population dynamics, and consequently the resilience of ecosystems (Loveridge, Wang, Frank, & Seidensticker, 2010; Ripple & Beschta, 2006). The expansion of human settlements into natural areas and livestock depredation has driven the conflict between humans and wildlife (Marchini, 2014). Human-wildlife conflict (HWC), however, is not limited to the damage caused by wildlife to livestock, crops and human lives. HWC also reflects differences in individual's value orientations toward wildlife and their management (Marchini, 2014). Therefore, HWC represents both the conflicts of interest amongst different groups toward wildlife, and the actual conflict between people and a particular wildlife species. These people-people and people-wildlife conflict situations are now a primary issue facing wildlife conservation (Marchini, 2014) that necessitates economic, legal, social, psychological and policy considerations (Knight, 2000).

The severity of human-felid conflict increases with the animal's body mass (Inskip & Zimmerman, 2009). The relationship between people and wild cats, however, is complex and paradoxical (Loveridge et al., 2010). While some people hold negative perceptions of these large carnivores in areas where they coexist, others value the existence of big cats (Loveridge et al., 2010). According to Loveridge et al. (2010, p.161) "the way in which people value and interact with organism and their habitats is at the heart of conservation". When different perspectives toward wildlife are incompatible, conflict situations amongst interest groups emerge that potentially jeopardize conservation efforts and social support for protected areas (PAs) (Treves (2009).

PAs are defined geographical spaces, recognized, dedicated and managed with the objective to promote *in situ* conservation of species, populations and ecosystems (IUCN, 2008). The successful conservation of big cats, however, does not depend exclusively on PAs. Ecological corridors, which provide the exchange of genetic material and thus slow inbreeding of isolated populations (Macdonald et al., 2012), are crucial for the conservation of jaguars and pumas in the Brazilian Atlantic Forest, a highly fragmented biodiversity hotspot (Costa, Leite, Mendes, & Dietchfield, 2005; SOS Mata Atlântica/INPE, 2015). The implementation of ecological corridors in the Atlantic Forest are important for several reason. First, jaguars in the Atlantic Forest are in decline and if no action is taken, this could be the first forested biome in Brazil to lose its largest predator (Galetti et al., 2013). Second, there are fewer than 250 mature jaguars in the Atlantic Forest, which are already separated in 8 sub-populations (Beisiegel, Sana & Moraes, 2012). Finally, as top predators, jaguars and pumas provide a crucial service in controlling herbivores (e.g., capybaras, deer, peccaries and

wild boars) and smaller predators (e.g., ocelots, foxes, and raccoons), and their extinction in the biome will likely disrupt predator-prey interactions with unpredictable effects on ecosystem functions (Jorge, Galetti, Ribeiro, & Ferraz, 2013).

However, species that range widely are the most likely to disappear from reserves, and are, therefore, most exposed to threats in reserve borders (Loveridge et al., 2012; Woodroffe and Ginsberg, 1998). In human occupied landscapes, such as PAs border areas, human-wildlife conflict often emerges because of the intolerance of the people who are visited by the carnivores (Consorte-McCrea, 2011). Such evidence stresses the fact that traditional ecological and conservation-based research of large predators will probably fail without the knowledge provided by the social sciences regarding human behavior toward wildlife (Ritchie et al., 2012). The conservation of apex predators will require, therefore, not only habitat restoration, but also a greater public acceptance of these predators, especially among people directly affected by them (Prugh et al., 2009). Given that ecological corridors have been proposed for the Atlantic Forest (see Rabinowitz & Zeller, 2010), people's tolerance toward big cats in those areas connecting PAs is a crucial element that should be taken into account when planning for conservation (Zeller Rabinowitz, Salom-Perez, & Quigley, 2013). Besides, although the major threat affecting jaguars and pumas outside protected areas is persecution (Costal et al., 2005), little has been done to understand tolerance and prevent persecution from happening.

The overarching goal of this study was to understand rural residents' acceptability of jaguars and pumas. Emotional dispositions (i.e. sorrow and fear), attitudes toward big cats and the management agency, existence values toward jaguars and pumas, as well as credibility of the management agency were used as predictors

of acceptability. The objectives were to: (a) inform decisions regarding the implementation of ecological corridors in the Atlantic Forest, and (b) contribute to the formulation of a framework for understanding people's acceptability of wildlife.

3.1.1 Theoretical framework

The proposed model is based on the principles of the cognitive hierarchy, where general concepts (e.g., general attitudes toward big cats) are predicted to influence more specific constructs (e.g., existence value towards big cats in the Vale do Ribeira region), that are used to evaluate objects or situations (e.g., acceptability) (Fulton, Manfredo, & Lipscomb, 1996; Vaske & Manfredo, 2012). Originally, the cognitive approach did not explicitly consider the role of emotional disposition as a predictor of behaviour (Vaske & Manfredo, 2012). However, emotions inform cognitions (Manfredo, 2008) and can communicate social acceptance (Jacobs, Vaske, & Dubois, 2014; Vaske & Manfredo, 2012). For this reason, exploring the influence of emotions on cognitions will improve the understanding of human response to wildlife (Jacobs, 2012). In the proposed model, emotions (e.g., fear of jaguars and pumas, and sorrow) are expected to influence cognitive dispositions. In addition, the effect of social credibility of the management agency on acceptability is examined (e.g., Bruskotter & Wilson, 2013; Sponarski, Vaske, Bath, & Musiani, 2014; Zajac, Bruskotter, Wilson, & Prange, 2012).

Emotions toward wildlife reflect our most basic reactions to animals that can lead to either conflict or coexistence (Jacobs, Vaske, & Roemer, 2012; Manfredo, 2008). Given that emotional dispositions are traits (reflecting *who* you are), they are usually stable and always present even if they are not active (Vaske & Manfredo,

2012). According to Dickman, Marchini, and Manfredo (2013), people may simultaneously like, hate, admire and fear large carnivores. Fear is a basic human emotion (Izard's, 1977; Kemper, 1987) that influences the way people experience and respond to wildlife (Bruskotter & Wilson, 2014; Dickman et al., 2013; Jacobs et al., 2014; Manfredo, 2008), for example, affecting the acceptance of bears (Zajac et al., 2012), the intention to kill jaguars (Marchini & Macdonald, 2012), and the attitudes toward Eurasian lynx (Bath, Olszanska, & Okarma, 2008) and wolves (Bath, 2009). Although the majority of the studies addressing emotions toward wildlife have focused on fear (see Jacobs et al., 2012), previous research on feelings and cognitions toward zoo polar bears found sorrow as an important negative emotion expressed by visitors who were concerned about the bear's welfare (Marseille, Elands, & Van Den Brink, 2012). In the Vale do Ribeira region, jaguars are highly threatened, and the possibility of a local extinction could generate either a sense of sorrow or relief, which could guide, directly or indirectly, acceptability for this particular jaguar population.

Attitudes are influenced by emotions (Manfredo, 2008); attitudes represent an evaluation either favorable or unfavorable about a person, management action, wildlife, or policy, and have been shown to influence human behavior (Vaske & Donnelly, 1999; Vaske & Manfredo, 2012). Despite the range of literature investigating attitudes toward large carnivores and their management (e.g., Agee & Miller, 2009; Bath et al., 2008; Consorte-McCrea, 2013; Sponarski et al., 2014), little is known about attitudes toward jaguars and pumas in the Brazilian Atlantic Forest, and the relationship between emotions, attitudes, existence values, and behavior toward these predators. Attitude studies of jaguars have primarily concentrated on sites where people have been directly involved in conflict with jaguars and/or are

livestock owners (i.e., Conforti & Azevedo, 2003; Marchini & Macdonald, 2012; Palmeira & Barella, 2007; Zimmerman et al., 2005). According to Consorte-Mc-Crea (2011), because conservation problems reflect the consequences of societal relationships with nature, people's attitudes are particular relevant to research. In this article, individuals' general attitudes toward jaguars and pumas were examined, irrespectively of the source of income or history of livestock depredation. Although the cognitive hierarchy model proposes that beliefs precede attitudes (Vaske & Donelly, 1999), for the present study, attitudes toward big cats are general and broad while existence value (i.e. belief) is specific to a particular jaguar population. Hence, to be consistent with the principle of hierarchy, it is expected that the more general cognition (attitudes) will influence the more specific cognition (belief). In addition, the influence of specific attitudes toward the park on agency credibility and acceptability were assessed.

Existence values are assessed through either an economic or cognitive perspective. From an economic perspective, existence value has been operationalized in terms of an individual's willingness to pay for biodiversity conservation (see Kontogianni, Tourkalias, & Skourtos, (2012) for a review). From a cognitive perspective, existence values represent a belief that certain species have an intrinsic right to exist (Park & Allaby, 2013; Steven et al., 1991). Given that carnivores do not have a market priced existence value (Macdonald, 2001), we adopted the cognitive perspective. Previous research of existence value as a cognitive component has found that wildlife positive existence value predicted acceptability for trapping and relocating black bears from urban areas in Central Georgia (Agee & Miller, 2009). Positive existence value also predicted acceptance for trap and euthanasia of feral cats

in Illinois (Loyd & Miller, 2010), and the support of non-hunters for mountain lion protection in North Dakota (Davenport, Nielsen, & Mangun, 2010).

Another component of the proposed model is credibility. Credibility (hereafter agency credibility) refers to the degree of confidence in a person or institution based on perceived performance records and trustworthiness (Fayram, Schenborn, Hennessy, Nate, & Schmalz, 2009; Renn & Levine, 1991). This refers to the trust people have of the management agency (Fayram et al., 2009) to successfully deliver information about big cats and their management. The history of strict PAs implementation in Brazil illustrates that conflict between local people and governmental authorities (Brito, 2008) affect credibility and wildlife conservation. The adoption of such a strict model of PAs in Sao Paulo state increases the illegal exploitation of natural resources (leading to people-state conflict), and affects conservation objectives since the management of these areas are complex and difficult (Arruda, 2000).

Political conflicts around PAs stem from a contradiction of views about wildlife, divergent interests between governmental authorities and the public, or from a lack of communication and inclusion of local communities in the decision making process (Consorte-McCrea, 2011). The implementation of Intervales state park in 1995 created a conflictual scenario between traditional communities and the state, since most parts of their territories overlapped with the original area proposed for the park (Palmeira & Barella, 2007). Although the territories of these communities were recognized by a state decree and excluded from the park perimeter in 2001, some of these traditional communities still do not possess the legal ownership of their lands and suffer the pressure of the state. The official implementation of PETAR state park

in the 1980s also generated land conflict between the residents and the state, as some of their agricultural lands were inside the park boundaries making it impossible to continue with agriculture practices (Silveira, 2010). According to Comissão Pró-Índio de São Paulo, a non-governmental organization working with indigenous and traditional communities since 1978, such restrictions may have increased the demand for forest products and consequently the conflict with local authorities. Apart from the tensions with the state, some residents adjacent to PETAR state park also express resentment due to the changes in their livelihoods (Silveira, 2010).

