ATTITUDES AND PERCEPTIONS OF LOCAL STAKEHOLDERS REGARDING PUMA (*Puma concolor*) IN THE SIERRA LA LAGUNA BIOSPHERE RESERVE, BAJA CALIFORNIA SUR, MEXICO

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Attitudes and Perceptions of Local Stakeholders Regarding Puma

(Puma concolor) in the Sierra La Laguna Biosphere Reserve,

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ABSTRACT OF THE THESIS

Attitudes and Perceptions of Local Stakeholders Regarding Puma (Puma concolor) in the Sierra La Laguna Biosphere Reserve, Baja California Sur, Mexico

by

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In the Sierra La Laguna Biosphere Reserve of Baja California Sur, Mexico, ranching communities have an historical relationship with puma (Puma concolor) that is marked by conflict and persecution. Killing puma in retaliation for livestock attacks is a human-wildlife conflict that is common in rural areas where livestock production is the main source of household income, and presents a challenge to large carnivore conservation. Although pumas were hunted nearly to extinction in the Reserve, there is anecdotal evidence suggesting that the population has begun to rebound. This may signal future human-puma conflict and the need to develop management strategies for both puma conservation and the support of local economic and social interests. The primary aim of this study is to provide an overview of the attitudes and perceptions of local communities regarding puma presence in order to elucidate ranchers’ needs in regard to the conservation of this large predator. This study is an exploratory anthropological assessment using quantitative methodology (questionnaires), the results of which are contextualized by qualitative data (interviews). Eighty-four percent of questionnaire respondents had a high or very high level of experience with puma. Combined attitude scores were neutral to slightly positive and there was a weakly significant negative correlation between isolation (minutes of travel to nearest population center) and attitude. Qualitative analysis suggested that ranchers are very concerned about issues affecting personal safety (e.g., puma attacks on humans due to rabies) and threats to livestock. Results also suggested the need for relationship building between Reserve managers and ranchers, and ranchers’ desire to retain autonomy. Reserve managers can use the results of this study to develop a puma management plan that is socially appropriate and acceptable, and therefore more likely to succeed.
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CHAPTER 1

INTRODUCTION

In the Sierra La Laguna Biosphere Reserve (Reserva Biósfera Sierra La Laguna; REBISLA) of Baja California Sur, Mexico, ranching communities have an historical relationship with puma (*Puma concolor*) that is marked by conflict and persecution. A government-sponsored bounty program in the 1950s, coupled with the killing of puma by landowners, decimated the Sierra’s mountain lion population to the point that natural resource managers were prepared to report that the predator no longer existed within the Reserve (Cariño, 2000; Comisión Nacional de Áreas Naturales Protegidas [CONANP], 2003; M. Rodriguez, personal communication, March 30, 2009). However, there is anecdotal evidence suggesting that the puma population has begun to rebound, raising the possibility of future human-puma conflict and the need to develop management strategies for both puma conservation and the support of local economic and social interests.

The management of large carnivores is often a contentious issue among stakeholders. Landowners may experience a negative impact from wildlife predators via livestock depredation, while natural resource managers are required to meet state-mandated carnivore conservation goals. Livestock depredation is an especially problematic form of human-wildlife conflict because of its direct economic impact on ranchers’ households, and can result in conservation concerns for the predator species (Clark, Curlee, & Reading, 1996; Hoogesteijn, 2005; Treves & Karanth, 2003; Zimmerman, Walpole, & Leader-Williams, 2005). The presence of large predators in close proximity to human settlements can also cause fear for human safety (Beier, 1991) and the belief that game species are being harmed by the predator. On the other hand, the presence of large predators can have positive impacts in the form of an enhanced appreciation for natural systems, an appreciation for the intrinsic value of wildlife, an appreciation for the cultural role of the animal, or the maintenance of ecological processes (Decker, Brown, & Siemer, 2001b; Riley et al., 2003).
PROBLEM STATEMENT

Human-felid conflict, especially when it involves depredation of livestock or threats to human safety, creates conservation concerns for the felid in question (Clark et al., 1996; Hoogesteijn, 2005; Rosas-Rosas & Bender, 2012; Treves & Karanth, 2003). The isolated nature of ranching communities in developing nations such as Mexico, compounded by a lack of sufficient agency enforcement resources, means that the responsibility for adherence to wildlife statutes often falls upon the shoulders of local people. Legal responsibilities take a backseat to the personal responsibilities of maintaining a household, however, and the need for immediate action to curtail livestock depredation can lead to the illegal persecution of felid predators by landowners (Rosas-Rosas, Bender, & Valdez, 2008).

Part of Mexico’s commitment to environmental conservation has been the creation of protected areas, such as the Sierra La Laguna Biosphere Reserve of Baja California Sur (CONANP, 2003; Simonian, 1995). Home to goat and cattle ranching communities, the area is characterized by its ruggedness and isolation and is inhabited by people who have long been independent from the outside pressures of government intervention (Davis & Breceda, 2008). More recently, however, with the establishment of the Reserve, the ranching communities are placed into more regular contact with government officials and their actions are under tighter scrutiny. These stakeholders, accustomed to an autonomous existence, have reacted in various ways to the increased government presence. In some contexts, the communities are willing to accept government intervention, for instance in the establishment of small government-subsidized stores that provide sundry items (Davis & Breceda, 2008). However, a general lack of trust in the government and the relatively new relationships between landowners and government agencies means that landowners will often take action on their own behalf without the input of natural resource agencies (Davis & Breceda, 2008).

It is important to note that due to the isolated nature of the ranches, residents do not have to work hard to subvert the management guidelines under which their ranches are supposed to work. The presence of government agency representatives and any enforcement efforts have been sporadic at best, and many community members continue to do things as they have always been done, which includes extracting resources as needed without outside intervention (A. Breceda, personal communication, March 1, 2011).
Although the puma population was nearly eradicated under a government-sponsored bounty program in the 1950s and retaliatory persecution by livestock owners (Cariño, 2000), recent anecdotal evidence suggests that puma populations are rebounding in the Reserve. Two successive directors of the Biosphere Reserve have reported sightings of puma and their sign by Reserve staff, and community members report recent sightings and interactions as well (J. Quiñones, personal communication, March 18, 2011; M. Rodriguez, personal communication, March 30, 2009; pers. obs.). If puma presence increases, so too will human-puma conflicts, which may necessitate the need for puma conservation management as ranchers return to persecuting the carnivore to protect their interests.

Given the independence of ranching communities, the key to a successful puma conservation management program in the Reserve will be to have the “buy-in” of the local communities who will effectively (if unofficially) manage the protected area on a day-to-day basis. When managing for a depredatory species such as the puma, that buy-in is even more important because ranching stakeholders tend to have strong feelings about the large predator. If managing agencies have an understanding of stakeholders’ attitudes about the puma and its management, and can allow stakeholders to identify their own needs in regard to puma management, they can then incorporate those insights into the creation of a collaborative puma management plan that has a greater chance of success.

**STUDY PURPOSE**

A critical step in designing and implementing any kind of natural resource management plan is gaining an understanding of the attitudes of the local populace in regard to the issue at hand (Bekoff, 2001; Clark et al., 1996; Enck et al., 2006; Messmer, 2009; Riley et al., 2002; Sillero-Zubiri & Laurenson, 2001). The necessity of this approach is threefold: a catalogue of the attitudes and perceptions of those affected by the plan creates a baseline that can be compared to the same data collected later to determine if the plan has affected a community’s mindset about the issue; an understanding of what people already know about an issue can help managers determine the course of future education programs; and the opportunity for a community’s concerns to be heard can alleviate tension and facilitate communication between private stakeholders and management agencies.
This study has three purposes in addressing a potential puma management plan. The primary aim of this study is to provide an overview of the attitudes and perceptions that local ranching communities have about puma presence in order to elucidate community needs in regard to large predator conservation. Additionally, by assessing factors that affect attitude and perception (experience level and stakeholder-identified impacts of puma) and by collecting qualitative data in the form of interviews, this study provides a holistic understanding of the human-puma conflict that can be used by natural resource management agencies in the design of appropriate puma conservation plans that are more likely to succeed.

Secondly, this study gives a voice to stakeholders who have historically been excluded from the wildlife conservation decision-making process. Natural resource managers understand that stakeholder participation in conservation plans can play a part in the success or failure of conservation efforts (Decker & Chase, 1997), and Mexico’s authoritarian and utilitarian approach to wildlife conservation has historically lacked formal stakeholder involvement (Simonian, 1995; Valdez, Guzmán-Aranda, Abarca, Tarango-Arámbula, & Sánchez, 2006).

Thirdly, this study provides methodological contributions to both the field of ecology and that of anthropology. By combining the strengths of quantitative and qualitative methods, this study contributes to the increasingly effective interdisciplinary body of research being undertaken (White, Jennings, Renwick, & Barker, 2005). By appropriately combining the research approaches through a mixed methodology, it also fills a gap in the research literature; most studies of this type tend to leave out important aspects of either quantitative or qualitative methodology (McCleery, Ditton, Sell, & Lopez, 2006; White et al., 2005). This study can be considered an exploratory anthropological assessment with quantitative methodology, the results of which are contextualized by qualitative data.

**Study Site**

The study site is located in the southern region of Baja California Sur, Mexico, in the buffer zone of the Sierra La Laguna Man and Biosphere Reserve (hereafter “REBISLA” or “Reserve”; Figure 1). The Sierra La Laguna Biosphere Reserve was officially designated in 2003 with the intent of protecting the area’s biodiversity (which includes 79 endemic plant

species and 16 endemic animal species), conserving its unique habitat structure, and bolstering local economic development efforts (CONANP, 2003; United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2007). The Reserve encompasses an area of more than 112 thousand hectares of southernmost Baja California Sur, with altitudes ranging from 400-2080 meters above sea level. This altitude range allows for a unique habitat matrix that includes deciduous dry forests, matorral scrub, semi-desert, and pasturelands (Arriaga & Ortega, 1988).

Approximately 640 people live in 146 households within Reserve boundaries (CONANP, 2003; Davis, 2008). Free-range cattle ranching is the largest economic sector in this region, with up to 90% of employed community members of the Reserve involved in ranching as a source of income, either as owners of livestock or as day laborers on ranches (CONANP, 2003; Davis, 2008). Pumas have historically been a “problem species” in the Reserve, which nearly led to their eradication in the first half of the 20th century during a government-sponsored bounty program (Cariño, 2000). Because of the passage of Mexico’s General Wildlife Law (which establishes hunting restrictions on carnivores), the Reserve’s
puma population may be rebounding. This supposition is supported by anecdotal evidence of sightings of mature and young pumas (J. Quiñones, personal communication, March 18, 2011; M. Rodriguez, personal communication, March 30, 2009). Although a large predator conservation plan does not yet exist in either study area, human population growth and the resulting increase in human-wildlife conflicts may precipitate such a plan.

**Chapter Organization**

This thesis is organized into six chapters. This chapter introduced the topic and purpose of this thesis. Chapter 2 presents a literature review of relevant concepts in human-wildlife conflict and how that conflict is addressed in communities that are impacted by the presence of large carnivores. Chapter 3 presents a contextual analysis of historical, environmental, and socio-cultural frameworks for the investigation of human-puma relationships in Baja California Sur. Chapters 4 and 5 describe the methods and results of the attitudes and perceptions research that forms the main focus of this thesis. Chapter 6 discusses the results of the research and presents a conclusion in the form of management recommendations and directions for future research. The Appendix includes data collection instruments used in the attitudes and perceptions research.

**Definition of Terms**

- **BCS** Baja California Sur
- **CIBNOR** Centro de Investigaciones Biológicas Noroeste (Northeastern Center of Biological Investigations)
- **CONANP** Comisión Nacional de Áreas Naturales Protegidas (National Commission of Protected Natural Areas)
- **REBISLA** Sierra La Laguna Biosphere Reserve
- **SEMARNAT** Secretaría de Medio Ambiente y Recursos Naturales (Ministry of Environment and Natural Resources)
- **UABCS** Universidad Autónoma de Baja California Sur (Autonomous University of Baja California Sur)
CHAPTER 2

LITERATURE REVIEW

Wildlife management is shaped by the collective history that a culture has experienced with wildlife, and a society’s values direct the way that wildlife management is carried out by natural resource management agencies (Decker, Brown, & Siemer, 2001a). The need to incorporate stakeholder desires and needs in wildlife management has been at the forefront of the developing field of human dimensions of wildlife (HDW; Decker & Chase, 1997). As wildlife populations that once faced decline rebound, as the push of human populations into wildlife habitat intensifies, and as people continue to affect wildlife populations through legal and illegal means, wildlife managers are recognizing that conservation efforts based on biological sciences alone will not succeed. An HDW approach is increasingly being recognized as an essential facet of successful conservation efforts, as it addresses conflict resolution, public relations, advocacy, mediation, and cultural, socioeconomic, historical, and political considerations (Clark et al., 1996; Decker et al., 2001b; Dickman, 2010; Madden, 2004; Messmer, 2009). This multi-faceted approach is especially critical when dealing with human-wildlife conflicts, which are made enormously complex because of their controversial, value-laden natures (Bekoff, 2001; Clark et al., 1996; Naughton-Treves & Treves, 2005).

HUMAN-WILDLIFE CONFLICT

Conflicts between people and wild animals have existed as long as humans themselves have been around. Human-wildlife conflict (HWC) may even have been one of the selection pressures that influenced the earliest humans’ shift to bipedal posture: being able to see over the vegetation line of grasslands may have allowed early humans to spot and avoid predators lurking in the grass (Day, 1986). To this day one of the major human-wildlife conflicts entails threats, real or perceived, to human safety (Kellert, Black, Rush, & Bath, 1996).

Decker and Chase (1997) include in their definition of HWC any situation in which “the behavior of wildlife creates a negative impact for some stakeholders, or is perceived by
some stakeholders to impact themselves or others adversely” (p. 789). Inskip and Zimmerman (2009) define human-wildlife conflict as occurring when a “wild animal species poses a direct and recurring threat to the livelihood or safety of a person or community and, in response, persecution of the species ensues” (p. 18). Treves and Karanth (2003) describe human-carnivore conflicts as “carnivore-related threats to human life, economic security, or recreation” (p. 1491). Human-wildlife conflict materializes not only as conflict between humans and wildlife, but also as conflict between humans about wildlife (Decker et al., 2001a; Madden, 2004). This sort of conflict can occur when, for instance, residents feel that the government values wildlife over their well-being, and as a result retaliate against wildlife management agency personnel (Madden, 2004). Crop raiding (McIvor & Conover, 1994; Naughton-Treves & Treves, 2005), airplane-bird collisions (Byron & Downs, 2002), competition for game or land (Sillero-Zubiri & Laurenson, 2001), real or perceived threats to human safety (Beier, 1991; Dickman, 2010; Kellert et al., 1996), and livestock depredation (Goldstein et al., 2006; Rosas-Rosas et al., 2008) are among the recent considerations of current human-wildlife conflict.

Human-wildlife conflict becomes a conservation concern when it results in the persecution of a species to such an extent that the species’ population experiences a decline. In the case of carnivores, and particularly large felids, human persecution has contributed substantially to conservation concerns (International Union for Conservation of Nature [IUCN], 2014). Inskip and Zimmerman (2009) found that more than 75% of the world’s felid species were affected by conflict with humans, with the severity of the conflict increasing in relation to felid body mass. Human-felid conflicts are generally related to fear for human safety and livestock depredation (Inskip & Zimmerman, 2009; Kellert et al., 1996).

Taken as whole, the following three studies illustrate an HDW approach to understanding the human-tiger conflict in and around Nepal’s Chitwan National Park. Carter, Riley, and Liu (2012) used traditional hypothesis testing and structural equation modelling to determine the effect of past experiences, beliefs, and risk perceptions of local stakeholders on their preference for future tiger population levels. The study uncovered relationships between beliefs about tigers that can shape effective management strategies. For instance, conflict avoidance efforts or efforts aimed at educating people about the rarity of tiger attacks may not be as successful as efforts that engender confidence in government management actions.
or that focus on the benefits tigers bring to a community (e.g., tourism revenue). Carter, Shrestha, Karki, Pradhan, and Liu (2012) measured the coexistence of tigers and people at the same spatial loci and found that their activity patterns overlapped spatially but not temporally, as tigers adjusted their behavior to avoid periods of disruptive human activity. Most recently, Carter, Riley, Shortridge, Shrestha, and Liu (2014) spatially mapped local stakeholders’ attitudes toward tigers in relation to socioeconomic status and demographic characteristics. People of lower social caste, those who were less educated, and women tended to have lower attitude scores overall. Two spatial attitude clusters emerged–more negative attitudes in an area with more lower-caste people who had less access to educational opportunities, and more positive attitudes in an area where higher-caste people had more educational opportunities and tended to own more livestock. The results of these three studies can be used to create a holistic view of this human-felid conflict, and the socioeconomic and geographic insights provided can help natural resource managers to effectively address the complex issue.

**Threat to Human Safety**

There are areas of the world where large felids have been known to attack humans (Carter et al., 2014; Inskip et al., 2013; Inskip & Zimmerman, 2009; Løe & Røskaft, 2004). Perhaps the most notorious felid man-killer is the tiger (*Panthera tigris*), responsible for more than 12,000 human deaths recorded throughout its range in southeast Asia, China, Russia, Indonesia, and the Indian subcontinent (Løe & Røskaft, 2004). Lions (*Panthera leo*) are also implicated in attacks on humans, and from 1990 to 2005, lions injured or killed nearly 900 people in Tanzania (Packer, Ikanda, Kissui, & Kushnir, 2005). Attacks peaked during harvest season, when farmers sleep alone in huts located in agricultural fields to protect their crops from crop-raiding wildlife. More men than women were attacked, probably because men were more likely to be tending crops, walking alone at night, and tending livestock in the field. Attacks were more common in areas with fewer preferred lion prey species. In Uganda, lions and leopards combined caused 146 injuries and 243 fatalities between 1923 and 1994 (Treves & Naughton-Treves, 1999). Humans were killed when scavenging the predators’ kills, in defense of their livestock, and while guarding crops.
The fear of attack by large cats in North America is grounded at least partly in actual occurrence (Beier, 1991; Inskip & Zimmerman, 2009; Kellert et al., 1996). Beier’s (1991) seminal paper on puma attacks in the United States and Canada reviewed records of attacks from 1890 to 1990. For that 100-year period, he found records for 10 fatalities and 44 nonfatal attacks in both countries. Fitzhugh (2003; as cited in Cougar Management Guidelines Working Group, 2005) amended these numbers to 17 fatalities and 92 nonfatal attacks.

It is possible that some people have a higher perception of risk of attack than the available data actually support. Perceptions of threats to human safety should not be discounted, however, as such perceptions can still drive the persecution of wildlife species (Madden, 2004). Dickman (2010) writes that “rare, devastating events” can result in a “hyper-awareness” of the risk of attack by predators that can persist in local memory and drive the retaliatory killing of carnivores many years later (p. 461).

Livestock Depredation

Sillero-Zubiri and Laurenson (2001) call livestock depredation “the root of a deeply ingrained hatred of carnivores throughout the world” (p. 286). Livestock depredation is felt directly as economic loss by the livestock owner, and can lead to negative feelings towards the predator or the natural resource managing agency, which can harm conservation efforts (Bekoff, 2001; Madden, 2004; Sillero-Zubiri & Laurenson, 2001). The losses incurred by livestock depredation can lead to various levels of risk and vulnerability for the stakeholders involved (Dickman, 2010), which is especially pertinent in less developed communities whose household incomes rely heavily on livestock production. For instance, a ranch owner may have livestock management practices that put him at high risk of economic loss via livestock predation, but if the rancher has other businesses, owns land in other areas, and has cash reserves in the bank, he is less vulnerable to those losses (Dickman, 2010).

Livestock depredation by puma has been documented throughout its range (e.g., Cunningham, Gustavson, & Ballard, 1999; Kissling, Fernández, & Paruelo, 2009; Michalski, Boulhosa, Faria, & Peres, 2006; Palmeira, Crawshaw, Haddad, Ferraz, & Verdade, 2008; Soto-Shoender & Giuliano, 2011; Torres, Mansfield, Foley, Lupo, & Brinkhaus, 1996). In Mexico, the investigation of livestock depredation by felids has been conducted in the
rainforests of Chiapas and Campeche (Amador-Alcalá, Naranjo, & Jiménez-Ferrer, 2013), the tropical deciduous forests of the state of México (Zarco-Gonzáles, Monroy-Vilchis, Rodríguez-Soto, & Urios, 2012), and the semi-tropical thorn scrub of the state of Sonora (Rosas-Rosas et al., 2008). With the exception of the research carried out in the state of México, this body of research is mostly concerned with jaguar (Panthera onca) livestock predation, but also includes opportunistic data collection and analysis of puma activity, which should be noted may present differently than in areas where jaguar and puma do not coexist. There has been scarce research conducted anywhere in Mexico that focuses solely on the ecology or livestock depredation of puma (Zarco-Gonzáles, Monroy-Vilchis, & Alaníz, 2013). The following body of research regarding livestock depredation by felids in Mexico illustrates that although the economic losses incurred by livestock owners are less than perceived, they are still substantial.

In southeastern Mexico, Amador-Alcalá et al. (2013) found that livestock owners experienced economic loss from jaguar (Panthera onca), puma, and other predators. This study included cattle, sheep, goats, pigs, equines (horses and donkeys), poultry (chickens, turkeys, and ducks), and dogs in the definition of livestock holdings. The study also considered losses incurred by many different predators, including jaguar, puma, several mammalian mesopredators, raptors, large reptiles, and more. Through interviews and site visits, Amador-Alcalá et al. (2013) discovered that 82% of livestock losses were attributable to predation, which was equivalent to 36.5% of total livestock holdings annually being lost through predation. This study’s inclusion of all livestock and all known predators was unique and valuable. Garcia-Alaníz, Naranjo, and Mallory (2010) investigated human-felid interactions from a social science perspective in one of the same regions as Amador-Alcalá et al. (2013). All five local felid species (jaguar, puma, ocelot [Leopardus pardalis], margay [Leopardus wiedii], and jaguarundi [Puma yagouaroundi]) were implicated in livestock predation events, with jaguarundi being the most frequently implicated.

In central Mexico, Zarco-Gonzáles et al. (2012) assessed the spatial and livestock husbandry practices associated with puma predation in the southwestern region of the state of México. Puma abundance is greater than that of jaguars in this area (Monroy-Vilchis, Rodríguez-Soto, Zarco-Gonzáles, & Urios, 2009; Zarco-Gonzales et al., 2012). Puma showed a selection preference for goats over cattle in this study; although goats and cattle were
almost equally available, puma selected goats almost twice as often. Livestock production in this area is solely for household consumption, not commercial purposes, so the resulting loss of 17% of the total value of livestock herds very directly affected individual households.

In northern central Mexico, Rosas-Rosas et al. (2008) found that jaguars were the main predator of cattle in northeastern Sonora ranches, although the predation rates were lower than what was perceived by ranchers, who attributed all livestock losses to the big cats. Puma killed very few cattle in this area, instead preferring deer species as prey, a function of the separate spatial, temporal, and resource niches of jaguar and puma where they coexist (Monroy-Vilchis et al., 2009).

A wild felid who feeds on livestock may do so for a number of reasons. Injured cats may not be able to practice their usual ambush tactics, and may rely on livestock as a slow prey with little predator avoidance behavior (Linnell, Odden, Smith, Aanes, & Swenson, 1999; Treves & Karanth, 2003). However, this is not a commonly reported reason for livestock depredation and the only documentation of injured cats killing livestock was reported by two studies done on jaguars in South America (Rabinowitz, 1986; Hoogesteijn, Hoogesteijn & Mondolf, 1993). A sub-adult cat whose mother is killed before he reaches adulthood may not have become sufficiently skilled in hunting techniques, and so may take cattle or other livestock because they are easier to catch than the cat’s customary prey item (Cougar Management Guidelines Working Group, 2005). Cats that live near the edges of protected areas are believed to be most likely to engage in depredation, due to the dispersion of young males and the suitability for movement in those areas adjacent to protected areas (Linnell et al., 1999).

A commonly cited reason for the depredation of livestock by wild cats is the changes in husbandry techniques that have occurred in recent decades (Cougar Management Guidelines Working Group, 2005; Hoogesteijn et al., 1993; Linnell et al., 1999). Where traditionally livestock were guarded by dogs or human herdsmen, livestock are now left to forage without supervision for days at a time (Cougar Management Guidelines Working Group, 2005; Hoogesteijn, 2005), and may graze in areas where they are more likely to be attacked by large predators. Rosas-Rosas et al. (2008) and Amador-Alcala et al. (2013) found that large felids preyed on livestock when they were in close proximity to dense vegetation and water sources. Zarco-Gonzáles et al. (2013) reviewed a number of papers on livestock
depredation in Mexico and were able to develop a spatial risk model for the prediction of livestock depredation based on environmental and livestock husbandry variables. They found that for puma, a forest environment (conifers, oaks, riparian vegetation) and altitude were positively correlated with predation risk, while livestock density was negatively correlated with predation risk. This is in contrast to a previous study conducted by the same team at a site-specific scale, where Zarco-Gonzáles et al. (2012) found that livestock density was positively correlated with predation risk, underscoring the importance of site-specific evaluation of livestock husbandry practices and other factors when determining predation risk.

**Addressing Human-Wildlife Conflicts**

The conservation goal of HWC management is to reduce the persecution of wildlife species that negatively impact people and their interests (whether that impact is real or perceived; Dickman, 2010; Inskip et al., 2013; Madden, 2004). The only way to effectively achieve conservation goals for large felid species that attack livestock is by accurately defining the problem in the context of a host of biological and social variables, and involving local stakeholders who are directly affected by livestock predation in the design and implementation of conservation plans (Clark et al., 1996; Decker et al., 2001b; Madden, 2004; Reed, 2008; Sillero-Zubiri & Laurenson, 2001, Zarco-Gonzáles et al., 2012).

**PROBLEM DEFINITION**

The first step in addressing a human-wildlife conflict is to accurately define the conflict, understanding that a thorough evaluation of the problem will direct the formulation of solutions and how successfully they can be carried out (Clark et al., 1996). Clark et al. (1996) lay out a compelling argument for the importance of the awareness of public attitudes when outlining a carnivore management plan. They write that historically, wildlife conservation has taken the stance that a human-wildlife conflict can be solved by objectively identifying a problem as having only one rational understanding, and basing any solutions on an unbiased accounting of that problem. The authors point out the limitations in this problem-solving method (namely that different stakeholders will view a problem in their own individual terms) and suggest instead using a modified version of the method laid out in Dery (1984). They identify 33 sub-variables that need to be considered in defining such conflicts,
grouped into 5 categories: cultural history, valuation, ecology, management systems, and policy process. Madden (2004) supports this thorough understanding of the conflict, including “social, cultural, historical, biological, ecological, political, economic, and geographic components” in any effective assessment of human-wildlife conflict (p. 253). Some researchers have begun to take this “inclusive exercise” approach to human-wildlife conflict problem-solving, because while a plan may look good on paper, it is only effective as long as it is acceptable to stakeholders (Clark et al., 1996; Inskip & Zimmerman, 2009; Riley & Decker, 2000; Tarrant, Bright & Cordell, 1997; Zimmerman et al., 2005).

The results of several studies underscore the importance of a thorough definition of a human-wildlife conflict, such that the most appropriate solutions can be sought. Inskip et al. (2013) measured the perception of risk posed by tigers in the Sundarbans area of Bangladesh. They found that while more than half of their respondents identified tigers as a problem and many classified the conflict as being of high severity, the perception of the severity of the problem is affected by many other social, economic, political, and environmental issues. In China, Liu et al. (2011) found that even though negative attitudes toward Asiatic black bears (*Ursus thibetanus*) were more prevalent in areas where bears did damage, the attitudes did not result in as much bear persecution as expected. The killing of bears was not linked to areas where they caused damage but rather to areas without human-bear conflict. The researchers discovered, through the use of interviews, that bear persecution in the region was not due to the human-bear conflicts but to the economic incentive of selling bear parts. Carter et al. (2014) spatially mapped attitudes toward tigers in Nepal and found that socioeconomic and cultural factors affected attitudes more than a history of livestock attacks.

**Stakeholder Participation**

Human-wildlife conflicts are partly a result of the behavior of local stakeholders who interact with wildlife, and these individuals are the only ones who can change the situation by changing their behavior. Taking that into consideration, it is essential to involve local stakeholders in the human-wildlife conflict resolution process. As Sillero-Zubiri and Laurenson (2001) stated, “seeking solutions that do not involve local communities is futile” (p. 283). The involvement of stakeholders in environmental management has been increasingly explored as a way to strengthen conservation efforts but is still a practice in its
infancy (Reed, 2008). Reed (2008) suggests a list of “best practices” for stakeholder participation, including that stakeholders should be involved as early as possible in the decision-making process, i.e., stakeholder participation should be incorporated into the design process instead of coming in at the implementation phase. He also notes that stakeholder participation should be characterized by “empowerment, equity, trust, and learning” (p. 2422). Although an evaluative process has not yet arisen to determine the success of stakeholder participation, some have suggested that stakeholders are also engaged in defining success criteria for their involvement (Reed, 2008).

**ADAPTIVE IMPACT MANAGEMENT**

The complexity of the human-wildlife conflict inherent in livestock depredation makes such a situation uniquely suited to the application of Adaptive Impact Management (AIM; Riley et al., 2003). AIM is a relatively new paradigm of wildlife management that takes a HDW approach by prioritizing the desires of a diverse array of stakeholders, including community members living in areas of conservation concern (Enck et al., 2006; Riley et al., 2002; Riley et al., 2003). AIM builds on the Adaptive Resource Management model that encourages making sound management decisions based on ongoing scientific inquiry of the phenomena associated with the individual wildlife species or community (Enck et al., 2006). Adaptive Impact Management retains this tenet but also seeks to define management objectives in terms of “desired stakeholder-identified impacts” (Enck et al., 2006; Riley et al., 2003). The approach allows for the integration of both biological and human dimensions of wildlife management decision-making, which may stimulate a more informed decision-making process in wildlife management issues (Cooke et al., 2009).

Riley et al. (2002) define wildlife impacts as “beneficial and detrimental effects resulting from events or interactions involving humans and wildlife, wildlife management intervention, or various stakeholders” (pp. 586-587). The impacts of puma presence in proximity to dwellings may be negative or positive depending on the value assigned to the impact by the individual. Negative impacts may include economic loss via livestock depredation, fear for human safety, predation of household pets, and perception of game animal population decrease due to puma predation. Positive impacts may include an
enhanced appreciation for natural systems, spiritual significance placed on puma presence, and the perception of the puma fulfilling a role in the ecosystem.