PAs, therefore, pose a fundamental dilemma (Treves, 2009). On one hand is the intention to preserve the biological heritage; on the other are the individual and economic motivations to safeguard human livelihood. Thus, agency credibility is crucial to any conservation program and to avoid conflict with local people (Fayram et al., 2009). Similarly, lack of agency credibility can affect the effectiveness of risk information (Arvai, Wilson, Rivers & Froschauer, 2004) and compromise communication and education campaigns.

Finally, acceptability of wildlife is essential in wildlife conservation, since people's acceptability influences a species distribution and density (Bruskotter & Wilson, 2014; Ripple et al., 2014). The concept of acceptability reflects the extent that an individual considers a wildlife species or management action, acceptable or unacceptable (Jacobs et al., 2014). In this study, the public's acceptability for jaguar and puma presence in the PA region, as well as the factors that can influence such acceptability were examined.

3.1.2 Hypotheses

Based on previous research on large carnivore management (i.e. Bath et al., 2008; Davenport et al., 2010; Dickman et al., 2013; Manfredo, Zinn, Sikorowski, & Jones, 1998; Sponarski et al., 2014), and the role of agency credibility (Fayram et al., 2009), it is hypothesized that (see Figure 1):

H_1 fear negatively relates to attitudes, existence value, agency credibility and acceptability, meaning that as fear increases, attitudes and existence value becomes more negative, and agency credibility and acceptability decreases.

H_2 sorrow positively relates to attitudes, existence value, agency credibility and acceptability, meaning that as sorrow for local extinction of big cats increases, attitudes and existence value become more positive, and agency credibility and acceptability increase.

H_3 attitudes toward jaguars and pumas positively relate to existence value and acceptability, meaning that as attitudes become more positive, existence value becomes more positive and acceptability of jaguars and pumas increase.

H_4 attitudes toward the park positively relate to agency credibility and acceptability, meaning that as attitudes become positive, agency credibility and acceptability increase.

H_5 existence value positively relates to acceptability, meaning that as existence value becomes positive, acceptability of jaguars and pumas increases.

H_6 agency credibility positively relates to acceptability of jaguars and pumas.

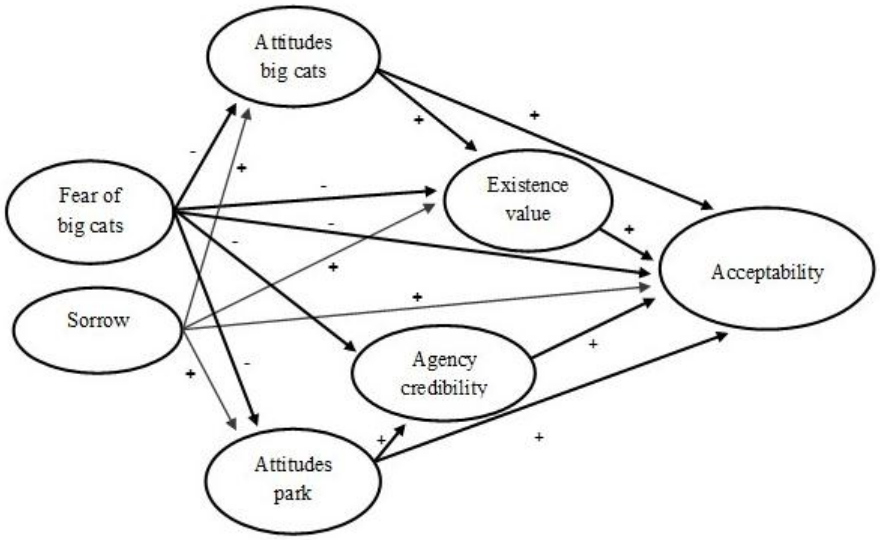

Figure 3.1. Hypothesized relationships among fear, sorrow, attitudes, existence value, park's management agency credibility and acceptability of an increase of jaguars and pumas. The plus or minus signs on the arrows indicate the hypothesized relationship between the constructs.

3.2 Study area

The study was conducted in the municipalities of Iporanga (4300 inhabitants) and Ribeirão Grande (7420 inhabitants), located in the Vale do Ribeira region, in the southwest of Sao Paulo State, Brazil. The main economic activity in the region is small-scale farming (Institute Brasileiro de Geografia e Estatistica/IBGE, 2010). Both municipalities are located adjacent to two protected areas, Alto Ribeira State Park (PETAR) and Intervales State Park (Figure 2). These two parks, along with Carlos Botelho State Park and Xitué Ecological Station (not included in this study), form the Paranapiacaba Ecological Continuum (PEC), which is the single largest tract of

Atlantic Forest in Brazil, with 140,000 ha of continuous forest of numerous types and in all stages of ecological succession. This area is considered as the core of "The Southeast Reserves of Atlantic Forest", a World Heritage Site (UNESCO, 1999), and part of the Serra do Mar Ecological Corridor.

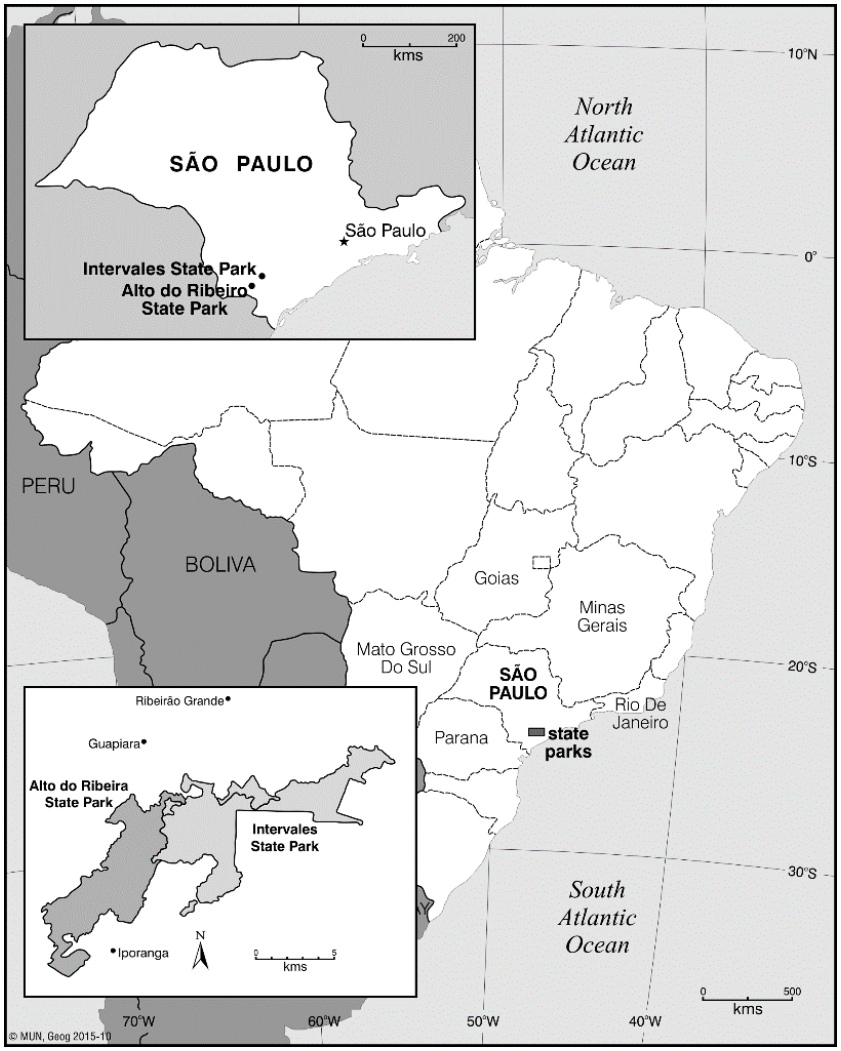

Figure 3.2. Study area. In the top-left corner highlighting Sao Paulo State and the location of Intervales and Alto do Ribeira State Parks. In the lower-left corner, highlighting the area of the parks with the municipalities of Ribeirao Grande and Iporanga. © C. Conway (Dept. Geography/MUN)

3.3 Methods

3.3.1 Data collection

During the months of May and June 2014, self-administered structured questionnaires were administered to rural residents (due to the higher probability of encounter with a big cat) of Iporanga and Ribeirao Grande. The instrument was previously tested during a pilot survey to adjust the vocabulary and length of time to respond to the questions. Data were collected using two different approaches. To collect data from individuals 18 years or older, 490 questionnaires were sent to the adults via rural elementary schools in the study area. Residents received the questionnaire accompanied by a cover letter explaining the purpose of the study and requesting the participation of one member of the family (father, mother or guardian). Questionnaires were returned via their children to the school within 10 days. The response rate was 38% (n = 187). Data from individuals between 15 and 17 years old were obtained from self-administered questionnaires completed in the classroom of six different classes of two high schools (n = 139, response rate = 65%). The schools were randomly selected, and before the questionnaires were distributed, the purpose of the study was explained and the students were invited to participate. Individuals had the option not to participate in the study. A total of 326 completed questionnaires were collected.

The questionnaire was designed to assess the following latent constructs: fear of jaguars and pumas (6 items), sorrow for the possible disappearance of jaguars and pumas (2 items), attitude towards jaguars and pumas (2 items), attitude towards the park (1 item), existence value (2 items), agency credibility (1 item) and acceptability

of jaguars and pumas in the region (2 items). For each of the constructs, questions were separated between jaguars and pumas. Fear of jaguars and pumas was measured at three different levels: 1) fear for own personal safety, 2) fear for family's safety, and 3) fear for domestic animal's safety. To measure sorrow, respondents were asked if they would feel sorry if jaguars and pumas were to disappear from the region. To assess attitudes toward jaguars and pumas, respondents were asked to evaluate the extent they like or dislike the big cats. Responses were coded as "strongly dislike (-2)", "dislike (-1)", "neutral (0)", "like (+1)" and "strongly like (+2)". To assess attitudes toward the park, respondents were asked to evaluate the park as "extremely bad (-2)", "moderate-bad (-1)", "neither good nor bad (0)", "moderate-good (+1)", and "extremely good (+2)". Park's credibility was measured through the following sentence: "how much, if anything, would you believe in the park authorities in offering you information about jaguars and pumas?" Answers were coded in a five-point scale: "nothing (0)", "a little (1)", "about half (2)", "most of it (3)", and "all of it (4)". As for acceptability, respondents were asked if they accept jaguars and pumas in the area of the parks. Answers for fear of jaguars and pumas, sorrow, existence value and acceptability were coded on a five-point scale with "strongly disagree (-2)" and "strongly agree (+2)" as extreme answers and a neutral point in the middle.

3.3.1 Analyses

Paired *t*-tests were used to test if attitudes, existence value, fear and acceptability were the same for jaguars and pumas. If fear, sorrow, attitudes, existence value, and acceptability were the same for jaguars and pumas. Cronbach's alpha was used to estimate the internal consistency of the scales containing more than 1 item.

Confirmatory factor analysis (CFA) was used to verify the legitimacy of the conceptual measurements of the latent variables. Structural equation model (SEM) was used to estimate the interrelationships among the latent variables in the model. LISREL version 8.8 was used to fit the model using the covariance matrix. The overall model fit was assessed using the following goodness-of-fit indices: chi-square (χ^2/df), the Comparative Fit Index (CFI, with an acceptable CFI $\geq$ .95), the Root Mean Squared Error of Approximation (RMSEA, with an acceptable RMSEA < .06 to .08), and the Normed Fit Index (NFI, with an acceptable NFI value $\geq$ .95) (Schreiber et al., 2006).

3.4 Results

The survey was completed by 326 individuals. In the sample, 56% were female and 44% were male. Forty-three percent were high school students with ages between 15 and 17 years old, and 57% were adults (>18 years old). Differences between adults and youth were tested. Since there was no significant difference between the two age groups (p>.05), youth and adults were aggregated in the proposed model. In addition, as there was no significant difference in people's responses between jaguars and pumas for any of the variables explored in this research (p>.05), the model also refers to existence value, attitudes, fear, sorrow, and acceptability towards both big cats, instead of jaguars and pumas separately. Therefore, the variables regarding jaguars and pumas were combined for each concept.

3.4.1 Latent variables

The confirmatory factor analyses confirmed the constructs associated with the latent variables, with factor loadings being >.90. The internal reliability of the scales from concepts containing more than one item (one for jaguar and one for puma) were high and acceptable (Vaske, 2008). The Cronbach's alpha for fear was .93, for sorrow .95, for existence value .92, for attitude towards big cats .92, and for acceptability .92.

The majority of respondents (84%) feared for their own personal safety, their family's safety and their domestic animals' safety (*M*=.80, *SD* ± .88). Overall, people would feel sorry if jaguars and pumas were to disappear from the region (*M*=.60, *SD* ± 1.16). While 62% agreed and strongly agreed they would feel sorry if the big cats were to disappear, 20% would not feel sorry, and 18% of the respondents were neutral. Overall, people held a slightly positive attitude toward the big cats (*M*=.53, *SD* ± 1.07). Nearly two-thirds (62%) of the respondents liked or strongly liked both jaguars and pumas; the remainder either did not like them (19%) or were neutral (19%). Attitude towards the park was positive (*M*=.96, *SD* ± 1.29), with two-thirds of the respondents evaluating the park as good (66%). Yet, 11% of the respondents evaluated the park as "bad", and 23% considered the park as neither good nor bad.

Agency credibility was mixed among the residents (*M*=1.93, *SD* ± 1.29). In general, people would believe in about half (33%), most (18%) and all of (15%) what the park's authorities would say regarding jaguars and pumas. However, 18% of the respondents would believe nothing and 16% would believe just a little. Existence value towards jaguars and pumas was positive (*M*=1.07, *SD* ± .91). While the majority of the respondents agreed and strongly agreed (82%) it is important to know that jaguars and pumas exist in the region, 8% of the respondents were negative and 10%

were neutral in their responses. Finally, respondents were slightly positive in their acceptability of jaguars and pumas in the park areas (M=.49, SD ± 1.04). Although a slight majority of people were supportive of having jaguars and pumas present (55%), almost as many of them were either neutral (28%) or against it (17%).

3.4.2 Structural Equation Model

The model fit of the data was acceptable (χ^2 = 34.01, df = 23, χ^2/df = 1.47; RMSEA (.038); NFI (.977); CFI (.992)) (Schreiber et al., 2006). Hypothesis 1 was partially confirmed, as there was a negative effect of fear on attitudes (β= -.21, p < .001). Fear, however, did not relate to attitudes toward the park, existence value, agency credibility nor acceptability of jaguars and pumas. Although feeling sorry for the disappearance of jaguars and pumas did not relate to attitudes toward the park, it had a positive and significant effect on attitudes toward big cats (β = .36, p <.001), on existence value (β = .32, p <.001), and on acceptability (β = .21, p <.001) (hypotheses 2).

Attitudes toward jaguars and pumas had a positive and significant effect on existence value (β = .18, p < .005), and on acceptability (β = .28, p< .001; hypothesis 3). On the other hand, attitudes toward the park did not relate to acceptability, but it positively affected agency credibility (β = .20, p = .001; hypotheses 4). Agency credibility also had a direct and positive effect on the acceptability of the big cats (β = .15, p = .005; hypothesis 6). As hypothesized, as existence values become more positive, acceptability of jaguars and pumas increase (β = .14, p < .05; hypothesis 5). The proposed model explained 18% of the variance for attitudes toward the big cats, 4% of

the variance for agency credibility, 20% of the variance for existence value, and 28% of the variance for acceptability (Figure 3).

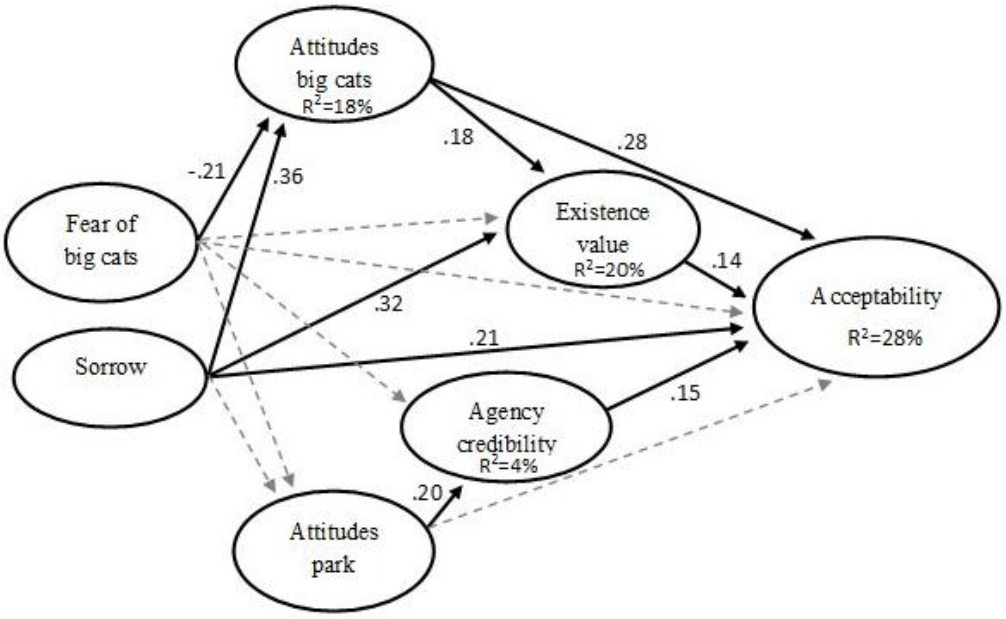

Figure 3.3. The acceptance model. Path coefficients are standardized regression coefficients. The solid lines between the variables indicate significant direct effect ($p < .05$), and dashed lines indicate no significant direct effect ($p > .05$).

3.5 Discussion

Results from this study have shown that acceptability of big cats around the state parks of Intervales and PETAR in Brazil's Atlantic Forest was predicted by sorrow, attitudes toward the big cats, existence values, and agency credibility. Different from expected, fear did not influence acceptability of jaguars and pumas in the park's region, but it negatively influenced attitudes toward the big cats. No

difference in people's perception between jaguars and pumas were found, thus corroborating findings from Conforti & Azevedo (2003). Livestock depredation is not common in these areas and jaguars are not abundant, hence people's perception may be similar for both species. Perceptions between these two species may be different in regions where jaguars are seen as "competitors" to humans, such as in the Brazilian Amazonia and Pantanal.

Although the variables assessed in this study only explained 28% of the variance in acceptability of big cats, the model fit was strong and acceptable, hence attention should be given to the findings. Between the two emotional dispositions assessed, sorrow was more important than fear in the model. The fact that most people would feel sorry if jaguars and pumas disappear is supported by Santos, Jácomo, & Silveira (2008) who found that approximately 84% of the interviewees from the Atlantic Forest biome believed that jaguars should not be eliminated from the wild. Yet, while the majority of the respondents agreed they would feel sorry (62%), our findings showed that 20% of the respondents would not feel sorry if jaguars and pumas disappeared; thus corroborating findings from others (Palmeira & Barella 2007; Santos et al., 2008). Such evidence suggest that a minority of people is still against the presence of jaguars and pumas in the region. Given that the number of mature jaguars in the Serra do Mar corridor is approximately 30-50 individuals (Beisiegel et al., 2012), it is not required a large number of people with negative emotions and attitudes to threaten the survival of the big cats. A longitudinal study to assess whether there is a growth or change of local support for the elimination (i.e. lethal control, or removal of problem animal) of jaguars and pumas in the region

would aid information to decision makers when implementing ecological corridors and planning for conservation.

Attitudes toward jaguars and pumas was predicted by fear, meaning that as fear increases, attitudes become more negative. Bath et al. (2008) found a similar correlation between fear and attitudes toward Eurasian lynx in Poland, where people with less positive attitudes toward lynx were the most afraid of the lynx. Similarly, fear had a negative influence on people's acceptability for black bears in Ohio, an area with an emerging black bear population (Zajac et al., 2012). Different from previous research (e.g. Zajac et al., 2012), fear did not directly predict acceptability for big cats. This contrasting result could be due to different measures and constructs applied in this study (i.e. Zajac et al. (2012) associated fear with risk perception), because different species elicit different results (Jacobs et al., 2014) even following in the same fear-relevant animal category, or because emotional reaction to a species (specifically fear) is a secondary factor driving people's acceptance for wildlife (Bruskotter & Wilson, 2013). The recent attention on the role of emotions on the people-wildlife relationship (Manfredo, 2008; Vaske & Manfredo, 2012), together with the challenges to conceptually and empirically investigate the relationships between emotional and cognitive dispositions (Jacobs et al., 2012) warrants further investigation in how emotions, such as fear, can affect acceptability for wildlife.