By understanding which impacts community members are most concerned about, managers can better plan a conservation program that addresses those concerns (Cooke et al., 2009; Riley et al., 2002). In situations where resources are limited, managers may only be able to address the most important concerns. Knowing how community stakeholders prioritize their concerns may also aid managers and community members in designing community-based plans for addressing impacts in the absence of agency presence.

Attitudes and Perceptions Research

The assessment of stakeholder attitudes and perceptions has been used to better understand community needs in regard to human-wildlife conflict, and can also be a valuable tool in facilitating communication between stakeholder groups (Heydlauff et al., 2006). The attitudes and perceptions of local communities regarding human-wildlife conflicts have been documented in a number of studies in the United States (e.g., Chavez, Gese, & Krannich, 2005; Naughton-Treves, Grossberg, & Treves, 2003). Riley and Decker (2000) quantified attitudes, perceptions of risk, and perceptions of current wildlife population trends to predict stakeholder acceptance capacity for puma population increase in Montana. Manfredo, Zinn, Sikorowski, and Jones (1998) examined the attitudes of residents about puma management practices and found that attitudes were affected by the situational specificity of survey items. Casey, Krausman, Shaw, and Shaw (2005) investigated the attitudes of residents toward puma near Saguaro National Park in Arizona and found that residents favored puma conservation and would benefit from educational opportunities.

Attitudes and perceptions research into human-wildlife conflict has also been carried out in Canada (Campbell, 2013; Thornton & Quinn, 2010), China (Liu et al., 2011), Nepal (Carter et al., 2014; Carter, Riley, et al., 2012), Latvia (Andersone & Ozolins, 2004), South Africa (Lagendijk & Gusset, 2008), and Bangladesh (Inskip et al., 2013), among others. In their investigation of attitudes toward Asiatic black bears in Sichuan Province, China, Liu et al. (2011) found that although participants who had experienced economic loss because of bear damage showed more negative attitudes, those attitudes did not signal increased bear persecution. In fact, more bear killing was recorded in areas with less bear damage. Through
analysis of interviews, the researchers were able to conclude that the killing of bears was carried out by non-resident poachers who earned money by selling bear parts, and was not a result of residents’ negative attitudes. Andersone and Ozolins (2004) used surveys to measure the attitudes and knowledge of two Latvian stakeholder groups (families with school-aged children and recreational hunters) in regard to brown bears (*Ursus arctos*), lynxes (*Lynx rufus*), and wolves (*Canis lupus*). Results showed that urban residents favored carnivore protection more than rural residents, and that respondents favored bear protection and the control of wolves and lynxes. Lagendijk and Gusset (2008) studied the attitudes toward large carnivores of people residing on the border of the Kruger National Park of South Africa. Despite considering the predators a threat to human and livestock safety, respondents reported favorable attitudes toward the carnivores. The authors believed that this was due to a cultural or aesthetic appreciation of large carnivores and the fact that a predator control program is conducted by the local natural resource agency. Inskip et al. (2013) quantified risk perceptions of tiger attack in Bangladeshi communities as compared to other problems faced by local stakeholders. They found that the perception of risk from tigers was influenced by other socioeconomic problems like employment, income and assets, education, and housing construction. These seemingly tangential problems were perceived by respondents as compounding tiger risk, and driving the probability and severity of human-tiger conflict events.

In Latin America, a small number of attitudes and perceptions studies have been conducted in regard to the human-felid conflicts that exist around ranching communities. Zimmerman et al. (2005) surveyed and interviewed ranchers in the Pantanal region of Brazil, and found that although they had positive attitudes about the puma in terms of its inherent value (natural beauty) and the intrinsic value of the lands that are protected for the animal (grazing lands), they were not willing to suffer losses due to jaguar predation, and would not guarantee to protect the animal. In another area of Brazil, Conforti and Cascelli de Azevedo (2003) used structured interviews and questionnaires, and found that people had generally positive perceptions about jaguars and puma, but did not approve of the presence of jaguar in a nearby protected area because they believed that park personnel had released jaguars into the area (an untrue but commonly held belief). People were generally amenable to the idea of changing husbandry practices to avoid livestock predation. In Argentina, Lucherini and
Merino (2008) used interviews to measure perceptions of and attitudes about carnivores, finding negative perceptions and attitudes about large felids due to livestock depredation, which resulted in felid persecution. In El Salvador, Campbell and Alvarado (2011) used structured interviews to assess public perceptions about two extinct felids (jaguars and pumas) and the fairly common coyote (*Canis latrans*) in anticipation of programs to reintroduce the two large felids. They found that older residents who remember the conflicts with the felids were less likely to be supportive of the idea of a reintroduction plan, and that despite feelings of fear of the animals, people generally had positive attitudes toward them.

The assessment of attitudes and perceptions about predator populations in Mexico seems to be limited to one study in northern Mexico. Rodríguez, Krausman, Ballard, Villalobos, and Shaw (2003) used questionnaires to assess the attitudes of different stakeholder groups (academia and ranching) about wolf reintroduction in Mexico. They found that overall, respondents with more positive attitudes and higher knowledge scores were more likely to be in favor of reintroduction. They also found that ranching stakeholders were very concerned that wolf reintroduction would result in livestock depredation, and that those respondents who initially reported being against wolf reintroduction would be amenable to a plan that included economic compensation for livestock losses.

**MIXED METHODOLOGY: MERGING QUANTITATIVE AND QUALITATIVE APPROACHES**

Traditionally, wildlife management and conflict resolution have focused on the quantitative aspect of the wildlife side of the conflict (Decker et al., 2001a; Riley et al., 2002). This approach has undoubtedly led to advancements in the field of wildlife management, but the identification and analysis of human attitudes, perceptions, needs, values, and viewpoints is becoming more valuable as a management tool due to the growing awareness of public interest in wildlife issues and the increasing occurrence of human-wildlife conflicts as human developments encroach upon wildlife habitats (Enck et al., 2006; Messmer, 2009; Riley et al., 2002; Riley et al., 2003). The logic behind this approach is simple: in any given human-wildlife conflict there are two parties involved, the humans and the wildlife, and a managing agency must address both sides of a conflict in order to fully realize a sustainable solution to the problem (Enck et al., 2006).
Mixed methodology (i.e., merging qualitative and quantitative research design) can give richer dimensions to a study’s conclusions and insights. As the use of social science techniques in wildlife management research becomes more popular, researchers with a background in biological sciences are being encouraged to learn more about the traditional social science use of the techniques, and to delve into the social science literature (McCleery et al., 2006). Interdisciplinary research methodologies can be found in both social science and biological literature, addressing concepts such as wildlife stakeholder acceptance capacity (WSAC), risk perception, and attitudes. Riley and Decker (2000) employed interviews and questionnaires in Montana to measure the predictability of three variables on WSAC of puma (i.e., the maximum acceptable number of animals in a given area). They created a model of the three variables (risk perception, perception of current puma population trends, and attitude) and found that low risk perception, belief that puma populations had decreased, and positive attitudes tended to predict positive WSAC (in this case, a desire to increase puma populations). In addition to the quantitative modelling, the researchers also used questionnaire design and statistical analyses prescribed by social science methodology, including the development of questionnaire items following insights gained from interviews and the use of factor analysis of items to determine reliability. They also measured experience with puma, demographics, and geographic characteristics to enrich the discussion of their results.

Inskip et al. (2013) used structured questionnaires to develop a tiger risk perception map for local stakeholders near a Bangladeshi protected area. Sampling strategies commonly used in anthropological research were employed in this study, including snowball and convenience sampling to target appropriate interview subjects. After risk mapping showed a relationship between perceived tiger risk and a number of socioeconomic factors, qualitative data (including interview excerpts and anecdotes) were used supplementally to provide insight into the “issue landscape” experienced by stakeholders. Liu et al. (2011) recorded the results of semi-structured interviews into a questionnaire to enable statistical analysis. When statistical analysis revealed unexpected results, they were able to contextualize the data with information gleaned from the interviews. Casey et al. (2005) examined the knowledge and attitudes of Arizona residents regarding puma and its management through the use of a questionnaire. They also interviewed natural resource agency managers to better understand
the agencies’ perspective on puma management and agency needs and responsibilities. When compared to the results of the survey, the researchers were able to recommend appropriate management strategies that were within natural resource agency means.

The use of questionnaires in ecological studies has increased, and so too have the criticisms and suggestions for better practices (McCleery et al., 2006; White et al., 2005). A literature review of ecological studies using social science techniques found that many researchers only use one type of research tool (interviews, surveys/questionnaires, or focus groups) which becomes limiting when it comes to data analysis (White et al., 2005). In some papers, aspects like a description of the sample selection process, which may be considered an elementary consideration in the social sciences, are completely missing from the ecological literature (White et al., 2005). Additionally, the oversimplification of statistical analyses may preclude more effective analysis of the data. In a review of 168 questionnaires designed for ecological research, White et al. (2005) found that while more than 90% of the papers summarized findings descriptively, only one-third of the papers attempted more robust statistical analysis.

McCleery et al. (2006) suggest that many wildlife management researchers attempting to catalog stakeholder attitudes have an “inadequate understanding of attitudes and their social psychological frameworks” (p. 537), which is important when attempting to draw a correlation between an individual’s attitudes and related behaviors. This sometimes presents as an oversimplification of data collection instruments. For instance, Peterson, Lopez, Mertig, and Liu (2011) interviewed residents in a U.S.-Mexico border region about public vs. private ownership of wildlife. The attitude assessment portion of the interview consisted of a single item. While their quantitative measure of income level, ethnicity, land ownership, and immigration status undoubtedly contributed valuable information to the study, attitudes themselves were not thoroughly explored or measured according to accepted psychological or anthropological methods (e.g., Weller, 1998). McCleery et al. (2006) suggest using both expectancy models and attitude-to-behavioral process models to better understand stakeholder attitudes (Ajzer, 2001; Fazio & Olson, 2014).
CHAPTER 3

CONTEXTUAL ANALYSIS

A contextual analysis of the stakeholders involved in the human-puma conflict in the Sierra La Laguna Biosphere Reserve is instrumental in fully understanding the conservation capacities inherent in the situation. Historical, environmental, and social contextual analyses are presented here to give perspective to the human-puma relationship in the Reserve and to support the analysis of the quantitative data collected in this study.

HISTORICAL CONTEXT

In the mid-sixteenth century, a romantic adventure novel by García Ordóñez de Montalvo described a verdant and bountiful island peopled by a race of black “Amazonian-like” women who kept men under their rule for procreative purposes (Polk, 1995). The queen of this fictional island was named Calafia, and California became her namesake. It would be another two hundred years before European explorers would travel north to the mouth of the Rio Colorado and confirm that lower California was in fact a peninsula (Baegert, 1952, as cited in Crosby, 1994). Those first impressions of a bounteous island were to be proven wrong in more ways than one, as the following centuries of precarious survival would show.

Mexico’s Baja Peninsula and the Mission Regime

The Baja Peninsula of Mexico comprises two states, Baja California and Baja California Sur. Both states experienced the extirpation of indigenous human populations during the missionary regime and the eventual marked increase of human populations as Spanish settlers established themselves on the peninsula.

There were at least 3 major indigenous groups living on the Baja Peninsula before the arrival of the Spanish, with the best available estimates placing their number at between thirty and fifty thousand people (Baegert, 1952; Crosby, 1974, 1994; Krutch 1961). At the very southern end of the peninsula lived the Pericú people, with the Guaycura people residing in the area between Loreto and San Bartólo. These two groups were thought to share a common heritage because they shared a language family. The northernmost group
inhabiting the peninsula during pre-contact years was the Cochimí tribe, believed to be more closely related to their Yumán neighbors to the north. Baja’s earliest known inhabitants had no agriculture, pottery, refined stone tools, or permanent structures; they were constantly on the move in the search for food in an arid, often inhospitable land. Shamans and healers held the only real positions of influence, though they eventually lost some credibility when they submitted to the powerful missionary leaders (Crosby, 1974).

In the 16th century, the first Spanish visitors to the Baja Peninsula were allegedly killed by the indigenous population for violating the native women (Crosby, 1974). Hernán Cortés had marginally better fortune a couple of years later in 1535, when he took 300 colonists and soldiers to settle in the area of present-day La Paz (Crosby, 1974). The settlers were unprepared for the harsh environmental conditions, however, and were forced back to the mainland as food and water ran out. It would be more than 150 years before a permanent Spanish settlement finally took hold on the peninsula.

Although the nomadic hunter-gatherers of Baja left elaborate cave paintings throughout much of the peninsula (Crosby, 1997; Hambleton, 1979), the most detailed records we have of their existence are the journals and books written by the Jesuit, Franciscan, and finally Dominican missionaries sent to convert them to Christianity (Baegert, 1952; Crosby, 1974). The texts chronicle life in Baja California during the mission period of 1697-1820.

The Jesuit Juan María Salvatierra was given permission by the Spanish crown to establish a mission system on the peninsula in 1696, but only if he could raise his own funds while securing ownership of the lands for Spain. He was able to convince wealthy mainland compatriots of the importance of bringing Christianity to the native people of the peninsula and the following year established Baja’s first permanent settlement at Loreto. Indian populations were lured to mission sites with small gifts of food and clothes and were convinced to give up their nomadic lifestyle to devote themselves to the Church (Baegert, 1952; Crosby, 1974, 1994).

The Church’s endeavors were met with mixed success as missions spread south and then north from Loreto. The missionaries were met with constant resistance from “recalcitrant” Indians unwilling to give up polygamy and other “sinful” activities (Baegert, 1952; Crosby, 1974). On at least one occasion a bloody rebellion claimed the lives of dozens
of converted natives and priests in the Cape Region before military reinforcements were sent from the mainland to quash the uprising (Baegert, 1952; CONANP, 2003).

The indigenous peoples of the southern part of the Baja Peninsula were especially noncompliant with missionary efforts and blamed missionary presence for natural catastrophes and unlucky accidents. For instance, Crosby (1994) details attempts to establish a mission at a foothill site between La Paz and Todos Santos in the early 1720s. An open-sided church structure was built at the site which collapsed in a storm, killing and injuring a number of native people but none of the padres and soldiers who were present. The foreigners were blamed for the deaths, as well as for subsequent plagues of locusts and outbreaks of disease, and the mission settlement was abandoned.

Food scarcity was a major problem for the missions, and for the first time, humans tried their hand at agriculture on the Baja Peninsula. Mission sites were chosen specifically for their proximity to a water source, so agriculture was eventually carried out with some success (Baegert, 1952). Cotton, grapes, melons, and corn were produced on small farms at each mission. Cattle, sheep, goats, chickens, horses, and donkeys were brought over from the mainland and though animal husbandry persisted in the settlements, it was an extraordinarily difficult endeavor with little reward. Much of the food consumed on the ranches had to be shipped from the mainland, especially in the earlier days before the farms were established. The ranches which were able to achieve some level of subsistence production in Baja California Sur were strategically located along canyon slopes near water sources, and survived to form the ranching communities still existing today (Davis, 2008).

Toward the end of the mission period in peninsular California, Father Junipero Serra was sent from mainland Mexico to take over and expand the mission system (Crosby, 1994). Some suggest that he may have foreseen the missions’ collapse, as he almost immediately began moving northward to establish new missions in Alta California. In the end, the decline of the Indian population was most likely the main reason that the missions failed. Crosby (1994) noted that by the early 1800’s, seventeen of twenty missions had shut down because the native population had been ravaged by native and introduced disease, starvation, and internal and external conflicts, leaving no neophytes to receive their ministry. By the end of the mission period in the early 19th century, the population of indigenous peoples in Baja California had dropped to 5000 or less and today one is unlikely to find a descendant of those
who first inhabited the peninsula (Krutch, 1961). The entire peninsula is now home to more than 3.3 million people, with more than 2.84 million people in the state of Baja California and over 637,000 people in Baja California Sur (Instituto Nacional de Estadística y Geografía [INEGI], 2010).

**Baja California Sur**

By the mid-1700s, the indigenous peoples’ dissatisfaction with missionary presence began to turn into outright revolt in the southern regions of the Baja Peninsula. The combination of violent rebellions and the eradication of indigenous populations via conflict and disease led to the abandonment of the mission regime in Baja California Sur by the early 1800s (CONANP, 2003; Crosby, 1994). The four missions that physically survived the conflicts – Loreto, La Paz, Santiago, and Todos Santos – now form four of the largest population centers of Baja California Sur.

Other major settlements took hold in the mid-1700s at El Triunfo and San Antonio as gold and silver mining settlements (CONANP, 2003; Crosby, 1994). Ranches were established near the mining towns and trade was undertaken with larger productive units in Todos Santos and Santiago, stimulating the production and trade not only of livestock but also of fruits, vegetables, honey, worked leather, and sugar cane. While the mining settlements thrived for more than a hundred years, in the late 1800s public concern arose over the environmental degradation caused by mining activities, and the mining industry came to a halt in the region. Despite recent talk of reopening mines on a limited basis, the mining towns are no longer economically important in the region (CONANP, 2003).

Today the population of the state of Baja California Sur is more than 637,000 people (INEGI, 2010), evidence that by manipulating the environment in such a way as to extract the necessary amount of resources, early settlers on the peninsula found strategies that allowed their population to flourish.

**ENVIRONMENTAL CONTEXT**

Mexican natural resource agencies have taken steps in recent decades to conserve some of the most beautiful and biodiverse lands in the world (Breceda, Castellanos, Arriaga, & Ortega, 1995; Simonian, 1995). Plans for habitat conservation, targeted species conservation, and community-based conservation programs have been issued by federal,
state, and local management agencies. However, the implementation of conservation programs has been hindered by the lack of a consistent institutional structure (Simonian, 1995; Valdez et al., 2006; Weber, García-Marmolejo, & Reyna-Hurtado, 2006), a lack of financial resources within Mexican natural resource management agencies (Breceda, Arriaga, Bojórquez, & Rodríguez, 2005; Simonian, 1995), and a lack of trained personnel within those management agencies (Carrera Lopez, 2003; Fuller, Sánchez-Cordero, Illoldi-Rangel, Linaje, & Sarkar, 2007; Valdez et al., 2006; Weber et al., 2006).

**Legislative and Institutional Structure**

Economic and social pressures in Mexico led to the de-prioritization of federal conservation efforts until late in the 20th century (Simonian, 1995; Valdez et al., 2006). Politicians decried conservation as an impediment to economic development for decades, despite the tangible negative consequences of environmental degradation (Simonian, 1995). Centuries of a utilitarian ethic and overexploitation of natural resources has left Mexico with a highly degraded land cover and a number of resulting conservation concerns (Breceda et al., 1995; Cartron, Ceballos, & Felger, 2005; Fuller et al., 2007; Simonian, 1995; Valdez et al., 2006; Weber et al., 2006).

Although Mexico passed its first game law in 1940 and had participated in international wildlife conservation efforts such as the Treaty for the Protection of Migratory Birds and Mammals in 1936, major legislative efforts aimed at wildlife conservation did not take shape until the late 1980s (Simonian, 1995; Valdez et al., 2006). The passage of the General Act for Ecological Balance and the Protection of the Environment (Ley General del Equilibrio Ecológico y la Protección al Ambiente; LGEEPA) in 2000 constructed the framework for Mexico’s modern conservation era and is considered “the most important piece of environmental protection legislation ever enacted in Mexico” (Szkéley, Martínez Morales, Spalding, & Cartron, 2006; p. 87). LGEEPA essentially acts as Mexico’s environmental constitution, and its goal is to encourage sustainable development by preventing and controlling pollution, designing restoration programs to reverse the effects of land cover degradation, creating and managing protected areas, and creating natural resource utilization schemes that blend economic development with environmental protection.
Wildlife conservation *per se* came into the modern legislative framework with the passage of the General Wildlife Law (Ley General de Vida Silvestre; LGVS) in 2000 (Székely et al., 2006). This law sets guidelines for the hunting of wildlife, sets up an approval system for Wildlife Conservation Management Units (Unidades de Manejo; UMA), provides for classification rules for protected wildlife species, and delegates responsibility for wildlife management to the Ministry of Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales; SEMARNAT). Extractive wildlife management activity (*i.e.*, hunting) can only occur in UMAs and is beholden to hunting seasons imposed by SEMARNAT (SEMARNAT, 2013; Weber et al., 2006).

The federal government constantly created and dissolved environmental protection agencies until around 2001, which saw the creation of SEMARNAT (Valdez et al., 2006). SEMARNAT and its sub-ministries are responsible for formulating and enacting land zoning programs, processing environmental impact assessments of development projects, managing protected areas, and implementing the provisions of the LGVS, among other duties. The management of protected areas is undertaken by CONANP under direction from SEMARNAT.

**Impediments to Successful Conservation Efforts**

Unfortunately, although Mexico has solidified its legislative approach to conservation and has shaped approaches to wildlife conservation, most of these conservation efforts exist only on paper (Simonian, 1995; Székely et al., 2006; Valdez et al., 2006; Weber et al., 2006). Székely et al. (2006) state that effective enforcement and implementation of environmental legislation is the exception, not the rule.

A lack of financial resources is a major contributor to the weakness of wildlife conservation programs. Valdez et al. (2006) note that while current wildlife conservation efforts involving collaboration between government agencies and local stakeholders are “concrete and pragmatic”, the overall effort has failed because of the inability of federal and state agencies to fund such programs (p. 278). Weber et al. (2006) note that UMAs are not meeting conservation goals because the local managing agencies are unable to pay for enough well-trained personnel. Wildlife conservation is difficult to prioritize in a country
suffering from social unrest, poverty, and institutional incapacity (Simonian, 1995; Weber et al., 2006).

The cost of conservation has been further augmented by a lack of technical capacity within managing agencies, an unfortunate phenomenon that is certainly not limited to Mexico (Madden, 2004). Some protected areas have been spatially designed in such a way that they do not effectively conserve habitat, leading to the creation of protected areas that are much larger than they should be and therefore, much more expensive to maintain (Fuller et al., 2007). Weber et al. (2006), in reviewing several different UMA management plans, found an unfortunate proliferation of plagiarism and “copy and paste” tendencies, in addition to methodological problems with population estimation techniques. They contribute the questionable nature of the information in the plans to a deficiency in trained personnel.

The lack of technical capacity in agency personnel is a major impediment to successful wildlife conservation and stems from Mexico’s failure to emphasize the education of wildlife management professionals (Carrera Lopez, 2003; Valdez et al., 2006; Weber et al., 2006). Carrera Lopez (2003) points out that although Mexico’s biologists, agricultural specialists, and wildlife veterinarians make wildlife management decisions, none of them have the practical tools to design or implement scientifically sound wildlife management. Mexico’s first university graduate program dedicated to wildlife management was only recently established in 1992, and undergraduate wildlife management programs do not exist (Carrera Lopez, 2003; Valdez et al., 2006). To fill this educational gap, Mexican nationals desirous of a wildlife management career have begun to study at American universities in order to get sufficient training in the wildlife sciences (Carrera Lopez, 2003; Valdez et al., 2006).

Sierra La Laguna Biosphere Reserve

The UNESCO Man and Biosphere Reserve Programme was created in the early 1970s to encourage sustainable development that accounts for both biological conservation and adherence to social justice values (Simonian, 1995; UNESCO, n.d.). Biosphere Reserves are proposed by the nation in which they are located, officially designated by a Man and Biosphere Programme council, and then operate under sovereign jurisdiction. To facilitate the interdisciplinary structure of the Programme, the Reserves are physically structured to
allow for research and economic activity: a “core area” in each Reserve is open only to non-consumptive activities and is surrounded by an outlying “buffer area” where sustainable economic activities and natural resource extraction are undertaken by local communities. There are currently 621 Biosphere Reserves in 117 countries.

Mexico’s 41 Biosphere Reserves account for 6.4% of Mexico’s land, and half of all of its federally protected lands (CONANP, 2012). The Sierra La Laguna Biosphere Reserve was officially designated in 2003 with the intent of conserving the area’s unique habitat structure, protecting its high level of biodiversity, and supporting local economic development efforts (CONANP, 2003; UNESCO, 2007).

The Reserve is managed by CONANP, operating under the direction of SEMARNAT. CONANP published a management plan for the Reserve in 2003, outlining objectives for the area’s biological, cultural, and economic conservation. CONANP’s ability to manage the Reserve is compromised by a lack of financial resources, which means that patrols for illegal activities are sporadic at best, and scientific studies or the implementation of conservation programs are usually conducted by local educational institutions (A. Breceda, personal communication, April 1, 2011)

The Reserve encompasses an area of more than 112 thousand hectares of southernmost Baja California Sur, with altitudes ranging from 400-2080 meters above sea level (CONANP, 2003). The terrain consists mostly of rugged mountains intersected by deep canyons and valleys, with wide plateaus. The lower elevations of the reserve fall within the approximately 80,000 hectare buffer zones, and include communities of deciduous dry forests, matorral scrub, semi-desert, and pasturelands (Arriaga & Ortega, 1988). The Tropic of Cancer runs through the southern portion of the reserve and the tropical dry forests found in this region are the only ecosystem of their kind on the peninsula (CONANP, 2003). The reserve’s highest elevations make up its core area, which is predominantly composed of a biologically rich pine-oak composition (Arriaga & Ortega, 1988).

Inside the 32,000 hectare core area, only those activities related to the preservation of the reserve’s ecosystems are allowed (CONANP, 2003). These include research, environmental education, and low-impact tourism. There are two separate buffer areas. One is a parcel of land of approximately 600 hectares located within the core area, and the rest of the buffer area is located around the outside of the core area. Almost all of the settlements in
the reserve are located within this larger buffer area. Acceptable activities within the buffer area include traditional consumptive activities such as timber and non-timber forest resource extraction, extensive grazing, ranching, bee keeping, and agriculture, all of which are subject to the reserve’s governance. Land ownership in the Reserve is characterized by private, federal, and communal holdings.

The reserve is a biologically valuable and diverse region, with 79 endemic plant species and sixteen endemic wildlife species that breed, overwinter, or feed in the reserve, making it an extremely important feature for wildlife (Breceda et al., 2005; CONANP, 2003). Nearly fifty amphibian and reptile species exist in the reserve, along with almost 90 bird species. Small mammals found in the reserve include brush rabbits, an endemic shrew, and more than a dozen rodent species (CONANP, 2003). Coyotes (Canis latrans), bobcats (Lynx rufus), badgers (Taxidea taxis), ringtails (Bascariscus astutus), and grey fox (Urocyon cinereoargenteus) are some of the mid-sized mammals encountered in the Sierra La Laguna. Mule deer (Odocoileus hemionus) and puma (Puma concolor) are the largest animals found within the reserve (G. Arnaud, personal communication, March 11, 2011; CONANP, 2003).

The puma is also known as mountain lion and cougar in English, and leon, leon de las montañas, and puma in Spanish (Nowak, 1999; University of Michigan Museum of Zoology, 2008). It is one of the largest animals of the order Carnivora, and the largest of the purring cats, with adults weighing between approximately 60 and 250 pounds. Females give birth to one to six kittens every other year (usually two to three), and offspring remain with the mother for about two years. Their historically extensive range has been reduced to the western United States, Mexico, and many regions of South America. Pumas are classified as an animal of Least Concern on the 2013 IUCN Red List (IUCN, 2013). The females have a home range that averages 140 square kilometers, while males have a home range of about 280 square kilometers; the males’ home range will overlap that of one or more females but will not overlap the home range of another male.

Existing historical records of puma in Baja California Sur can be found in the writings of Baegert (1952) and Barco (1973, as cited in Crosby, 1994) from the late 1700s. These writings mention puma as a killer of livestock, as when Barco (1973) writes about puma limiting the growth of cattle herds at the San Luis Gonzaga mission. In response, the mission offered a bounty of one bull for every puma skin collected by indigenous people.
Knowledge of the puma in the Sierra de la Laguna mountain range, in fact in most of the Baja Peninsula, is purely anecdotal (G. Arnaud, personal communication, March 11, 2011; Gallina, Gallina-Tessaro, & Alvarez-Cárdenas, 1991; Laundré & Hernández, 2010). Although they have been federally listed as protected species with special management considerations in the past, as of the 2010 Norma Oficia Mexicana-059 (NOM-059, which assigns wildlife species to categories of conservation risk, and therefore federal protection categories) they are no longer a protected species in Mexico (SEMARNAT, 2010). The hunting of puma is permitted in UMAs from September to January in Baja California Sur (SEMARNAT, 2013). From 1998 to 2011, seven pumas were legally removed by hunters across the country (SEMARNAT, 2013). Although the NOM-059 is supposed to be based on scientifically sound data, there seems to be a policy gap in the case of the puma, as only one population study (and a distribution study at that) has ever been performed in Baja California Sur (G. Arnaud, personal communication, March 11, 2011; C. Chávez, personal communication, March 7, 2014).

Pumas have historically been a “problem species” in the Reserve due to real or perceived threats to livestock, and the puma population was nearly decimated after a county-wide bounty program was implemented (G. Arnaud, personal communication, March 11, 2011; M. Rodríguez, personal communication, March 30, 2009). This puma “control” effort was undertaken by the local county government in the 1950’s, whereby at least eight people presented the pelts of at least 15 mountain lions to the local authorities to receive payments of 100-200 Mexican Pesos per skin (Cariño, 2000; CONANP, 2003). Although the amount of money paid to hunters was substantial enough for its time, the effort involved in hunting puma (10-14 days of traversing rugged country in pursuit of the cat) may have been the reason that relatively few people collected the reward (Key Informant 1, personal communication). The bounty program exacerbated the effects of decades of retaliatory killing by local ranchers, and the puma population quickly decreased (J. Quiñonez, personal communication, March 18, 2011).

However, more recently, and perhaps especially since the passage of the General Wildlife Law in 2000 (which gives SEMARNAT the responsibility of restricting the hunting of predators to defined hunting seasons), anecdotal evidence has begun to surface which suggests that the Reserve’s puma population may be rebounding. Reports of recent sightings
of puma and their sign in the Reserve, including sightings of juveniles, leads reserve managers and local researchers to believe that the population may be increasing (J. Quiñonez, personal communication, March 18, 2011; M. Rodríguez, personal communication, July 28, 2009), either by increased reproductive success or because the animals are able to migrate from mountain ranges in the north (G. Arnaud, personal communication, March 8, 2011). Although a large predator conservation plan does not yet exist in the study area, human population growth and the resulting increase in human-wildlife conflicts may precipitate such a plan.