Fear was not the most important emotion in the model, yet it is an important element in people's perceptions of big cats in the Atlantic Forest. At present, only one unprovoked fatal attack by a jaguar on a human has been documented in Brazil (Neto, Neto, & Haddad, 2011). In 1998, however, a man from the Vale do Ribeira was injured by a jaguar while it was attacking his pigs. According to Palmeira and Barella

(2007), this episode could still be influencing people's fear associated with the big cats, even though it was a provoked attack. People from the region still refer to this episode as an example of the threat of jaguars to humans. Added to this episode, livestock predation also incites fear and support toward killing jaguars and pumas in the region (Palmeira & Barella, 2007). Although rare, events of predation may have a disproportional effect on attitudes toward predators, increasing negative feelings and beliefs (Hill, 2004).

Decreasing fear among local residents may increase positive attitudes and consequently acceptability. According to Marchini and Macdonald (2012), fear influences ranchers' intentions to kill jaguars in Amazonia. As fear is also influenced by knowledge (Cavalcanti, Marchini, Zimmermann, Gese, & Maconald, 2010), to increase the acceptability of jaguars and pumas, managers are encouraged to implement educational and communication efforts addressing livestock predation by jaguars. Such programs might help farmers correctly identify a depredation event, implement preventive measures, and adjust often exaggerated perceptions of jaguar impact on livestock and human safety to reality (Marchini, 2010).

On average, people held a slightly positive attitude towards the big cats. Nonetheless, attitudes toward jaguars are mixed and can be difficult to predict (Zimmerman et al., 2005). Positive attitudes toward jaguars and pumas have been documented in different parts of the Atlantic Forest biome (e.g., Conforti & Azevedo, 2003). However, in two communities adjacent to PETAR and Intervales State Parks, Palmeira and Barella (2007) found negative attitudes toward these big cats. Negative attitudes toward jaguars have also been documented in Amazonia and Pantanal (Marchini & Macdonald, 2012). While in some parts of North America and Brazil

people held positive attitudes toward pumas (e.g., Casey, Krausman, Shaw & Shaw, 2005; Conforti & Azevedo, 2003), in Chile and Argentina pumas elucidate negative attitudes among people (Lucherine & Merino, 2008; Silva-Rodríguez, Ortega-Solís, & Jiménez, 2007). These findings suggest that attitudes toward big cats are context specific, and influenced by different forces such as experience with livestock loss, social norms, fear, and knowledge about the species. Given that attitude towards the big cats was the strongest predictor of acceptability, investigating the drivers of attitudes in different contexts is fundamental to increase public support for jaguars and pumas.

Agency credibility also predicted acceptability of big cats. Although agency credibility was the weakest predictor in our model, this evidence is crucial for wildlife managers and other interest groups alike. Examples from fishery management suggests that agency credibility is critical if successful management is to be achieved (Fayram et al., 2009). Previous research has found that, among other factors, lack of trust represents a barrier in natural resource planning (Lachapelle, McCool, & Patterson, 2003). Distrust of the management agency is also recognized as an obstacle to a positive relationship between communities and authorities affecting constructive dialogue and public inquiry (Nie, 2003). While PAs have ecological benefits for jaguars and pumas, local residents may not perceive that the benefits outweigh the costs. In this part of Brazil, park establishment and the early relationship between park authorities and local residents (Palmeira & Barella, 2007) could have generated this fairly moderate level of credibility. As documented by Engel et al. (in preparation), social-political challenges, of which park credibility was often mentioned, were identified as major threats to jaguars and pumas in the Vale do Ribeira region. Given

that the agency credibility among the respondents was about the same across negative, neutral and positive responses, and that the acceptability of big cats was just slightly positive, this situation could potentially change quickly to conflict if the relationship between park authorities and local residents deteriorates. Therefore, special attention should be given to this people-people interaction by wildlife managers as distrust is a driver of conflict (Nie, 2003). This situation should be monitored and managed through, for example, an applied human dimension facilitated workshop approach (Bath, 2009). Information interventions addressing the benefits of parks - including ecosystem services directly related to agricultural production - might improve attitudes toward the park and consequently agency credibility among residents. Attitudes toward the park predicted credibility, yet it only explained 4% of the variance. Historical factors and the relationship between park authorities and the communities could have a bigger influence on credibility. According to a residents, "the park is not good because they [managers] don't listen [to the residents], and everything is prohibited; but the park is good because it protects the animals" (personal communication).

As expected, the more people valued the existence of jaguars and pumas in the parks region, the more they would accept their presence. However, existence value was the least significant predictor in the model. Although in accordance with the cognitive hierarchy (i.e. context and situational specific), the belief associated to the existence value of jaguars and pumas perhaps is still too abstract to have a strong direct effect on acceptability.

Jaguars are not abundant in the Atlantic Forest anymore, thus requiring a sense of urgency if we wish to achieve conservation. To better our understanding of the

forces that influence people's acceptability for big cats, further exploration of how individuals formulate judgments about acceptability is recommended in regions with either high and low levels of encounters with the target species. Broader applications of the proposed model, and more in depth analyses of the different variables, adapted to different geographical contexts and species is recommended, as well as increasing the understanding of the psychological and social factors that influence acceptance. Furthermore, the acceptability model would improve if benefits associated with the big cats were assessed (Bruskotter & Wilson, 2013). Benefits associated to large carnivores include ecological, cultural, economic and existential elements (Kellert, 1985).

3.6 Conclusion

The model provided practical and theoretical insights to big cat conservation. While assisting managers and decision-makers to identify the focal and priority elements of conservation programs for jaguars and pumas in the Atlantic Forest, it indicated that implementing ecological corridors should not only be planned based on ecological information, but also on people's willingness to coexist with wildlife; and people from the Vale do Ribeira are slightly positive to share their lands with the big cats.

The application of cognitive models and social research to understand human behavior is highly recommended for wildlife conservation purposes. The findings from this research contribute to the understanding of emotion dispositions (Jacobs et

al., 2014) into the cognitive model of human behaviour (Vaske & Donelly, 1999). The finding also provides further evidence that people are prone to care and protect what they like, and people from the region often refer with pride that they still have jaguars wandering around. Given that pride towards a local wildlife species contributes to a decrease in people-wildlife conflicts (Sillero-Zubiri et al., 2004), this feeling of pride observed in the region should not disappear; rather, it should increase and be valued among the residents and other interest groups. It is recommended that the pride of having big cats around should to be used as a starting point of a more open and inclusive discussion between the communities and park authorities. Finding the common ground amongst different interest groups is an important starting point for working toward a common vision, common set of objectives and strategies to achieve such objectives (Bath, 2009). The credibility of the management agency was a significant factor in the model. Although not the strongest predictor in the model, agency credibility is still an important and significant element to be considered, therefore suggesting that a positive relationship between park authorities and people is crucial to achieving the long-term conservation of jaguars and pumas. As such, it is important to acknowledge local people's need, as agency credibility is at risk when local needs are not addressed nor taken into account (Fayram et al., 2009).

Finally, this study have some limitations. For example, the method used did not include adults with no children. This particular situation is important to be taken into account as this could have biased the results. Therefore, expanding the data collection, randomly selecting the rural population adjacent to the two state parks in a way that the results could be generalized to the whole region, irrespectively of having children or not is recommended.

3.7 Bibliography

Agee, J.D., & Miller, C.A. (2009). Factors contributing toward acceptance of lethal control of black bears in Central Georgia, USA. *Human Dimensions of Wildlife Journal*, 14, 198-205.

Arvai, J., Wilson, R., Rivers, L., & Froschauer, A. (2004). *Environmental risk communication: A review and annotated bibliography.* Albany: USDA Forest Service and Decision Research.

Arruda, R.S. (2000). Populações tradicionais e a proteção dos recursos naturais em unidades de conservação. In Diegues, A.C.S. (Ed.), *Etnoconservacão. Novos rumos para a protecão da natureza nos trópicos* (pp. 273-290). São Paulo: Editora Hucitec, NUPAUBUSP.

Bath, A.J., Olszanska, A., & Okarma, H. (2008). From a Human Dimensions Perspective, the Unknown Large Carnivore: Public Attitudes toward Eurasian Lynx in Poland. *Human Dimensions of Wildlife*, 13(1), 31-46.

Bath, A. J. (2009). Working with People to Achieve Wolf Conservation in Europe and North America. In M. Musiani, L. Boitani & P.C. Paquet (Eds.), *A New Era for Wolves and People – Wolf Recovery, Human Attitude, and Policy* (pp. 173-199). Calgary: University of Calgary Press.

Beisiegel, B.M., Sana, D.A. & Moraes, E.A., Jr. (2012). The jaguar in the Atlantic Forest. *CATnews Special Issue*, 7,14-18.

Brito, D.M.C. (2008). Conflitos em Unidades de Conservação. *PRACS: Revista de Humanidades do Curso de Ciências Sociais UNIFAP*, 1,1-12.

Bruskotter, J.T., & Wilson, R.S. (2013). Determining where the wild things will be: using psychological theory to find tolerance for large carnivores. *Conservation Letters*, 7(3), 158-165.

Casey, A. L., Krausman, P. R., Shaw, W. W., & Shaw, H.G. (2005). Knowledge of and attitudes toward mountain lions: a public survey of residents adjacent to Saguaro National Park, Arizona. *Human Dimensions of Wildlife*, 10, 29–38.

Caso, A., Lopez-Gonzalez, C., Payan, E.,Eizirik, E., de Oliveira, T., Leite-Pitman, R., Kelly, M., Valderrama, C. & Lucherini, M. (2008). *Puma concolor*. The IUCN Red List of Threatened Species.Version 2014.3.<www.iucnredlist.org>. Downloaded on 22 December 2014.

Cavalcanti, S.M.C., Marchini, S., Zimmermann, A., Gese, E.M., & Macdonald, D.W. (2010). Jaguars, livestock, and people in Brazil: Realities and perceptions behind the conflict. In D.W. Macdonald, & A.J Lowerdige (Eds.), *Biology and conservation of wild felids* (pp. 383-402). Oxford: Oxford University Press.

Chapron, G., Miquelle, D.G., Lambert, A., Goodrich, J.M., Legendre, S., & Clobert, J. (2008). The impact on tigers of poaching versus prey depletion. *Journal of Applied Ecology*, 45, 1667-1674.