**Sociocultural Context**

Davis and Breceda (2008) write that the ranching communities of the Sierra La Laguna Biosphere Reserve have a high value because they are a window into the past, and the ranching lifestyle is a cultural relict that is worth conserving. For all the cultural value placed on the ranching lifestyle, it is not the most lucrative of economic endeavors (Aragón, 2008). Indeed, the reserve’s management plan notes that often ranching is more a matter of tradition and pride than as a reliably profitable source of income (CONANP, 2003). Unfortunately, given the overexploitation of foraging resources and the resulting widespread land surface degradation, ranching is more and more considered an unsustainable practice (Aragón, 2008; Davis & Breceda, 2008).

Approximately 640 people live in 146 households within Reserve boundaries (Figure 2; CONANP, 2003; Davis, 2008). The population is in constant flux, however, due to the migration of young adults into urban areas of the peninsula as they search for economic opportunity, and then their return to the Reserve as economic opportunities arise at home (CONANP, 2003; Davis, 2008).

Although cattle were first introduced by Spanish settlers to the peninsula as a food source and as a form of payment for labor in the 16th Century (Baegert, 1952; Crosby, 1994), ranching as an economic institution did not become established until almost 200 years later (CONANP, 2003, Davis, 2008). Free-range cattle ranching is the largest economic sector in the Reserve, with up to 90% of employed community members involved in ranching as a source of income either as owners of livestock or as day laborers on ranches (CONANP,
There are currently between 7,250 and 7,500 ranch cattle in the reserve (Breceda et al., 2005; CONANP, 2003). There are also approximately 1200 goats on the ranches, and about 1000 sheep and pigs combined. Other economic activities include legal and illegal forest resource extraction, agriculture, and tourism (Aragón, 2008).

The ranching culture in the Reserve developed outside the sphere of government influence, primarily due to the physical isolation of its rugged and inaccessible canyon setting, and it has mostly remained that way. The communities are isolated from each other and from major population centers by distance and by the effort of physically reaching them— the roads are extraordinarily rugged, and accessibility is a constant concern. While the county road department maintains the primary dirt roads that connect to state highways, the secondary, tertiary, and quaternary roads are at the mercy of violent storms, and must be maintained by community members.
The poor roads and long travel times to town affect the accessibility of schooling, medical care, and the purchase of consumer goods (Davis, 2008). Most children attend boarding school during the week in Santiago, San Antonio, and Todos Santos, to which they are transported by their parents or by carpool. Medical services are limited in the Reserve—there is one pharmacy in the community of San Jorge, otherwise one must drive to an outlying population center for medical treatment. Major medical treatment can only be sought in the Los Cabos region or La Paz, either of which may be two or more hours away.

Consumer goods can be purchased in population centers, roadside markets, and the government-subsidized Rural Supply Program (Programa de Abasto Rural). The establishment of three of these small stores in San Jorge, San Dionisio, and La Choya was requested by community organizations, and sell basic household items such as baskets, health and hygiene products, and limited food and nutrition products. The ranches themselves produce almost all of the basic necessities to meet household needs—food products such as cheese, milk, meat (including chorizo and salted meats), lard, honey, fruits, and vegetables; products such as leather, saddlery, and honey are either made at home or purchased from neighbors. Davis (2008) found that while most people were satisfied with the local availability of goods, many also traveled to La Paz to shop, where prices are cheaper than in other population centers.

Living spaces in the ranches consist of several different outbuildings, each with its own purpose. Buildings generally have dirt floors, walls made of woven palo de arco branches in a cement matrix, and palm leaf roofs. Occasionally roofs are made of composite material and government programs provide for the construction of concrete outbuildings. Hammocks or beds are located in sleeping buildings. An open-air kitchen is served by wood-burning stoves. The aforementioned wet latrines open into a large pit that acts as a septic system, and a separate bathing room with rudimentary plumbing is supplied with water from a hose. The living spaces are modest, austere, and functional.

Most ranches receive electricity from solar cell generation and are able to run small refrigerators, televisions, radios, and sometimes washing machines. Cell phone reception is spotty, but cell phone pay stations allow for a mode of communication in addition to the short-wave radios that most ranches have. Water usually comes from a well and is pumped to the living spaces with an electric pump or is gravity fed if the ranch sits lower on a slope.
Davis (2008) hesitates to characterize the ranching communities of the Reserve as “rural poor” (p. 87). That term is generally reserved for agricultural workers or indigenous peoples, neither of which technically hold land and must work for other people to earn a wage in a position that is in no way guaranteed to be long term. Reserve ranchers, on the other hand, own their own land and work their own livestock. Even day laborers own their own ranches and receive payment in the form of livestock, and therefore the opportunity to increase the yields of their own ranches. Their basic needs are met in large part by their own strategies for survival, and unemployment rates in the Reserve are enviably low at 3.4% (Davis, 2008).

It is very important to note, however, that this is a population with many of the characteristics of poverty. Severe storms or drought years can seriously affect household cash reserves if livestock are injured, lost, or die of dehydration. Davis (2008) found that 45% of her sample was spending 70-100% of the household’s cash resources on the purchase of goods not available locally, signifying a fragile household economy and inability to save money. Health and hygiene are ongoing concerns: the federal Secretary of Health funds a traveling medic that visits ranches infrequently to administer basic health services such as vaccinations and dental cleanings, and the wet latrines used by households are a hygienic nightmare. Education is available to Reserve communities, but school drop-outs are a common occurrence, and the ranching communities spend an average of less than five years in school (Davis, 2008).

Davis (2008), in discussing the danger of extinction of the ranching culture in the Reserve, notes that demography is probably the area’s most pressing problem. Within the Reserve, Davis showed that there is disparity in age-sex composition, where males are more regularly distributed among age classes than females after the age of 24. Additionally, across both sexes, the age distribution pyramid is inverted (wider at the top than the bottom), signaling an aging population that is not being replaced by younger generations. In the case of the Reserve, dispersal has increased as young people leave the Reserve to attend college or to look for work elsewhere, usually in an unskilled tertiary sector of the tourism industry in the Los Cabos region, Todos Santos, or La Paz (CONANP, 2003). The relatively recent phenomenon of “generational exodus” precipitates a population decline that threatens the
continued existence of ranching in the Reserve, which Davis (2008) calls “not only a natural reserve, but a cultural one as well” (p. 94).

A sense of autonomy and a close relationship with the environment have characterized the ranchers of the Sierra La Laguna Biosphere Reserve for centuries. The creation of the Reserve has changed the circumstances of the ranches’ existence, if only marginally, and has necessitated a renegotiation of ranchers’ relationship with the outside world.

The people of REBISLA can best be described as fiercely independent, self-sufficient, and although generous in their hospitality, they are wary of outsiders. Lorella Davis Solís, a researcher from the Universidad Autónoma de Baja California Sur, has written the most current and thorough anthropological record of the ranches and rancheros of the Sierra La Laguna Biosphere Reserve (Davis, 2008). She describes the Reserve’s ranchers as people who “don’t like to owe anyone, nor do they like to work for others, and much less do they like to submit to any form of external authority” (p. 78). The official Biosphere Reserve management plan published by CONANP states, “One thing is certain: the idiosyncrasies of the people of this unique region were forged over the span of centuries in an environment of neglect by the central government. And maybe it has not changed much, because it is a people inextricably linked to its environment” (CONANP, 2003, p. 42). The designation of the Reserve has, however, challenged this autonomy. Not only has the Reserve brought the increased presence of government employees, but tourists and private tourism outfits have also begun to “invade” the sierra (Davis, 2008).

The ranchers of REBISLA had very little contact with government agency personnel until recently. The success of the Reserve’s management plan, however, depends on more agency presence than is currently realized. As previously mentioned, CONANP’s capacity to manage the Reserve has been hampered by a lack of resources, especially in the sense that there are not enough park rangers to efficiently patrol the large area of the Reserve. CONANP has maintained its presence in the Reserve by performing regular (if infrequent) patrols, hiring community members as park rangers, and coordinating work-week home stays for non-resident park rangers. These strategies have met with mixed success (see Chapter 6 of this thesis), and Reserve residents and out-of-town visitors have not had to work hard to subvert the managing authority. For instance, while I was on a ride-along with Reserve staff,
we came upon stacks of illegally extracted firewood sitting by the side of the road, waiting for pickup. Because CONANP is not an enforcement agency, the park rangers contacted the Federal Environmental Protection Agency (Procuraduría Federal de Proteccion al Ambiente; PROFEPÁ). The rangers told me that PROFEPÁ agents would probably arrive in a day or two to investigate. In the meantime, as we visited local ranches, the park rangers inquired about information related to the logging. Ranch residents told the rangers that the wood had been cut by people from out of the area. It was impossible to verify the truth of that claim. In this instance, CONANP had very little authority over the situation, as enforcement is out of their hands, and the lag time in the arrival of PROFEPÁ allowed the illegal extractors plenty of time to remove evidence. Had the park rangers not been making a special trip to the Reserve for my benefit, the stacks of wood may never have been seen.

CONANP employees (names withheld for confidentiality) told me on several occasions that it was very difficult to convince Reserve residents to adopt the new Reserve guidelines. If people were accustomed to cutting firewood in a particular spot, they were going to continue to do so because they saw no reason not to. When I reacted with surprise to the mention of cattle grazing that continued to occur in the Reserve’s core area, I was told, “They’ve always grazed their cattle there. It’s too hard for them to change their ways.” Whether it is because local ranchers are consciously rebelling against the Reserve, have not been educated about the new guidelines, or do not understand the importance of compliance with those guidelines is unclear. Whatever the case may be, Reserve ranchers are being put in a position where they must negotiate a new relationship with the federal agency, and their lack of compliance with Reserve guidelines may have negative legal consequences in the form of fines or imprisonment should park officials take a hard line on enforcement.

Some residents seem to have benefitted at least marginally from the Reserve’s creation in the form of the development of tourism (Aragón, 2008). Although there are several small companies just outside the boundaries of the Reserve that provide hiking trips into REBISLA, only a few Reserve residents have embraced tourism as an alternative economic activity. One rancher (who served as a key informant in this study) operates a small ranch with an organic farm, and supplements his income by guiding tourists into the Reserve, by foot or by burro. Another rancher provides the same service but is located on the opposite side of the Reserve. Active involvement in the tourist industry is rare, and aside
from the aforementioned tour guides, the community members only realize a benefit if tourists are given the opportunity to purchase crafts or ranch products. On the other hand, tour guide outfits outside the Reserve and in major population centers can certainly be considered the end financial beneficiaries of tourism-related activity within the Reserve, and serve as competition to any tourism-related start-up by Reserve residents.
CHAPTER 4

METHODS

This study employed a valid research methodology that respected the guidelines set forth by the SDSU Committee on the Protection of Human Subjects and the Institutional Review Board.

Five field visits were made to the study site from 2009 to 2011 to introduce myself to the community members of REBISLA, CONANP employees, CIBNOR and UABCS researchers, and other stakeholders. The first four visits allowed stakeholders to become familiar with me, and allowed me to build a relationship with them before collecting data. Data were collected during the fifth visit in the spring of 2011.

ARCHIVAL RESEARCH

Archival research was performed to investigate the historical context of the relationship between landowners, natural resource agencies, and pumas. State historical archives were searched for information about previous government-sponsored puma bounty programs. Federal and state natural resource agency records were also consulted. The results of this research were integrated into the Discussion section of this thesis chapter.

SAMPLE SELECTION AND PARTICIPANT CHARACTERISTICS

Various groups of stakeholders may be identified in this particular human-wildlife conflict: urban university students, urban conservationists, ranchers within the Reserve, ranchers with lands adjoining the Reserve, federal agency personnel, state agency personnel, non-ranching rural and urban residents, etc. In this study, two groups of stakeholders are identified- resident ranchers within the Reserve and CONANP personnel. The focus of this study is on resident ranchers, and their perceptions and attitudes are therefore the focus of data collection and analysis. The relationship of ranchers with CONANP as an agency and with individual CONANP employees is discussed qualitatively in Chapter 6.
Two samples were required for this study: key informants and questionnaire participants. In order to generate reliable data related to the human-puma relationship, i.e., data that can be used to predict human behavior in regard to puma and their management in the Reserve, it was important to identify a sample of individuals with “accessible” attitudes about puma (Ajzer, 2001; Fazio & Olson, 2014). Attitudes are accessible when a respondent has direct and personal experience with an attitude object. To that end, respondent characteristic requirements included tenure in the Reserve and livelihood activities that had high probability of exposure to puma. These criteria provided for respondents with the relevant personal experience that allows for the more accurate identification and evaluation of attitudes and opinions (Ajzer, 2001; Fazio & Olson, 2014; McCleery et al., 2006).

Key informants were chosen by snowball sampling, whereby local researchers were asked to provide the names of adult community members who were either ranch laborers or owners living in the Reserve for at least nine months out of the year, and who were willing to talk at length about pumas in the Reserve.

Questionnaire participants were selected using a convenience cluster sampling method in order to equally sample all inhabited regions of the Reserve. Ranches in the buffer zone of the Sierra La Laguna Biosphere Reserve are located along the slopes of canyons in a number of geographically distinct watersheds (Breceda et al., 2005; Figure 2). Sampling occurred by driving through each community (there is generally a main road, with occasional secondary and tertiary roads), and stopping at each household to determine willingness to participate in the study. Questionnaire participants had the same characteristics as key informants, with the additional requirement of self-identification as the head of the household. The head of the household was defined as the person who makes the majority of decisions regarding household finances, type and extent of involvement in local economy, community involvement, and other such decisions directly impacting the household.

Surveys were conducted at the respondent’s home, and lasted between thirty and sixty minutes. Aside from the respondent and surveyor, a local community member, researcher, or park ranger was also present to make introductions to community members and/or to facilitate the questionnaire process. The participant was given a copy of the questionnaire in order to follow along during administration, and the researcher recorded responses on a separate data sheet.
INTERVIEWS AND QUESTIONNAIRES

A standardized set of open-ended questions were asked of key informants (Appendix). The conversations with key informants allowed for the editing of the questionnaire to include more culturally appropriate items and to edit items to be more readily accessible to participants.

To strengthen the validity of questionnaires composed in the researcher’s native English language, and to ensure proper cultural adaptation of the materials, each item on the questionnaire underwent two full translation loops, i.e., items were translated from English (source language) to Spanish (target language), and then back to the source language, using a separate bilingual translator for each step (Weller, 1998). Two pilot questionnaires were conducted and the results analyzed to detect misunderstandings of the survey items (Weller, 1998; White et al., 2005). Questionnaires were then edited before official data collection (Appendix).

The questionnaire included five sections: demographics, experience with puma, attitude assessment, inventory of other damage-causing wildlife, and puma impact assessment (modified from Riley & Decker, 2000 and Zimmerman et al., 2005). The questionnaire was designed to probe into various facets of the human-wildlife relationship, and its several different response formats (free-listing, Likert-type scaling, and close-ended) were intended to minimize memory bias, provide a more robust set of data for analysis, and to allow for rich data collection (Charmaz, 2006; Weller, 1998).

Demographics

The demographic section included open-ended response items regarding age, sex, general location with the reserve, number of people/children in household, and time needed to reach nearest town or city.

Experience with Puma

A person’s attitude can signal his or her behavior toward a situation or item, but the predictability of behavior based on reported attitude is influenced by a person’s experience with the attitude object (i.e., the “accessibility” of the attitude; Ajzer, 2001; Fazio & Olson, 2014). For instance, if a person has a favorable attitude toward hunting, and has hunted often in the past, then that person will have a more accessible attitude toward hunting, and
therefore, a more predictable behavior associated with hunting (Ajzer, 2001; Fazio & Olson, 2014; McCleery et al., 2006). In order to allow for some discussion on the predictability of behavior based on the attitudes uncovered in the Attitudes section of the questionnaire, respondents’ experience with puma was measured as adapted from Riley and Decker (2000).

Eleven yes-or-no response items were designed to gauge whether respondents had very high, high, moderate, or low/no experience with pumas. Very high experience items (n=3) included statements of personal experience or threat with puma. High experience items (n=4) included statements reflecting experiences of the participant’s family members, neighbors, or livestock. Moderate experience items (n=3) involved events that the respondent heard about, and one low/no experience item was given a positive response when no other items were applicable. Respondents were placed into experience categories based on the highest experience item with a positive response (Carter, Riley, et al., 2012; Riley & Decker, 2000).

Attitude toward Puma

Seventeen attitude assessment items were presented to participants, as adapted and modified from Riley and Decker (2000) and Zimmerman et al. (2005). These included five items concerning attitudes about pumas in general, four items regarding puma management, four items involving knowledge of puma natural history, and four items gauging perceived risks of mountain lion presence. Items were evenly distributed as positive, negative, and neutral statements, and were randomly ordered, following Weller’s (1998) outline of Nunnally (1978).

Items were presented as a 3-point Likert scale (agree-no opinion-disagree). This method was used instead of a more common 5- or 7-point scale due to difficulties encountered with the wider scale during pilot testing; respondents seemed to have difficulty with scaling the magnitude of agreement or disagreement. This may be explained by a low degree of education among participants, coupled with the oral nature of the questionnaire (Davis & Breceda, 2008; Weller, 1998).

Inventory of Other Damage-Causing Wildlife

To inventory other damage-causing wildlife, participants were asked to free-list all wildlife species that caused damage on ranches, exclusive of puma. This enabled
triangulation of data and allowed for discussion about other human-wildlife conflicts within the Reserve.

**Puma Impacts**

The section on puma impacts required the respondent to generate positive and negative impact statements regarding puma, and to choose the impact they felt was the most important with both categories. Prepared items gleaned from key informant interviews were provided when participants requested examples or to prompt item generation, and participants were permitted to choose one of those impacts as the most important, or to self-generate another.

**DATA ANALYSIS**

Key informant interviews were transcribed and coded iteratively to extract common themes. Descriptive statistics were used to summarize all questionnaire data. The scores of six attitude statements were combined and scores summed to create an attitudinal scale with values from -6 to 6, with higher scores indicating a more positive attitude toward puma (Kellert et al., 1996; Zimmerman et al., 2005). Interval-level explanatory variables (e.g., age, isolation, or number of livestock) were log_{10} transformed to better approximate normality (Zimmerman et al., 2005). Relationships between attitude scores and explanatory variables were evaluated using analysis of variance (ANOVA) and Pearson’s correlation coefficient as appropriate given the level of measurement of the variables (i.e., nominal, ordinal, or interval). Calculations were performed in Microsoft Excel 2007.

**LIMITATIONS OF STUDY**

General attitudes are not always predictive of situationally specific attitudes, nor can they necessarily predict behaviors in a specific situation (Manfredo et al., 1998; McCleery et al., 2006). For instance, the general attitude item “Carnivores have a right to live in the jungle” may have different results than “Carnivores that eat livestock have a right to live in the jungle”. Likewise, a respondent who generally believes that carnivores have a right to live in the jungle may still kill one if it attacks his livestock. Because this research investigates general attitudes and perceptions among stakeholders, it is not well-suited to drawing specific predictive conclusions about stakeholder behavior. This potential weakness
is counteracted by this study’s qualitative analysis, which attempts to give situational perspective to the human-puma relationship in the Reserve, thereby strengthening predictive ability.

Technically, the sampling method used for questionnaire participants was of a nonrandom nature, and the study area’s rugged inaccessibility coupled with time and financial constraints, resulted in a relatively small sample size for statistical analysis (n=24; however, it should be noted that the sample accounted for sixteen percent of the total population of households). Additionally, because the research deals with fluid constructs of human psychological characteristics, which are affected by non-tangible variables that are in turn affected by personal history and internal/external pressures, so the normality of the data cannot be assumed across the population as a whole. Indeed, some facets of the sample data collected showed a non-normal distribution that had to be transformed before data analysis. While this can limit the applicability of robust statistical analyses, and in most cases excludes the reasonable use of parametric analyses, some statistical analyses can (and should) be performed in such research. The goal then is to use statistical analyses in such a way that: (1) anthropological insights are not lost to technical statistical insignificance, and (2) meaningful results can be drawn by obtaining statistical inferences from the data. The data analysis and conclusions derived in this study should not be applied to other protected areas, with other wildlife species, or in general to the greater sampled population.

The sample in this study consists of the heads of households in the study area. Because I was only examining the responses of the household decision-makers in the Reserve, inferences cannot be made to all people living in the Reserve. The study is intended only to investigate the potential actions of each *household* in the Reserve.

Language barriers can be obstructive when collecting data through verbal communication. Although I am a high intermediate Spanish speaker who has lived in several Latin American countries for up to six months at a time, I am still not a native Spanish speaker. There were several times where I am sure I could not understand the details of what respondents were telling me. Sometimes I would ask the respondent to repeat what they had said, but for most part I was loathe to interrupt their narrative flow. I sought to remedy this shortcoming in several ways. First, I was always accompanied by someone who could act as a translator or facilitator during the session. Secondly, after each questionnaire
administration, my facilitator and I reviewed all questionnaire answers for accuracy. Thirdly, since all questionnaire sessions were audio-recorded, I was able to review the conversation at a later time if there was still some question about the accuracy of an answer that I had recorded. The interviews with key informants were transcribed by a native Spanish speaker, which allowed me to accurately translate the conversation.

The language barrier was not the only limitation I experienced in talking with the ranchers of Sierra La Laguna. I was told as I began my research that they are a very friendly people who are nonetheless wary of outsiders. To counteract any unwillingness to talk openly with me about potentially sensitive issues, I made several short visits to ranches before beginning my research. During these visits, we only socialized, speaking peripherally about my project, if at all. I also made sure to visit ranches for interviews and questionnaires in the company of someone the ranchers already knew and trusted. For instance, I conducted questionnaires in San Dionisio in the company of a woman from La Paz who had previously stayed in the community for periods of time while conducting her own research. She was clearly considered part of the family by many residents there, and I was welcomed because she brought me. In other communities I was accompanied by CONANP rangers who were community members, or by a member of a CIBNOR research team who had family in the area and was well-liked. Although these measures undoubtedly smoothed the way for people to speak openly with me, it is certainly possible that some participants lied, under- or over-exaggerated, withheld information, or otherwise subverted my attempts to collect accurate data. I did not, however, feel that that was the case, with the exception of a conversation with one rancher far north of the study site, which is discussed in Chapter 6.
CHAPTER 5

RESULTS

INTERVIEWS

A total of three key informant interviews were conducted. Two key informant interviews were conducted prior to editing the pre-designed questionnaire. An additional key informant interview was also performed after commencing questionnaire methodology. During a number of questionnaires, participants told me that I should talk to a community elder who had a rich personal history in the Reserve and had spent most of his life as a leonero. I felt that an interview, rather than the questionnaire, would better capture the valuable insights he had to offer.

QUESTIONNAIRES

Twenty-seven questionnaires were administered in the Biosphere Reserve between 14 April 2011 and 9 May 2011. Three questionnaires were dropped from the data set; these participants were of advanced age and had difficulty mentally staying on task with the survey process, resulting in incomplete data acquisition. The remaining twenty-four questionnaires compose the data set analyzed in this study.

Demographics

Two females and twenty-two males participated in the questionnaires as heads of household (Table 1). The mean age of participants was 61.5 years. On average there were 3.9 people in the household, 1.3 of which were children. Respondents had to travel an average of about an hour to the nearest population center.

Experience with Puma

Eight-four percent of questionnaire participants had a “high” or “very high” level of experience with pumas (Table 2). It is worth noting that more than half of the participants had seen puma tracks (67%) and/or had heard that a puma was killed by someone (67%), and that 79% of participants had heard about someone’s pet or livestock being attacked by puma.
Table 1. Demographic Characteristics of Respondents

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>61.5</td>
<td>58.5</td>
<td>13.05</td>
<td>37</td>
<td>88</td>
</tr>
<tr>
<td>Number of people in household</td>
<td>3.9</td>
<td>4</td>
<td>1.84</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Number of children in household</td>
<td>1.3</td>
<td>1</td>
<td>1.94</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Time to town (isolation)</td>
<td>60.4</td>
<td>55</td>
<td>35.20</td>
<td>10</td>
<td>120</td>
</tr>
</tbody>
</table>

Table 2. Percentage of Questionnaire Respondents Reporting Experience with Puma

<table>
<thead>
<tr>
<th>Experience category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td></td>
</tr>
<tr>
<td>Has seen a puma</td>
<td>46</td>
</tr>
<tr>
<td>Has hunted for or killed a puma</td>
<td>8</td>
</tr>
<tr>
<td>Has been personally threatened or attacked by puma</td>
<td>8</td>
</tr>
<tr>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Has seen puma tracks</td>
<td>67</td>
</tr>
<tr>
<td>A puma has threatened or attacked his/her pet</td>
<td>8</td>
</tr>
<tr>
<td>A puma has threatened or attacked his/her livestock</td>
<td>25</td>
</tr>
<tr>
<td>Knows a friend, family member, or neighbor who has been attacked or threatened by a puma</td>
<td>21</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Has heard that a puma was killed by someone</td>
<td>67</td>
</tr>
<tr>
<td>Has heard that a puma attacked someone’s pet or livestock</td>
<td>79</td>
</tr>
<tr>
<td>Has heard that a puma has attacked or threatened someone</td>
<td>33</td>
</tr>
<tr>
<td>No experience</td>
<td>4</td>
</tr>
</tbody>
</table>

Attitude Assessment

The results of all of the questionnaire’s attitude items can be found in Table 3. The internal consistency of the six combined attitude statements was high enough to suggest a reliable measure of attitude for a small sample (Cronbach’s alpha= 0.63; Hair, Anderson, Tatham, & Black, 2006). Combined attitude scores ranged from -6 (very negative) to 6 (very
Table 3. Participant Agreement with Individual Attitude Items

<table>
<thead>
<tr>
<th>Attitude statement</th>
<th>% Agree</th>
<th>% Disagree</th>
<th>% Don't know/no opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>The presence of pumas means that the ecosystem is healthy.</td>
<td>92</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Pumas are an important part of my culture.</td>
<td>92</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Pumas destroy the equilibrium of an ecosystem.</td>
<td>42</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>Pumas help to maintain the equilibrium of deer populations.</td>
<td>63</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>I worry that a puma could harm me or someone in my family.</td>
<td>67</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>Pumas should be removed from the countryside.*</td>
<td>46</td>
<td>46</td>
<td>8</td>
</tr>
<tr>
<td>Pumas have the right to live anywhere they might occur.*</td>
<td>96</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Pumas should be allowed to exist wherever they might occur.</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pumas are an acceptable threat to livestock.*</td>
<td>83</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Pumas are a threat to humans.*</td>
<td>63</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>Pumas are a threat to livestock.*</td>
<td>75</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>It would be okay with me if there were more pumas in the future.*</td>
<td>63</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>I admire the men who have killed pumas.</td>
<td>42</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>Every ranch should solve its own problem with puma.</td>
<td>63</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>I would like help from natural resource agencies in solving puma problems.</td>
<td>88</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>If there were a reward program for hunting puma, I would participate.</td>
<td>50</td>
<td>46</td>
<td>4</td>
</tr>
<tr>
<td>There are more pumas now than 20 years ago.</td>
<td>17</td>
<td>79</td>
<td>4</td>
</tr>
</tbody>
</table>

* Items used for summative attitude scale
positive). The mean of the combined attitude scores was neutral to slightly positive (mean=1.1, SD=3.05)

**ATTITUDES TOWARD PUMA**

Almost all respondents believed that pumas were an important part of their culture (92%) and that pumas have an intrinsic right to live wherever they might occur (96%). Most respondents were agreeable to the idea of puma population growth (63%). Respondents were divided about whether they admired *leoneros*, with 50% saying they did not admire such men, and 42% saying that they did (8% unsure or no opinion).

While nearly all participants (92%) reported that the presence of pumas signifies a healthy ecosystem, they were more divided on whether pumas contributed to natural equilibria within ecosystems. Almost half (42%) felt that pumas destroy an ecosystem’s equilibrium, while 68% agreed that pumas maintain the equilibrium of deer populations. Few participants (17%) believed that were more pumas at the time of the questionnaire than 20 years prior.

More than half of survey participants (68%) reported believing that pumas are a threat to humans, and that they worry that a puma could harm them or their family members (67%). While 75% of respondents reported believing that pumas are a threat to livestock, 83% also felt that pumas are an *acceptable* threat to livestock.

**ATTITUDES TOWARD PUMA MANAGEMENT**

While the majority of respondents (65%) reported believing that every ranch should solve its own problems with puma, a larger majority (88%) also reported wanting help from natural resource agencies in solving those problems. Similarly conflicting results were found between items involving puma presence: 100% of respondents believed that pumas should be allowed to exist wherever they might occur, but nearly half (46%) of respondents agreed that pumas should be removed from the countryside. A little more than half (52%) of respondents expressed a willingness to participate in a puma bounty program, if such a program were offered.
FACTORS INFLUENCING ATTITUDE

There was no significant relationship between attitude score and level of experience with puma, age, number of children in the house, or number of livestock. There was a weakly significant negative correlation between isolation and attitude ($r = -0.28$, $p < 0.05$; Figure 3).

![Figure 3. Correlation between isolation (minutes to town) and attitude score.](image)

Inventory of Other Damage-Causing Wildlife

All participants identified coyotes as a damage-causing wildlife species (Table 4). Other species identified by the majority of respondents as problem wildlife included the bobcat (86%), and the gray fox (50%).