Conforti, V.A., & F.C.C. Azevedo. (2003). Local perceptions of jaguars (*Pantheraonca*) and pumas (*Puma concolor*) in the Iguaçu National Park area, south Brazil. *Biological Conservation*, 111, 215-221.

Consorte-McCrea, A. (2011). Conservation of the maned wolf (Chrysocyon brachyurus): carnivore and people relationships in the southeast of Brazil. Ph.D. thesis, University of Kent.

Consorte-McCrea, A. (2013). Relationships between the maned wolf and people. In A.G. Consorte-McCrea, & E.F. Santos (Eds.), *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives* (pp. 35-52). CRC Press.

Costa, L.P., Leiter, Y.L.R., Mendes, S.L., & Ditchfield, A.D. (2005). Mammal conservation in Brazil. *Conservation Biology*, 19(3), 672-679.

Davenport, M.A., Nielsen, C.K., & Mangun, J.C. (2010). Attitudes toward mountain lion management in the Midwest: implications for potentially recolonizing large predator. *Human Dimensions of Wildlife,* 15, 373-388.

Dickman, A., Marchini, S., & Manfredo, M. (2013). The human dimensions in addressing conflict with large carnivores. In D.W. Macdonald, & K.J. Willis (Eds.), *Key topics in Conservation Biology 2* (pp. 110-126). John Wiley & Sons Ltd.

Fayram, A.H., Schenborn, D.A., Hennessy, J.M., Nate, N.A., & Schmalz, P.J. (2009). Exploring the conflict between broad scale and local inland fisheries management: the risk to agency credibility. *Fisheries*, 34(5), 232-234.

Fulton, D. C., Manfredo, M.J., & Lipscomb, J. (1996). Wildlife Value Orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife,* 1(2), 24-47.

Galetti, M., Eizirik, E., Beisiegel, B., Ferraz, K.M.P.M.B., Cavalcanti, S., Srbek-araujo, A.C., … Morato, R. (2013). Atlantic rainforest's jaguars in decline. *Science,* 342(6161):930.

Hill, C. (2004). Farmers' perspectives of conflict at the wildlife-agriculture boundary: some lessons learned from African subsistence farmers. *Human Dimensions of Wildlife*, 9, 279-286.

IBGE (Brazilian Institute of Geography and Statistics). (2010). *Pesquisa nacional por amostra de domicílios*. IBGE, Rio de Janeiro, Brazil. Available fromhttp://cidades.ibge.gov.br/xtras/home.php?lang= (accessed July 2014).

Inskip, C., & Zimmerman, A. (2009). Human-felid conflict: a review of patterns and priorities worldwide. *Oryx*, 43(1), 18-34.

Izard, C.E. (1977). *Human emotions*. New York: Plenum Press.

Jacobs, M.H. (2012). Human emotions toward wildlife. *Human Dimensions of Wildlife*, 17, 1-3.

Jacobs, M.H., Vaske, J.J., & Roemer, J.M. (2012). Toward a mental system approach ho human relationships with wildlife: the role of emotional dispositions. *Human Dimensions of Wildlife*, 17, 4-15.

Jacobs, M.H., Vaske, J.J., & Dubois, S. (2014). More than fear: role of emotions in acceptability of lethal control of wolves. *Europe Journal of Wildlife Research*, 60, 589-598.

Jorge, M.L.S.P., Galetti, M., Ribeiro, M.C., & Ferraz, K.M.P.M. (2013). Mammal defaunation as surrogate of trophic cascade in a biodiversity hotspot. *Biological Conservation*, 163, 49-57.

Kellert, S.R. (1985). Social and perceptual factors in endangered species management. *Journal of Wildlife Management*, 49, 528–536.

Kemper, T. (1987). How many emotions are there? Wedding the social and autonomic components. *American Journal of Sociology*, 93, 263-289.

Knight, J. (2000). Introduction. In J. Knight (Ed.), *Natural enemies: People-wildlife conflicts in anthropological perspective* (pp. 1-35). London: Routledge.

Kontogianni, A., Tourkalias, C., & Skourtos, M. (2012). Services providing units, existence values and valuation of endangered species: a methodological test. *Ecological Economics*, 79, 97-104.

Lachapelle, P., McCool, S.F., & Patterson, M.E. (2003). Barriers to effective natural resource planning in a ‘‘messy’’ world. *Society and Natural Resources,* 16(6), 473–490.

Loveridge, A.J., Wang, S.W., Frank, L.G., & Seidensticker, J. (2010). People and wild felids: conservation of cats and management of conflicts. In D.W. Macdonald, & A.J Loveridge (Eds.), *Biology and conservation of wild felids* (pp. 161-195). Oxford: Oxford University Press.

Loyd, K.A.T., & Miller, C.A. (2010). Influence of demographics, experience, and value orientations on preferences for lethal management of feral cats. *Human dimensions of Wildlife*, 15, 262-273.

Lucherine, M., & Merino, M.J. (2008). Perceptions of Human–Carnivore Conflicts in the High Andes of Argentina. *Mountain Research and Development*, 28(1), 81-85.

Macdonald, D.W. (2001). Postscript – carnivore conservation: science, compromise, and tough choices. In J.L. Gittleman, S.M. Funk, D. Macdonald, & R.K. Wayne (Eds.), *Conservation Biology 5: Carnivore Conservation* (pp. 524-538). Cambridge: Cambridge University Press.

Macdonald, D.W., Loveridge, A.J., & Rabinowitz, A. (2012). Felid futures: Crossing disciplines, borders, and generations. In D.W. Macdonald, & A.J Lowerdige (Eds.), *Biology and conservation of wild felids* (pp. 599-649). Oxford: Oxford University Press.

Manfredo, M. J., Zinn, H. C., Sikorowski, L., & Jones, J. (1998). Public acceptance of mountain lion management: A case study of Denver, Colorado, and nearby foothills areas. *Wildlife Society Bulletin*, 26(4), 964–970.

Manfredo, M.J. (2008). *Who cares about wildlife? Social science concepts for exploring human-wildlife relationships and conservation issues*. Fort Collins, CO: Springer.

Marchini, S. & Macdonald, D.W. (2012). Predicting ranchers' intention to kill jaguars: case studies in Amazonia and Pantanal. *Biological Conservation,* 147(1), 213-221.

Marchini, S. (2014). Who's in conflict with whom? Human Dimensions of the conflict involving wildlife. In L.M. Verdade, M.C Lyra-Jorge, & C.I. Piña C.I. (Eds.), *Applied Ecology and Human Dimensions in Biological Conservation* (pp. 189-209). Springer Berlin Heidelberg.

Marker, L., Dickman, A.J., Mills, M.G., & Macdonald, D.W. (2010). Cheetahs and ranchers in Namibia: a case study. In D.W. Macdonald, & A.J Lowerdige (Eds.), *Biology and conservation of wild felids*) (pp. 353-372). Oxford: Oxford University Press.

Marseille, M.M., Elands, B.H.M, & Van Den Brink, M.L. (2012). Experiencing polar bears in the zoo: feelings and cognitions in relation to a visitor`s conservation attitude. *Human Dimensions of Wildlife*, 17, 29-43.

Neto, M.F.C., Neto, D.G., & Haddad, V., Jr. (2011). Attacks by jaguars (*Panthera onca*) on humans in Central Brazil: report of three cases, with observation of a death. *Wilderness and Environmental Medicine*, 22, 130-135.

Nie, M. (2003). Drivers of natural resource-based political conflict. *Policy Sciences*, 36:307–341.

Palmeira, F.B.L, & Barella, W. (2007). Conflitos causados pela predação de rebanhos domésticos por grandes felinos em comunidades quilombolas na Mata Atlântica. *Biota Neotropica*, 7(1), 120-128.

Park, C., & Allaby, M. (2013). Non-consumptive value. In *A Dictionary of Environment and Conservation.* Oxford University Press. Retrieved 25 May.2015, from http://www.oxfordreference.com/view/10.1093/acref/9780199641666.001.0001/acref-9780199641666-e-5471.

Prugh, L.R., Stoner, C.J., Epps, C.W., Bean, W.T., Ripple, W.J., Laliberte, A.S., & Brashares, J.S. (2009). The rise of the mesopredator. *BioScience*, 59(9), 779-791.

Rabinowitz, A. & Zeller, K. (2010). A range-wide model of landscape connectivity and conservation for the jaguar, *Panthera onca*. *Biological Conservation,* 143(4), 939-945.

Renn, O., & Levine, D. (1991). Credibility and Trust in Risk Communication. In R.E. Kasperson , & P.J.M. Stallen (Eds.), *Communicating Risks to the Public* (pp. 175-214). Kluwer: Dordrecht.

Ripple, W.J. & R.L. Beschta. (2006). Linking a cougar decline, trophic cascade, and catastrophic regime shift in Zion National Park. *Biological Conservation,* 133, 397-408.

Ripple, W.J., Estes, J.A., Beschta, R.L., Wilmers, C.C., Ritchie, E.G., Hebblewhite, M.… Wirsing, A.J. (2014). Status and Ecological effects of the world's largest carnivores. *Science*, 343, 1241484.

Ritchie, E.G., Elmhagen, B., Glen, A.S., Letnic, M., Ludwig, G. & Macdonald, R.A. (2012). Ecosystem restoration with teeth: what role for predators? *Trend in Ecology and Evolution*, 27(5), 265-271.

Santos, F.R., Jácomo, A.T.A., & Silveira, L. (2008). Humans and jaguars in five Brazilian biomes: same country, different perceptions. *CATNews*, 4, 21- 25.

Schreiber, J.B., Stage, F.K., King, J., Nora, Amaury, & Barlow, E.A. (2006). Reporting Structural Equation Modeling and Confirmatory Factor Analysis results: a review. *The Journal of Education Research*, 99(6), 323 – 337.

Sillero-Zubiri, C., Hoffmann, M. and Macdonald, D.W. (2004). *Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan*. IUCN/SSC

Canid Specialist Group. Gland, Switzerland and Cambridge, UK.

Silva-Rodríguez, E.A., Ortega-Solís, G.R., & Jiménez, J.E. (2007). Human attitudes toward wild felids in a Human-dominated landscape of Southern Chile. *CATNews*, 46:19-21.

Silveira, P.C.B. (2010). Florestas e lutas por reconhecimento: território, identidades e direitos na Mata Atlântica brasileira. *Campos*, 11(2), 95-112.

SOS Mata Atlântica/Instituto Nacional de Pesquisas Espaciais (INPE). (2015). *Atlas dos remanescentes florestais da Mata Atlântica Período de 2013-2014.* Relatório Parcial. São Paulo.

Sponarski, C.C., Vaske, J.J, Bath, A.J., & Musiani, M.M. (2014). Salient values, social trust, and attitudes toward wolf management in south-western Alberta, Canada. *Environmental Conservation*, 41(4), 303-310.

Treves, A. (2009). The human dimensions of conflicts with wildlife around protected areas. In M.J. Manfredo, J.J Vaske, P. Brown, D.J Decker, & E.A Duke (Eds.), *Wildlife and Society: The Science of Human Dimensions* (pp. 214-228). Island Press, Washington DC.

UNESCO. (1999). Convention Concerning the Protection of the World Cultural and Natural Heritage. World Heritage Committee, United Nations Educational, Scientific and Cultural Organization (UNESCO), Marrakech, Morocco.

Vaske, J.J. (2008). S*urvey Research and Analysis: Applications in Parks, Recreation and Human Dimensions*. Pennsylvania: Venture Publishing, Inc. State College.

Vaske, J.J., & Donnely, M.P. (1999). A value-attitude-behavior model predicting wildland preservation voting intentions. *Society and Natural Resources*, 12, 523-537.

Vaske, J.J, & Manfredo, M.J. (2012). Social Psychological Considerations in Wildlife Management. In D.J Decker, S.J Riley, & W.F. Siemer (Eds.), *Human Dimensions of Wildlife Management* (pp. 43-57). Maryland: The Johns Hopkins University Press.

Zajac, R.M., Bruskotter, J.T., Wilson, R.S., & Prange, S. (2012). Learning to live with black bears: a psychological model of acceptance. *Journal of Wildlife Management*, 76, 1331-1340.

Zeller, K.A. (2007). Jaguars in the new millennium data set update: the state of the jaguar in 2006. *Wildlife Conservation Society.*

Zeller, K.A., Rabinowitz, A., Salom-Perez, R., & Quigley, H. (2013). The jaguar corridor initiative: a range-wide conservation strategy. In M. Ruiz-Garcia, & J.M. Shostell, J.M. (Eds.), *Molecular Population Genetics, Evolutionary Biology and*

Biological Conservation of Neotropical Carnivores (pp. 629-657). Nova Science Publishers.

Zimmermann, A., Walpole, M.J., & Leader-Williams, N. (2005).Cattle ranchers' attitudes to conflicts with jaguar (*Pantheraonca*) in the Pantanal of Brazil. *Oryx,* 39(4), 406-412.

Chapter 4. Summary

In this final chapter, I offer highlights of the research and an analysis of how it fits into the existing literature; this provides direction for future research on jaguar and puma conservation.

4.1 Discussion

With continued expansion of human settlements, it is unlikely that wildlife management will happen effectively without considering human societies (Manfredo 2008; Charles & Wilson, 2009). Currently, places are rare where people do not come into conflict with large carnivores, as it is the case of people and sea lions in Argentina (Crespo et al., 1997), bears in Slovenia (Kaczensky et al., 2004), lynx in Poland (Bath et al., 2008), wolves in Finland (Bisi et al., 2007) and jaguars (Cavalcanti et al., 2010; Marchini & Macdonald, 2012) and pumas (Palmeira & Barella, 2007) in Brazil. Jaguars and pumas are solitary and elusive creatures, capable of generating both hate and admiration in people. Throughout history, jaguars and pumas have been killed for their body parts, for the threat they may cause to people and domestic animals, and/or for cultural and societal reasons. Big cat conservation requires an interdisciplinary approach to succeed, integrating elements from biology, ecology, sociology and psychology (Bruskotter & Shelby, 2010).

From a social psychological perspective, wildlife management and conservation seeks to understand, predict and influence the public's behaviour towards wildlife (Vaske & Manfredo, 2012). Human dimensions of wildlife

management has been built upon the concepts of values, attitudes, norms and emotions, as forces underlying the process of human thought and action (Vaske & Manfredo, 2012). Since the long term survival of large carnivores will depend mostly on people's tolerance (Ripple et al., 2014), the information gathered through this research is important for the management and conservation of the two largest wild felids of the Americas.

The two research objectives I aimed to meet here were to explore public acceptability of killing jaguars and pumas in different scenarios of people-big cat interactions, and to explore predictors of public acceptance of jaguars and pumas presence in the park's region, both of which were addressed in Chapters 2 and 3, respectively. The findings of this research provide valuable information on the relationship between people and the big cats in the most pristine fragment of the Atlantic Forest.

First, jaguars and pumas were not necessarily seen as nuisance animals to the residents living adjacent to Intervales and PETAR State Parks, yet they posed a threat to people in the region. Despite the threat they posed and the evidence of predation to domestic animals, killing big cats was, on average, unacceptable across all scenarios of people and big cat interactions, although people with negative attitudes were more acceptable of killing big cats in the more severe scenarios. This specific manuscript (see Chapter 2) contributes to the understanding of the role of attitudes on the acceptability of killing (in this case an illegal activity), and how consensus differs across scenarios and among three attitudinal groups (negative, neutral, positive). The findings suggest that as the severity of people and big cats interactions increase, the acceptability of killing a big cat becomes more positive and the consensus decreases,

which means that more people have divergent opinions. According to Manfredo et al. (1998), to assess people's responses in different specific contexts is important as a way to predict future behaviour in case the described events occur. Although encounters with jaguars and pumas are rare within the Atlantic Forest, depredation of domestic animals has been reported in the region and has the potential to become more frequent with the implementation of ecological corridors, as does the number of individuals outside the habitat boundaries. Therefore, knowing how people would react (i.e., acceptability of killing) in these situations is crucial to avoid human-wildlife conflict and thus illegal killing of big cats.

In Chapter 2, consensus was assessed using the Potential for Conflict Index$_2$ (PCI$_2$) (Vaske et al., 2010). The PCI$_2$ has been used within the human dimensions of wildlife discipline as a practical way to describe and communicate quantitative results. Furthermore, the PCI$_2$ expands the understanding of statistical data regarding the relationship between people and wildlife, and provides details on the acceptability of a given action, which could be any management strategy or specific human behaviour (Manfredo et al., 2003; Vaske et al., 2010). According to Vaske et al. (2006), the understanding of the public's acceptability is important in guiding management actions and decisions. The increase in acceptability of killing across the scenarios is supported by previous research (e.g., Manfredo et al., 1998), therefore stressing the need to better understand how people respond to wildlife in different situations.

Second, a slightly positive acceptability of jaguars and pumas presence was observed, thus indicating that coexistence between people and these predators is possible in the region. There were four factors that directly influenced acceptability: sorrow, attitudes, existence values and park's management agency credibility. These

findings stress the fact that public perceptions of wildlife managers have the potential to impact conservation. In this sense, a positive relationship between park officials and the public is fundamentally important.

In Chapter 3, the influence of fear and sorrow relative to cognitive variables and the acceptability of jaguars and pumas were examined. According to Vaske and Manfredo (2012), the examination of emotions in human-wildlife relationships has only recently been explored. The findings from this research contribute to the understanding of emotion dispositions (Jacobs et al., 2014) into the cognitive hierarchy model of human behaviour (Vaske & Donelly, 1999). Although fear did not influence acceptability, it directly influenced attitudes. As argued by Jacobs et al. (2014), emotional responses to wildlife vary by species and context, thus requiring further investigation.

In conclusion, this thesis has relevance for the human dimensions of wildlife discipline as it: (a) explored the role of attitudes on acceptability of killing, and (b) examined the role of emotional disposition (i.e., fear and sorrow) within the cognitive hierarchy model. Furthermore, this research contributed to expanding the literature on public attitudes toward jaguars and pumas in the Atlantic Forest, as well as the existence values associated with these species. Results from this research, therefore, help to support the implementation of management strategies, such as ecological corridors. In summary, it was observed that the public have the potential to coexist side by side with jaguars and pumas, although future research and management interventions are needed to avoid people-big cat conflicts.

Given the geographical conditions of the area (some places were remote and only accessible by small boats), and the limited time available to stay in the field

collecting data (because of financial constraints), the method used in this research did not include adults with no children. This particular situation is important to be taken into account as this could have biased the results. Therefore, I suggest expanding the data collection, randomly selecting the rural population adjacent to the two state parks in a way that the results could be generalized to the whole region, irrespectively of having children or not.

Considering some limitations of this research, in the following section of this chapter I offer recommendations for future research as well as practical recommendations for managers and decision-makers. The limitations of this research also reflects the challenges of collecting data in a place with illegal and criminal activities such as the extraction of palm heart from the Juçara palm tree (*Euterpe edulis*). Frequently, illegal palm heart harvesters come into conflict with the local police. During the data collection season, I came across a sensitive situation when I was recommended to leave the study area as quickly as possible because of the conflict between the police and some criminal groups involved in the palm harvesting. Situations such as this highlight the challenges encountered by researchers in the field, and stress the fact that security is primordial when planning and developing any research.

4.2 Recommendations for future research:

I. Further explore the variables capable of influencing public acceptance of jaguars and pumas presence in different social and ecological contexts (e.g. where big cats are both abundant *versus* scarce) and different landscapes;

II. Investigate the role of emotional dispositions (beyond fear and sorrow) on the acceptability of jaguars and pumas presence, and on the acceptability of killing big cats;

III. Assess the benefits associated to jaguars and pumas (e.g. economic, ecological, cultural) and how they influence acceptability for their presence in the wild;

IV. Expand the analyzes of acceptability of killing to different scenarios of people-big cat interactions (i.e., a big cat injures a person; a big cat kills a person);

V. Assess attitudes, existence values and behaviour among young children to aid in the targeting of educational messages that are most likely able to influence attitudes and behaviour.

4.3 Recommendations for managers and decision-makers:

I. Take variation in acceptance into account, improve relationships with communities providing an environment where different interest groups can openly discuss their issues and concerns related to jaguars and pumas together with park authorities, such as an applied human dimensions facilitated workshop (for details see Bath, 2009);

II. Develop communication campaigns and education programs designed to improve the existence values associated to jaguars and pumas, and to decrease fear among the residents, as fear directly influences attitudes and is indirectly associated to acceptance of jaguars and pumas presence;

III. Investments in wildlife-based tourism as ways to improve the local economy and public attitudes toward wildlife in general and the big cats and parks in particular.