Puma Impacts

All positive and negative impacts of puma presence identified by participants are found in Table 5. Fifty percent of participants identified “Pumas harm livestock” as the most important negative impact of puma presence. An equal amount of participants (29%) identified “Pumas can attract tourists who want to see them” and “Can’t say/none” as the most important positive impacts of puma presence.
Table 4. Percentage of Respondents Identifying Other Problem Wildlife Species

<table>
<thead>
<tr>
<th>Wildlife Species</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coyote</td>
<td>100</td>
</tr>
<tr>
<td>Bobcat</td>
<td>86</td>
</tr>
<tr>
<td>Grey fox</td>
<td>50</td>
</tr>
<tr>
<td>Rattlesnake</td>
<td>46</td>
</tr>
<tr>
<td>Skunk</td>
<td>38</td>
</tr>
<tr>
<td>Kestrel</td>
<td>29</td>
</tr>
<tr>
<td>Eagle (nondescript/real)</td>
<td>13</td>
</tr>
<tr>
<td>Scrub jay</td>
<td>8</td>
</tr>
<tr>
<td>Ticks/fleas</td>
<td>4</td>
</tr>
<tr>
<td>Wild pigs</td>
<td>4</td>
</tr>
<tr>
<td>Mosquitoes/flies</td>
<td>4</td>
</tr>
<tr>
<td>Crow/raven</td>
<td>4</td>
</tr>
<tr>
<td>Owl</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 5. Percentage of Participants Identifying Impacts of Puma Presence as "Most Important"

<table>
<thead>
<tr>
<th>Impact</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negative</strong></td>
<td></td>
</tr>
<tr>
<td>Can harm livestock</td>
<td>50</td>
</tr>
<tr>
<td>Can harm people</td>
<td>25</td>
</tr>
<tr>
<td>Can't say/none</td>
<td>21</td>
</tr>
<tr>
<td>Can harm other wildlife</td>
<td>17</td>
</tr>
<tr>
<td><strong>Positive</strong></td>
<td></td>
</tr>
<tr>
<td>Pumas can attract tourists who want to see them</td>
<td>29</td>
</tr>
<tr>
<td>Can't say, none</td>
<td>29</td>
</tr>
<tr>
<td>Pumas control coyotes</td>
<td>13</td>
</tr>
<tr>
<td>Pumas have an important role in the ecosystem</td>
<td>8</td>
</tr>
<tr>
<td>I appreciate the beauty of puma</td>
<td>8</td>
</tr>
<tr>
<td>All are important</td>
<td>8</td>
</tr>
<tr>
<td><strong>Foreigners admire us because we have pumas here</strong></td>
<td>4</td>
</tr>
</tbody>
</table>

Note: Percentages in Negative Impacts total more than 100% due to some participants reporting that "Puma can harm humans" and "Puma can harm livestock" are equally important. Percentages in Positive Impacts column total less than 100% due to rounding.
CHAPTER 6

DISCUSSION AND CONCLUSIONS

The results of this study suggest that ranchers within the Sierra La Laguna Biosphere Reserve have a neutral to slightly positive attitude about puma. Combined attitude scores covered the entire range of scores, from extremely negative (-6) to extremely positive (6). This suggests that attitude toward puma is a function of individual beliefs that is affected by a host of influences (Riley & Decker, 2000), some of which may be outside the scope of this project or could not be analyzed given project constraints (e.g., sample size, general nature of questionnaire items).

Participants showed a higher level of experience with puma (84% high or very high level of experience) than Riley and Decker’s (2000) sample of Montana stakeholders, which is probably explained by Riley and Decker’s sample having different key characteristics than this study’s sample. For instance, Riley and Decker’s inclusion of urban residents would almost certainly have impacted experience scores. The experience level of participants is also much higher than that found in Carter, Riley, et al. (2012), where only 17% of participants had high or very high experience levels with tigers in Nepal. This may be explained by the results of Carter, Shrestha, et al. (2012), who studied the coexistence of tigers and humans in the same study area at a fine spatial scale. They found that while tigers and human shared the same spatial patterns, tigers were much more active at night, when human activity was lowest. The difference in temporal activity patterns may have resulted in a local stakeholder group that had less direct experience with tigers. In this thesis, the location of REBISLA ranches along the human-wildlife interface, the history of a puma bounty program, and the existence of retired leoneros in the communities are all characteristics that may contribute to increased levels of experience with the puma.

The only explanatory variable with a significant relationship with attitude score was isolation ($r = -0.28$, $p < 0.05$). Isolation has not been quantified as a variable in other attitude studies and so cannot be compared to other findings. However, the more isolated ranches are, the less contact they tend to have with other people (e.g., neighbors, tourists, CONANP...
officials). If a ranch is more isolated, ranchers have no choice but to deal with real or perceived threats to their livestock according to what they believe will solve the problem, because they, not CONANP, are the only ones present to take action. For the ranchers of Sierra La Laguna, that solution has often been to kill puma when the predators are suspected to have attacked livestock. The puma may very well have engendered more negative attitudes in people who have been more often subject to livestock depredation, either presently or in the past (a variable that was not measured in this study). While it may be that more isolated ranches have had more interactions with puma, the statistical tests of this study did not show a significant relationship between isolation and level of experience with puma. However, the fact that this relationship approaches significance suggests that a study with a larger sample size or random sampling might have found a relationship between isolation and experience, but this is speculative and would require additional data to explore the potential effect of sample size.

Variables such as age and experience level, which have had significant relationships to combined attitude scores in other studies (e.g., Riley & Decker, 2000; Zimmerman et al., 2005), did not show significance in this study. However, it is possible to extract some themes about ranchers’ general perceptions of puma and its ecology based on the questionnaire results and conversations with respondents. I have also provided a discussion on evidence of a “Not in My Backyard” (NIMBY) mentality, and how natural resource management agencies and ranchers will need to build a relationship that allows for ranchers’ autonomy while recognizing government authority. Lastly, this chapter details management recommendations and directions for future research suggested by the results of this study.

**VALUES PLACED ON PUMA**

A number of values placed on puma can be inferred from the questionnaire results. Participants gave the puma intrinsic value (value in and of itself) as evidenced by high agreement (96%) with “Pumas have the right to live wherever they might occur”. This is in accordance with the results of Zimmerman et al. (2005), who found evidence of the intrinsic value of jaguars and their associated protected areas in a region of Brazil. Results differ from those attitudes about puma found by Riley and Decker (2000) in Montana, where participants were divided on whether they agreed with that statement (44% agree vs. 45% disagree;
Aesthetic values (Decker et al., 2001a; King, 1948) were uncovered in stories such as that told by Questionnaire Respondent 14. “I saw a puma, full with pig, and it was walking across a ridge top and jumped up onto this really huge, tall rock. I couldn’t believe how high it jumped! I was far away, so I wasn’t afraid, but it was an incredible thing to see” (Questionnaire Respondent 14).

Almost all participants considered the puma an important part of their culture (92%), suggesting a strong sociocultural value placed on the animal (Decker et al., 2001a; King, 1948). I suggest that there are two reasons for this. First, the ranchers of Baja California Sur have a rich oral tradition, and stories about puma abound. Corazón del Vaquero is a documentary film that celebrates the lives of ranchers in Baja California Sur and often depicts ranchers and their families sitting around a campfire or the dinner table while telling stories of days gone by. Sometimes those stories are about interactions with puma. In my interactions with the Reserve’s ranchers, I found that these are people who love to tell stories, and I myself was regaled with a few of them, some of which are detailed in this discussion.

Second, the puma as livestock predator acts as a symbol of this people’s struggle with nature to survive. Centuries of precarious survival in an inhospitable land have left their mark on the residents of the Reserve in a number of ways, and it is no surprise if the puma has come to be a tangible manifestation of that struggle.

Other values of pumas may be seen in the percentage of agreement with the attitude items “Pumas should be allowed to exist wherever they might occur” (100%) and “It would be okay with me if there were more pumas in the future” (63%). Answers to the latter item were often followed up by comments about how puma control coyote populations (a biological value [Decker et al., 2001a; King, 1948]), which is beneficial to local people because coyotes are currently attacking livestock on a regular basis. Some households also saw an increasing puma population as an opportunity to attract tourists to the area (and therefore economic development), as evidenced by nearly one third of participants identifying tourist draw as the most important positive impact of puma. This indicates a commercial value being placed on puma (Decker et al., 2001a; King, 1948).
BELIEFS ABOUT PUMA ECOLOGY

The questionnaire items regarding the puma’s role in the ecosystem were sometimes unclear to respondents, who were unsure of the meaning of “equilibrium” in the context of ecology. When the meaning was made clear, some respondents reported that the puma is not responsible for any kind of ecological equilibrium in the Reserve because there are hardly any puma to be found locally. This may have led to under-reporting of positive attitudes toward the puma’s role in the ecosystem, although most respondents did agree that puma presence signifies ecosystem health (92%) and that pumas maintain the equilibrium of deer (63%).

Several respondents believed that puma regulate the coyote population, with various speculations about the mechanism of that regulation. Questionnaire Respondent 1 stated, “Many years ago there were a lot of puma, and there no were no coyote, because the coyote fought with the puma, and the puma killed them”. Two respondents specifically stated that the reason they agreed with “It would be okay with me if there were more puma in the future” is that if there were more pumas, there would be fewer coyotes.

Most respondents believed that there are very few puma left in the area of the Reserve. “If you ask me, why are they gone? Why did they leave? There are many reasons. Mostly they left here because people were permitted to hunt them, including American hunters who want to take pictures [of trophy animals]” (Questionnaire Respondent 2). Key Informant 2 also alluded to hunting as the reason for less puma presence, and additionally believed that pumas had been scared away by the noise from road construction in the late 1970s and early 1980s.

FEAR FOR HUMAN SAFETY

While more than half of the participants reported that they believed that pumas are a threat to humans (63%), and that they worry that a puma could harm them or one of their family members (67%), there is no official report of puma attack in the Reserve. There does exist, however, at least one story of a puma threatening an entire community. A key informant and almost every questionnaire participant in the affected community related this story to me, suggesting that the story has entered the public consciousness and the local lore. As the story goes, 50 or 60 years ago a puma walked out of the hills, acting strangely. It
started at the high end of the canyon, staggering unsteadily and walking right up to people’s
back doors. It walked onto a ranch where two children were playing outside. The children ran
frightened into the house, where the elder child grabbed the family’s shotgun and fired at the
puma, but missed. The children stayed in the house with the door closed. Dogs barked,
children were scooped up and tossed into houses, and livestock panicked. The puma,
however, showed no real interest in attacking livestock or people; it simply lurched along and
sent a ripple of panic through the community. Eventually a rancher shot the animal as it
approached his ranch. The puma’s strange behavior caused everyone to believe that it had
rabies. This story may have resulted in what Dickman (2010) calls a “hyper-awareness” of
potential risks (p. 461), making people disproportionately worried about puma attack.

Stories from other regions may contribute to the hyper-awareness of potential risks to
human safety. Questionnaire Respondent 14 related the following story to me:

A puma killed a child in Sonora. The boy went to pick vegetables in the garden
below the house without his father. When his mother returned home and saw that
the child hadn’t returned, she had a bad feeling in her body, like something bad had
happened… [they went down to the garden and] there were puma tracks. They set traps for the puma. One man from there, he said it was horrible, they
found the [boy’s] body and it was in pieces. It didn’t have clothes, it was in a tree. They found the puma near there and killed it.

Rabies seems to be a big concern to the Reserve’s ranchers, particularly when it
afflicts puma. Of the twenty-four questionnaire respondents, seventeen people mentioned
safety concerns about pumas that are afflicted with rabies. Fear of rabies and the resulting
fear for human safety was an important consideration in evaluating the responses to three
particular attitude items. Respondents unanimously agreed (100%) that “Pumas should be
allowed to exist wherever they might occur” and all but one respondent agreed that “Pumas
have the right to live wherever they might occur” (96%), but almost half of respondents
agreed that “Pumas should be removed from the countryside” (46% agree, 46% disagree, 8%
don’t know/ no opinion). What at first seems like a stark contradiction makes more sense
when placed in the context of specific situations. Several respondents who agreed that pumas
should be removed from the countryside noted that they should be removed if they are a
problem, specifically if they carry rabies, as the disease may lead them to attack people. Key
informants and questionnaire participants noted the dangers of other animals’ carrying rabies
as well. During the portion of the questionnaire where respondents were asked to note any
other animals that cause damage, some noted that coyotes, foxes, and skunks can carry and transmit rabies.

Aside from puma posing a threat to humans if they have rabies, there is also evidence that people feel that puma can be a threat to humans simply based on their status as a large carnivore. The comments of Questionnaire Respondent 2 illustrate this perception, as well as noting the belief that pumas are also afraid of humans—“The puma is the animal that likes to kill the most. It’s distinct in that it can kill any animal. It’s very agile, very fast, very prepared to act. People are afraid of it and it is afraid of people”.

**FEAR OF LIVESTOCK LOSS**

I killed a lot of them. And I had to kill them, because they multiplied a lot. There were pigs [on the ranch]…and [the puma] passed close by the house. They did a lot of damage and I had to kill them, I had to persecute them. (Key Informant 3)

Widespread or ongoing problems with puma are, for the most part, a thing of the past in the Reserve, although it’s possible that livestock depredation is occurring. When presented with items regarding puma threats to livestock and humans, many participants who agreed that puma in general can pose a threat to livestock (75%) also stated that in the Reserve, no such threat existed. All three key informants also claimed that puma don’t really cause problems these days because there just aren’t very many of them around. All key informants and questionnaire respondents claimed that coyote attacks on livestock are much more of a concern.

However, livestock depredation was the most important negative impact of puma presence identified by Reserve residents, 25% of respondents reported that their livestock had been threatened or attacked by puma, and 79% had heard that a puma had attacked someone else’s livestock. One questionnaire respondent stated, “One thing is certain- it’s a problem that they eat a person’s animals” (Questionnaire Respondent 2).

Two study participants claimed that female puma with young are very dangerous and should be killed immediately due to threats posed to livestock. There may be some truth to this assumption, as large felids may attack livestock continuously in a single area for a period of time when they are caring for young. Rosas-Rosas et al. (2008) describe a situation in northeastern Sonora where a ranch experienced the loss of 21 cattle over a month-long
period. Two jaguars were observed near the last kill site: a female and a juvenile male. When ranchers killed the juvenile male, the predations ended.

A large majority of people (83%) agreed with the item “Puma are an acceptable threat to livestock.” This may be partly because the incidence of livestock predation has been so low that ranchers’ attitudes about the acceptability of livestock attack are less accessible than if predations had been occurring recently and regularly. It could also be a matter of acceptance capacity and situational specificity, such that responses may have differed if I had presented the items as describing circumstances where ranchers lost one or twenty head of cattle, and then asked whether those were acceptable losses. As a CONANP manager commented, “When the puma kills the first goat, they’re like, well, we lost a goat. When it’s the fourth or fifth goat, they go looking for the puma.”

The reality of a situation in which puma are often or regularly threatening livestock may be a dim enough memory that respondents may report attitudes one way, but their actual actions may be different should the situation actually present itself (Ajzer, 2001; Fazio & Olson, 2014; Manfredo et al., 1998). In this study, attitudes toward the puma were neutral to slightly positive, although livestock depredation is clearly a concern. For the most part, participants did not seem worried about puma depredation of livestock in the Reserve, which means that it would be difficult to begin to predict ranchers’ behavior in the event of depredation. So I counted it as an extraordinarily opportune occurrence when, in the middle of data collection for this thesis, a rancher reported the alleged depredation of his livestock by puma.

Due to the potentially sensitive nature of this story, all names have been changed for confidentiality. While meeting with Claudio, a CONANP manager, he showed me an email that he had received from Dr. Peña, a professor at a local university. Dr. Peña was forwarding to Claudio an email that he had received from Ramiro, the son of a Reserve rancher and a sustainable development major at a local university. Ramiro related how one of his neighbors, Don Paulo, had claimed that some of his livestock had been killed by a puma. Ramiro claimed that some men in the community were planning on going out to find the puma and kill it, and Ramiro was concerned about the conservation implications of such actions. Dr. Peña had felt that as a Reserve manager, Claudio should be informed of the situation. Claudio contacted Agustín, the park ranger who was stationed in Ramiro’s
community, to check on the status of the situation. Agustín spoke with the ranchers who were determined to hunt the puma, and convinced them to allow CONANP employees to accompany them on the trip to find the puma. The trip was scheduled for several days hence, but in the end, the ranchers went looking for the puma the day before they agreed to meet with the CONANP employees. The ranchers claimed to find puma tracks, but no puma, and no puma killing was reported as of the time I left the field site. This situation is further discussed below in regard to its significance to the relationship between CONANP and the Reserve’s ranchers, but it also suggests that there may be human-puma conflict currently occurring in the Reserve, if on a small scale, and that ranchers who feel that their livestock are threatened will take action against the puma.