Given the novelty of Human Dimensions of Wildlife research in Brazil, particularly in regards to jaguars and pumas in the Atlantic Forest, this research has shown that conservation of large and charismatic carnivores is much more complex than just gathering ecological data of the species. To achieve conservation, humans must understand and predict human behavior toward wildlife. The findings of this master's thesis show evidence that people may be able to coexist with big cats as long as these large predators stay away from domestic animals and livestock. The differences on the acceptability of killing big cats across different scenarios of interaction between people and the big cats stressed the need to investigate how people would act in a given situation. As mentioned earlier, jaguars are disappearing from the Atlantic Forest biome, and if no action is taken, this hotspot for biodiversity could lose its largest predator within the next few years. The consequences of such a loss could be devastating not only for the ecosystem, but also for all living things (including humans). In summary, if people want to conserve the two largest felids of the Americas and all that depend upon them, we must listen to people and work toward solutions.

References

Ab'Saber A.N. (1970). Provincias geologicas e dominios morfoclimaticos no Brasil. *Geomorfologia,* São Paulo, BR.

Amit, R., Gordillo-Vhavez, E. J., & Bone, R. (2013). Jaguar and puma attacks on livestock in Costa Rica. *Human-wildlife interactions,* 17(1):77-84.

Bath, A.J. (1998). The role of human dimensions in wildlife resource research in wildlife management. *Ursus,* 10: 349-355.

Bath, A.J., Olszanska, A. & O'Karma, H. (2008). From a human dimensions perspective, the unknown large carnivore: Public attitudes toward Eurasian lynx in Poland. *Human Dimensions of Wildlife*, 13(1):31-46.

Bath, A. J. (2009). Working with People to Achieve Wolf Conservation in Europe and North America. Pages 173-199, in M. Musiani, L. Boitani & P.C. Paquet editors. *A New Era for Wolves and People – Wolf Recovery, Human Attitude, and Policy*. University of Calgary Press, Calgary, Alberta.

Beisiegel, B.M., Sana D.A., & Moraes Jr., E.A. (2012). The jaguar in the Atlantic Forest. *CatNEWS Special Issue,* 7.

Bisi, J., Kurki, S., Svenseberg, M., & Liukkonen, T. (2007). Human dimensions of wolf (Canis lupus) conflicts in Finland. *European Journal of Wildlife Research,* 53(4): 304-314.

Bruskotter, J.T., & Shelby, L.B. (2010). Human Dimensions of Large Carnivore Conservation and Management: Introduction to the Special Issue. *Human Dimensions of Wildlife,* 15(5): 311-314.

Bruskotter, J.T., & Fulton, D.C. (2012). Will Hunters Steward Wolves? A comment on Treves and Martin. *Society & Natural Resources*, 25:97-102.

Campbell, M.O., & Alvarado, M.E.T. (2011). Public perceptions of jaguars *Panthera onca*, pumas *Puma concolor* and coyotes *Canis latrans* in El Salvador. *Area*, 43(3): 250-256.

Charles, A., & Wilsons, L. (2009). Human Dimensions of Marine Protected Areas. *Ices Journal of Marine Science*, 66: 6-15.

Conforti, V.A., & Azevedo, F.C.C. (2003). Local perceptions of jaguars (*Panthera onca*) and pumas (*Puma concolor*) in the Iguaçu National Park area, south Brazil. *Biological Conservation*, 111:215-221.

Crespo, E.A., Pedraza, S.N., Reys, L.M., Garcia, N.A., Coscarella, M., & Schiavinni, A.C.M. (1997). Direct and indirect effects of the high seas fisheries on the marine mammal populations in the northern and central Patagonia coast. *Journal of Northwest Atlantic Fishery Science*, 22: 317-342.

Decker, D.J., Riley, S.J., & Siemer, W.F. (2012). Human Dimension of Wildlife Management. Pages 3-14, in D.J. Decker, S.J. Riley, & W.F. Siemer editors. *Human Dimension of Wildlife Management*. The Johns Hopkins University Press, Baltimore, USA.

Durán, E., Figel, J.J., & Bray, D.B. (2010). Uncertain coexistence: Jaguars and communities in montane forests of Mexico. *Unasylva*, 234/235: 21-22.

Eisenberg, C. (2014). *The Carnivore Way: Coexisting with and conserving North America's Predators.* Island Press, USA.

Engel, M.T., Marchini, S., Pont, A.C., Machado, R., & de Oliveira, L.R. (2014). Perceptions and attitudes of stakeholders towards the wildlife refuge of Ilha dos Lobos, a marine protected area in Brazil. *Marine Policy*, 45:45-51.

Estes, J.A. et al. (2011). Trophic downgrading of planet Earth. *Science*, 333: 301-306.

Estes, J.A., Crooks, K., & Holt, R. (2001). Ecological role of predators. *Encyclopedia of Biodiversity*, V.4. Academic Press.

Fulton, D. C., Manfredo, M.J., & Lipscomb, J. (1996). Wildlife Value Orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife,* 1(2): 24-47.

Galindo-Leal, C., & Câmara, I.G. (2003). Atlantic forest hotspots status: an overview. Pages 3-11, in Galindo-Leal, C., and Câmara I.G editors. *The Atlantic Forest of South America: biodiversity status, threats, and outlook*. Center for Applied Biodiversity, Science e Island Press, Washington.

Gigliotti, L., Decker, D. J., & Carpenter, L.H. (2000). Developing the wildlife stakeholder acceptance capacity concept: research needed. *Human Dimensions of Wildlife,* 5:67–82.

Kaczensjy, P., Blazic, M., & Gossow, H. (2004). Public attitudes towards brown bears (*Ursus arctos)* in Slovenia. *Biological Conservation*, 118: 661-674.

IBGE (Brazilian Institute of Geography and Statistics). (2014). *Pesquisa nacional por amostra de domicílios*. IBGE, Rio de Janeiro, Brazil. Available

Inskip, C., & Zimmerman, A. (2009). Human-felid conflict: a review of patterns and priorities worldwide. *Oryx*, 43(1): 18-34.

IUCN (2008). *Panthera onca. The IUCN Red List of Threatened Species v*. 2015.1. <www.iucnredlist.org>. [accessed 06 June 2015].

Jacobs, M.H., Vaske, J.J., Teel, T.L., & Manfredo, M.J. (2012).Human Dimensions of Wildlife. Pages 77-86, in L. Steg , A.E. van den Berg, & J.I.M. de Groot editors. *Environmental Psychology: an introduction*. Oxford: Wiley-Blackwell.

Joly, C.A, Rodrigues, R. R., Metzger, J. P., Haddad, C. F. B., Verdade, L. M., Oliveira, M. C., & Bolzani, V. S. (2010). Biodiversity conservation research, training, and policy in São Paulo. *Science*, 328(5984):1358--9.

Macdonald, D.W., Loveridge, A.J., & Rabinowitz, A. (2012). Felid futures: Crossing disciplines, borders, and generations. Pages 599-649, in D.W. Macdonald, and A.J Lowerdige editors. *Biology and conservation of wild felids*. Oxford: Oxford University Press.

Machado, A.B.M., Drummond, G.M., & Paglia A.P. (2008*). Livro vermelho da fauna brasileira ameaçada de extinção*. Brasília: MMA/ FundaçãoBiodiversitas.

Manfredo, M.J., Vaske, J.J., & Sikorowiski, L. (1996). Human dimensions of wildlife management. Pages 53-72, in A. Ewert editor. *Natural resource management: the human dimensions*. Boulder, CO: Westview Press.

Manfredo, M.J., Decker, D.J., & Duda, M.D. (1998). What is the future for Human Dimensions of Wildlife? *American Wildlife and Natural Resource Conference.* Trans. 63rd No.

Manfredo, M.J., Vaske, J.J., & Teel, T.L. (2003). The Potential for Conflict Index: A graphic Approach to Practical Significance of Human Dimensions Research. *Human Dimensions of Wildlife,* 8: 219-228.

Manfredo, M.J. (2008). *Who cares about wildlife? Social science concepts for exploring human-wildlife relationships and conservation issues*. Fort Collins, CO: Springer.

Manfredo M.J., Vaske, J.J., Brown, P.J., Decker, D.J., & Duke, E.A. (2009). *Wildlife and society: the Science of Human Dimensions*. Island Press, USA.

Marchini, S. (2010). *Human Dimensions of the conflicts between people and jaguars (Panthera onca) in Brazil.* Ph.D. Dissertation. University of Oxford, Oxford, UK.

Marchini, S. & D.W. Macdonald. (2012). Predicting ranchers' intention to kill jaguars: case studies in Amazonia and Pantanal. *Biological Conservation* 147(1): 213-221

Marchini, S. (2014). Who's in conflict with whom? Human Dimensions of the conflict involving wildlife. Pages 189-209, in Verdade L.M., Lyra-Jorge M.C. and Piña C.I. editors. *Applied Ecology and Human Dimensions in Biological Conservation.* Springer Berlin Heidelberg.

Matoso et al. (2008). Carlos Botelho management Plan, Sao Paulo.

Muphy, T., & Macdonald, D.W. (2012). Pumas and people: lessons in the landscape of tolerance from a widely distributed felid. Pages 431-452, in D.W. Macdonald, and A.J Lowerdige editors. *Biology and conservation of wild felids*. Oxford: Oxford University Press.

Nowell, K. & Jackson, P. (1996). *Wild Cats: Status Survey and Conservation Action Plan*. IUCN/SSN Cat Specialist.

Oliveira, T., Cassaro, G.E. (2006). *Guia de Campo dos felinos do Brasil*. Instituto Pró-Carnívoros; Fundação Parque Zoológico de São Paulo; Sociedade de Zoológicos do Brasil; Pró-Vida Brasil: São Paulo.

Palmeira, F.B.L, & Barella, W. (2007). Conflitos causados pela predação de rebanhos domésticos por grandes felinos em comunidades quilombolas na Mata Atlantica. *Biota Neotropica*, 7(1): 120-128.

Pinto, L. P., & Wey de Brito, M. C. (2003). Dynamics of biodiversity loss in the Brazilian Atlantic Forest: An Introduction. Pages 27-30, in C. Galindo-Leal, & I. de Gusmao Camara editors. *The Atlantic Forest of South America: biodiversity status, trends, and outlook*. Center for Applied Biodiversity Science and Island Press, Washington, DC.

Prugh, L.R. et al. (2009). The rise of the Mesopredator. *Bioscience,* 59:779-791.

Rabinowitz, A. & Zeller, K. (2010). A range-wide model of landscape connectivity and conservation for the jaguar, *Panthera onca*. *Biological Conservation,* 143(4): 939-945.

Reis, N.R., Peracchio, A.I., Pedro, W.A., & Lima, I.P. (2006). *Mamíferos do Brasil.* Londrina, Parana, BR.

Ribeiro, M. C., Metzger, J. P., Martensen, A. C., Ponzoni, F. J. & Hirota, M. M. (2009). The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. *Biological Conservation,* 142:1141-1153.

Ripple, W.J., & Beschta, R.L. (2006). Linking a cougar decline, trophic cascade, and catastrophic regime shift in Zion National Park. *Biological Conservation,* 133: 397-408.

Ripple, W.J., et al. (2014). Status and Ecological effects of the world's largest carnivores. *Science,* 343, 1241484.

Ritchie, E.G., et al. (2012). Ecosystem restoration with teeth: what role for predators? *Trends in Ecology and Evolution,* 27:265-271.

Sanderson, E.W., Redford, K.H., Chetkiewicz, C.L.B., Medellin, R.A., Rabinowitz, A.R., Robinson, J.G, & Taber. A.A. (2002) Planning to save a species: the Jaguars as a model. *Conservation Biology* 16(1):58-72.

Shulz, F., Printes, R.C., & Oliveira, L.R. (2014). Depredation of domestic herds by pumas based on farmer's information in Southern Brazil. *Journal of Ethnobiology and Ethnomedicine*, 10:73.

Smith, N.J.J. (1976). Spotted cats and the fur trade. *Oryx*, 13: 362-371.

SOS Mata Atlântica/Instituto Nacional de Pesquisas Espaciais (INPE). (2009). *Atlas dos remanescentes florestais da Mata Atlântica Período de 2005-2008*. Relatório Parcial. São Paulo.

SOS Mata Atlântica/Instituto Nacional de Pesquisas Espaciais (INPE). (2015). *Atlas dos remanescentes florestais da Mata Atlântica Período de 2013-2014.* Relatório Parcial. São Paulo.

Soto-Shoender, J.R., & Main, M.B. (2013). Differences in stakeholder perceptions of the jaguar (*Panthera onca*) and puma (*Puma concolor*) in the tropical lowlands of Guatemala. *Oryx*, 47(1): 109-112.

Stone, R.R. (2011). *The Jaguar Within: Shamanic Trance in Ancient Central and South American Art*. University of Texas Press, USA.

Sunquist, M., & Sunquist, F. (2002). *Wild Cats of the World*. The University of Chicago Press, USA.

Vaske, J.J., & Donnely, M.P. (1999). A Value-Attitude-Behavior Model Predicting Wildland Preservation Voting Intentions. *Society and Natural Resources*, 12: 523-537.

Vaske J.J., Shelby L.B. & Manfredo M.J. (2006). Bilbiometric reflections on the first decade of Human Dimensions of Wildlife. *Human Dimensions of Wildlife*, 11:79-87.

Vaske, J.J. (2008). *Survey Research and Analysis: Applications in Parks, Recreation and Human Dimensions*. Venture Publishing, Inc. State College, Pennsylvania.

Vaske, J.J., Beaman, J., Barreto, H., & Shelby, L.B. (2010). An extension and further validation of the Potential for Conflict Index. *Leisure Sciences*, 32: 240-254.

Vaske, J.J, & Manfredo, M.J. (2012). Social Psychological Considerations in Wildlife Management. Pages 27-30, in Decker, D.J., Riley, S.J., & Siemer, W.F. editors. *Human Dimensions of Wildlife Management.* Maryland: The Johns Hopkins University Press.

Werdelin, L., Yamaguchi, N., Johnson, W.E., & O`Brien, S.J. (2012). Phylogeny and evolution of cats (Felidae). Pages 59-82, in D.W. Macdonald, and A.J Lowerdige editors. *Biology and conservation of wild felids*. Oxford: Oxford University Press.

Wilson, E., & Reeder, D.M. (2005). *Mammals Species of the World: A Taxonomic and Geographic Reference*. 3rd Edition. Johns Hopkins University Press.

Woodroffe, R., & Ginsberg, J.R. (1998). Edge effects and the extinction of populations inside protected areas. *Science*, 280(5372): 2126-2128.

Zimmermann, A., Walpole, M.J., & Leader-Williams, N. (2005).Cattle ranchers' attitudes to conflicts with jaguar (*Pantheraonca*) in the Pantanal of Brazil. *Oryx*, 39(4): 406-412.

Appendix – Research instrument

Local resident initiative:
Attitudes and perceptions towards jaguars and pumas

Dear resident,

You are invited to take part in a research project entitled *"People and Big Cats (Panthera onca and Puma concolor) of the Atlantic Forest, Brazil".*

My name is Monica Engel, a graduate student from the Department of Geography at Memorial University in Canada. As part of my Masters thesis, I am conducting research under the supervision of Dr. Alistair Bath. This project is being carried out in the municipalities that surround the Intervales State Park and Alto Ribeira Touristic State Park in Sao Paulo/Brazil. The project focuses on understanding public attitudes and behavior towards jaguars and pumas.

All responses are valuable to our research, but you have the right to not participate in this research. Thank you in advance for your time in helping us to better understand the relationship between people and jaguars and pumas in the Atlantic Forest.

In you have any questions, please do not hesitate in contact me (m.engel@mun.ca).

Thank you for expressing your opinion.

Sincerely,

Monica T Engel
Principal investigator
m.engel@mun.ca

RESEARCH INSTRUMENT **QUESTIONNAIRE N°:_____**

1. How do you feel about the following animals?

		Strongly dislike	Dislike	Neither like or dislike	Like	Strongly like
1.1	Jaguar	1	2	3	4	5
1.2	Tapir	1	2	3	4	5
1.3	Snake	1	2	3	4	5
1.4	Monkey	1	2	3	4	5
1.5	Puma	1	2	3	4	5

2. The next few questions ask you about jaguars and pumas.

	Sentence		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
2.1	I accept the presence of (…) in the park area.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.2	I would support it if the government allowed the hunting of (…).	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.3	I would feel sorry if (…) disappear in the region.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.4	(…) are nuisance animals in the region.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.5	I may never see a (…) but it is important to me to know they exist in the region.	Jaguar	1	2	3	4	5
		Puma	1	2	3	4	5
2.6	(…) pose a threat to people in the region.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.7	If a (…) attacks my domestic animals, I should be allowed to kill the animal.	Jaguar	1	2	3	4	5
		Puma	1	2	3	4	5
If you saw the tracks/sign of a (…) close to your home, how would you feel about the following strategies:			Strongly disagree	Disagree	Neutral	Agree	Strongly agree
2.9	Moving the predators to another area.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.10	Killing the predator.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.11	Calling the park for help.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.12	Do nothing.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
If you saw a (…) close to your home, how would you feel about the following strategies:							
2.13	Moving the predators to another area.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.14	Killing the predator.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.15	Calling the park for help.	Jaguars	1	2	3	4	5

		Pumas	1	2	3	4	5
2.16	Do nothing.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
If you saw that one of your domestic animals was attacked by a (…), how'd you feel about the following strategies:							
2.17	Moving the predators to another area.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.18	Killing the predator.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.19	Calling the park for help.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
2.20	Do nothing.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5

	Sentence		Decreasing	The same	Increasing	Don't know
3	Are (…) decreasing, the same or increasing in the three parks area?	Jaguars	1	2	3	4
		Pumas	1	2	3	4

3.1 How many jaguars do you think exist in the three parks area?_____

3.2 How many pumas do you think exist in the three parks area?_____

4. Next questions just ask about your fear, if any:

	I **fear** for:		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4.1	My own personal safety.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
4.2	My family's safety.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
4.3	My neighbors' safety.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
4.4	My domestic animals' safety.	Jaguars	1	2	3	4	5
		Pumas	1	2	3	4	5
	What is the **likelihood of**:		Extremely unlikely	Unlikely	Neutral	Likely	Extremely likely
4.5	Seeing a (…) in the forest?	Jaguar	1	2	3	4	5
		Puma	1	2	3	4	5
4.6	Seeing a (…) close to my home?	Jaguar	1	2	3	4	5
		Puma	1	2	3	4	5
4.7	Being approached by a (…)?	Jaguar	1	2	3	4	5
		Puma	1	2	3	4	5
4.8	Have domestic animals killed by (…)?	Jaguar	1	2	3	4	5
		Puma	1	2	3	4	5

5. What have you heard about jaguars and pumas?

	Sentence	True	False	Don't know
5.1	Pumas are bigger than jaguars.			

5.2	The jaguar's track is wider than it is longer, with round toes.			
5.3	The puma's track is longer than it is wider, with pointed toes.			
5.4	Jaguars have black spots in their body.			
5.5	Both jaguars and pumas are very active in day light.			

	Sentence	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
6	Pumas are more dangerous than jaguars.	1	2	3	4	5

7. The last few questions just ask about your domestic animals.

7.1 Have your neighbors ever found any domestic animals killed by other animals on their properties?
( ) Yes ( ) No ( ) Don't know

7.2 Have you ever found any of your domestic animals killed by other animal?
( ) Yes ( ) No ***(if no, go to section 8)***

7.3 When was the last time you found an animal killed on your property? _____

7.4 Which animal was killed?
( ) cattle:_____ ( ) pig:_____ ( ) chicken:_____
( ) sheep:_____ ( ) dog: _____ ( ) other: _____

7.5 Do you think the number of domestic animals killed in the three parks area are?

Decreasing	The same	Increasing	Don't know
1	2	3	4

7.6 Which predator do you think is killing most of these animals?
( ) wild dog ( ) jaguar ( ) pumas ( ) don't know ( ) other:_____

8. A few questions about the parks.

8. 1 Do you think of the park as:

	Extremely	Moderate	Neither	Moderate	Extremely	
Bad	1	2	3	4	5	Good

Why do you consider the park as that?
_____
_____
_____

8.2 Of the following organizations that could offer you information about jaguars and pumas, how much, if anything, would you believe:

	Nothing 0%	A little 25%	About half 50%	Most 75%	All 100%	Never heard of them
Park authorities	1	2	3	4	5	6

IBAMA	1	2	3	4	5	6
Local school teacher	1	2	3	4	5	6
Researcher	1	2	3	4	5	6

9. These last questions just help us to understand the people we have interviewed:

9.1 How long have you lived here? _____

9.2 Place of birth: _____

9.3 What do you do for living? _____

9.4 How many of the following animals do you have?
( ) cattle ( ) pig ( ) poultry ( ) sheep ( ) buffalo ( ) cat
( ) dog ( ) other:_____

9.5 Gender: Female ( ) Male ( )

9.6 Age: 18-24 ( ) 25-34 ( ) 35-44 ( ) 45-54 ( ) 55-64 ( )
over 65 ( )

9.7 Do you have any children? Yes ( ) No ( )
9.8 What are their ages?_____

Thank you!
Monica Engel
Researcher
m.engel@mun.ca