*Si no se meten en mi casa*: The NIMBY Phenomenon in REBISLA

Study participants believe that the presence of pumas signifies ecosystem health, that the puma is an important part of their culture, and most would be amenable to a puma population increase. Respondents seem to be comfortable with the existence of puma in the countryside, as evidenced by comments like, “*El campo es de ellos* (the countryside is theirs)” (Questionnaire Respondent 14).

However, this is no guarantee that ranchers would not take or support action against a puma that poses a threat, and the majority of respondents did agree that pumas are a threat to people (63%) and livestock (75%). One questionnaire respondent, when presented with the attitude item “Pumas have the right to live anywhere they might occur” responded, “*Si no se meten en mi casa!* (If they don’t get into my house!)”. This is a typical “Not in My Backyard”, or NIMBY, mentality, where a stakeholder is accepting of a wildlife species as long as it is not causing problems. This attitude has been detected in other studies relating to attitudes about damage-causing felids in the United States (Riley & Decker, 2000) and Brazil (Zimmerman et al., 2005).

**Autonomy and the Presence of Authority: A Reconcilable Paradox?**

The ranching communities of the Sierra La Laguna Biosphere Reserve exhibit a culture of autonomy and individualism most likely stemming from a legacy of self-
sufficiency and isolation from outside (e.g., government) intervention, support, or pressure (Davis, 2008). This individualism was evidenced in the survey results with the item “Every ranch should solve its own problem with puma”, with which 63% of respondents agreed. This attitude fits with Davis’s (2008) finding that ranchers’ individualism presented itself in comments such as “everyone solves their own problems and everyone scratches with their own fingernails” and “each to their own saint” (p. 77).

It’s interesting then that most respondents (88%) also expressed willingness to receive help with puma problems from government agencies. This may be due to the fact that government presence increased with the establishment of the Reserve, making ranchers aware of services that may prevent damage to their livelihood, especially if activities that ranchers may otherwise undertake to protect themselves and their property are considered illegal and may result in legal troubles.

I feel it’s important to note that although there didn’t seem to be any hesitation when agreeing with each ranch’s responsibility for its own puma problem, there was sometimes hesitation about agreeing that government should help with those problems. Fazio and Olson (2014) might suggest that the attitude related to independence is “primed”, that is, Reserve ranchers have so long identified themselves as independent entities that they were able to make a fast evaluation about that item. Government intervention, on the other hand, is relatively new in being accepted, and it may have taken longer to consider its acceptability.

When key informants were asked what the government should do if puma are causing damage on ranches, they unanimously replied that the government can’t do anything about the problem. Key Informant 1 commented, “When calves are in the mountains and get attacked by puma, the government has never done anything in such situations. However, I don’t think there’s anything the government can do because these are not common problems.” However, in the event that puma cause problems on ranches, key informants felt that the government should allow ranchers to solve the problem in the way they always have—by persecuting the predator. Key Informant 3 stated, “With this animal that causes so much damage, they should give someone permission to kill them [the puma], because when they want to cause damage, they walk around the ranches near the meadows, stealing cattle, eating chickens, pets, pigs, goats, sheep.”
The story about Don Paulo’s ranch allegedly experiencing livestock loss by puma depredation related above makes for an instructive lesson about the current relationship between CONANP and the ranchers of the Reserve. Ideally, if Don Paulo thought that a puma had attacked his livestock, he should have contacted CONANP to relay the situation. Instead, the information took a circuitous route outside of the Reserve and back into it, so that instead of information flowing directly from the rancher to CONANP, the information flowed from a rancher to a rancher’s neighbor to a neighbor’s son to a university professor and then to CONANP. This suggests one of two circumstances: either the ranchers don’t know that they can (or should) report such incidences to CONANP, or they don’t trust CONANP enough to do so.

After hearing about this incident, I interviewed Claudio, the CONANP manager, and Agustín, the CONANP park ranger, about the situation. It turned out that Don Paulo’s goats had actually been attacked a year prior, and then again three months prior to the ranchers deciding to look for the puma. Agustín had reported the incidents to Claudio, who instructed him to look around the area for evidence of puma presence. Don Paulo and his nephew, who often helped at the ranch, said that they’d found puma tracks but neither Agustín nor Claudio saw such sign. I asked Agustín what he said to ranchers who said they intended to hunt for and kill a puma for causing damage.

S: What do you say to someone when they’re like, there’s a puma and I’m going to kill it?

A: I say, you’re not supposed to kill it, because the puma, because there are very few of them left, and if you kill them then they’ll be gone... On the other hand, you have to inform people that they don’t have to kill them [i.e., that there may be other solutions].

S: And how do people react when you tell them this?

A: They say, no, when a puma causes me damage, I’ll stop it, I’m going to kill it, it’s doing me damage.

Both Agustín and Claudio noted that ranchers don’t even usually mention such incidents to CONANP employees because to the ranchers, livestock depredation is not an unusual occurrence but rather a part of life in the sierra. Such communication issues may need to be corrected if a puma conservation plan is initiated.

If ranchers are told that they cannot take action that would protect their livelihood, they are unlikely to cooperate. This was illustrated by an interaction with a SEMARNAT
employee reported to me by a goat rancher named Miguel (name changed for confidentiality) in the Comondú region. Although this region was not included in the study area, it shares some characteristics with REBISLA: (1) until recently, there has been minimal contact with government agencies in regard to conservation issues, and (2) the region’s ranchers are mostly smaller land and livestock holders, so they are less likely to be able to absorb losses from livestock depredation. Miguel related that a SEMARNAT employee had been out to visit his land, and asked Miguel if he’d had any problems with puma. Miguel replied that a puma had killed some of his goats, so he killed the puma the next time it came around. The SEMARNAT employee became very angry at this news and proceeded to berate Miguel to the point that Miguel began to feel physically threatened. In subsequent interactions with this SEMARNAT employee, Miguel said, “I told him that I hadn’t had any problems with puma, even if I had just killed one the day before”. In fact, in interviewing Miguel, it was very difficult to establish enough rapport with him that he was willing to be honest about his experiences with puma. He was nervous about being reported for his actions. When we began the interview, he answered several questions inconsistently and, unlike every other person I’d spoken with in the Comondú area, he insisted that he had never had a problem with puma, and had not even heard of any problems with them. This raised my suspicion of the veracity of his answers, and that of Dr. Aurora Breceda of CIBNOR, who was facilitating the interview. Dr. Breceda stopped the interview and explained to Miguel that we did not work for the government, and that his identity would remain confidential. It was only after this assurance (and showing him my data sheet, where his participant identification code was a number and not his name) that he began to open up about his experiences.

Ultimately, the ranchers of REBISLA have adopted the same attitude to outside interference that was expressed by the Pericú of old: fierce independence, pride in their self-sufficiency, and a refusal to accept surplus aid from outside entities. Perhaps the similarity is rooted partly in the impressive ability of both REBISLA ranchers and the Pericú to extract enough resources from the land to meet their basic needs, or arranging their own trade to facilitate the acquisition of that which they cannot produce themselves. The ranchers have made some acquiescences (e.g., the Abasto Rural stores that supply rural areas with basic products) but this may be more a matter of convenience than of need. The ranchers allow the presence of the rural tiendas as it suits them, just as the Pericú engaged in outside trade when
convenient. It follows, then, that as it applies to puma conservation, natural resource managers will need to find a way to allow ranchers and their families to retain their autonomy if managers hope to retain their own authority.

**MANAGEMENT RECOMMENDATIONS**

The biological facet of a puma conservation program in the Sierra La Laguna Biosphere Reserve would have to start with the basics—understanding of puma populations in the Reserve and defining conservation goals based on desired population outcomes. The efforts to obtain these data would be the responsibility of managing agencies, and may include CONANP and other SEMARNAT entities. The CONANP managers with whom I spoke during the course of this thesis were very interested in the idea of gathering puma population data, but lacked funds and, in some cases, the capacity to do so. This is a common theme in wildlife management across Mexico (Simonian, 1995; Valdez et al., 2006; Weber et al., 2006). There is the potential for CONANP to undertake puma population studies through a partnership with local universities. A puma distribution study has recently been conducted by a local CIBNOR graduate student in the Sierra La Giganta in the northern part of the state (C. Chávez, personal communication, March 7, 2014), and Reserve managers should take the opportunity to explore such partnerships.

Beyond basic biological data collection, the priority for puma conservation must be to engage local stakeholders in the design and implementation of a conservation program that addresses local residents’ needs. In this region, where communities display a high degree of autonomy and wariness of government intervention, the success of conservation measures “will depend on taking into account communities’ interests and initiatives” (Zarco-Gonzales et al., 2012, p. 636). If puma populations are negatively affected by human behaviors, then “seeking solutions that do not involve local communities is futile”, because only the communities themselves can change the situation by changing their behavior (Sillero-Zubiri & Laurenson, 2001, p. 283). The CONANP personnel that manage the Reserve will first have to define a management approach that is most appropriate for the area.

Wildlife managers can take a number of approaches to addressing stakeholder involvement and undertaking management schemes. Mexico’s approach at a national level can probably be best characterized as an “authoritative” approach (Decker & Chase, 1997),
whereby an expert makes the decisions and stakeholders are held to them, in Mexico’s case, by government decree (adding another layer of meaning to an authoritative approach; Simonian, 1995). Although an authoritative approach can have its successes, it will only be successful as long as stakeholders agree with the decisions of those in authority (Decker & Chase, 1997). For instance, take the example of Miguel detailed above, who reported that he continued to kill puma that predated his livestock, regardless of the fact that an agency biologist admonished him for potentially harming puma populations.

On a local level, the Sierra La Laguna Biosphere Reserve seems to take a “passive-receptive” approach to natural resource management (Decker & Chase, 1997). Park managers interact with stakeholders and listen to their concerns, but their needs are not systematically sought, nor are they necessarily incorporated into management schemes.

A “co-managerial approach” may be an appropriate undertaking for Reserve management (Decker & Chase, 1997). In this approach, natural resource agencies share the responsibility for managing wildlife with stakeholders, recognizing that due to budgetary/personnel constraints, increased incidents of human-wildlife conflict, and stakeholders’ tendency to disregard law in favor of personal interest, the agency’s capacity for effective management may be limited. A co-managerial approach would require that agencies delegate some authority for puma management to local stakeholders, and would necessitate agreements on the process and nature of management, stakeholder education, and agency oversight. For such an approach to be effective, however, capacity-building would have to occur at the agency level first, and from where the most appropriate instruction would come still remains to be seen. Foreign researchers have already expressed interest in working in the Reserve, and opportunities exist to undertake capacity-building programs through international organizations (e.g., Wildlife without Borders). Bringing in a skilled facilitator may allow for the instruction of management knowledge and strategies (Madden, 2004). Park agency personnel have expressed enthusiasm at the idea of capacity-building programs; the challenge will be in assuring ranchers that their autonomy is not at jeopardy, that they will not be swamped with foreigners, that they will not be judged harshly by outside parties, and that they will be able to retain the authority and independence they have enjoyed within their communities.
In this study, the most important negative impact identified by the majority of ranchers was “Puma can harm livestock,” and the most commonly identified positive impacts of puma were that “They can attract tourists who want to see them” and “Can’t say/ there are no positive impacts”. Although as Decker and Chase (1997) point out, “wildlife managers must avoid any temptation to use only stakeholder preferences as the basis for decisions” (p. 794), the impacts of puma presence identified as most important by local stakeholders may give managers a starting point for the design of a puma conservation program. It may be especially important to focus on these stakeholder-identified impacts in order to efficiently use limited agency resources. Assuming that a major priority for managers would be the collection of baseline data on puma populations, other facets of a puma conservation program could be put into place in tandem with biological studies. These facets might include citizen science programs, ecotourism and educational programs, the modification of husbandry practices, and perhaps in the future, financial compensation programs.

Citizen Science

Citizen science is an emerging practice in which researchers train citizen volunteers to collect data that would otherwise be too costly to collect or generally inaccessible to them. For instance, Christmas Bird Counts have been undertaken by the Audubon Society for decades, whereby groups of birding enthusiasts organize to collect avian distribution data every year.

It would be very reasonable to think that the Reserve ranchers have the capacity to become citizen scientists. They are undoubtedly more knowledgeable about puma than anyone else currently involved in the Reserve. They accurately described puma natural history characteristics in more than one context, and I believe that they would be interested in learning more about the predator’s habits on their land. One of the key informants of this study leads tourist groups on treks through the mountains and expressed interest in making plaster casts of puma tracks while on the treks. This would be not only an informative exercise for puma conservation efforts but also could double as part of the tourist activity if enough tracks are present to allow tourists to bring home a plaster cast souvenir.

The potential for data collection on puma via citizen science programs is promising. In the case of puma in REBISLA, citizen science efforts might best be aimed at the collection
of baseline data and future monitoring of puma populations. Puma distribution data can be collected with camera traps and paw print plaster casts, which ranchers can be trained to operate and collect. In the event of suspected puma depredation, ranchers could record various data about the attack and, if furnished with disposable cameras, could collect photographic evidence. Ranchers seem to be knowledgeable about areas that puma frequent, and this could allow for the collection of scat samples and hair samples via hair snare, which may be used in population studies to a variety of ends. If agencies and/or researchers can obtain the funds, there are ranchers in the Reserve who would be able to participate in the tracking and trapping of puma for the fitting of radio collars to study puma movement patterns and to verify puma attacks on livestock.

For a citizen science program to be successful, participants must be motivated to stay involved for the duration of the project. Pilot projects will best determine what the level of dedication and motivation to such programs would be. Any citizen science efforts will start with CONANP defining its research goals and then training and organizing groups of citizen science volunteers. Such efforts will be most successful when research answers questions that ranchers themselves are interested in, which may increase motivation to participate in such programs.

**Ecotourism and Education**

Almost a third of questionnaire respondents identified “Pumas can attract tourists” and “Can’t say/none” as the most important positive impacts of puma presence. Ecotourism and education may be means by which to address both of those impacts. Ecotourism and education have both been recommended as solutions to human-wildlife conflict (e.g., Lucherini & Merino, 2008). However, ecotourism can have negative consequences such as the inequality of benefit distribution to local communities (Dickman, 2010; Heinen, 2010) and education programs may not actually prove effective in reaching conservation goals (Baruch-Mordo, Breck, Wilson, & Broderick, 2011). The success of such programs is dependent on the specific manner in which they are operated. Ecotourism and educational possibilities are presented here as possible facets of puma conservation in REBISLA, but by no means should they be considered the predominant conservation strategies. If such programs were to be further developed in the Reserve, caution would need to be taken to
avoid the pitfalls of other ecotourism programs and to maximize the benefits reaped from educational programs.

Ecotourism has been named as a potentially viable sustainable development strategy in the Reserve (Aragón, 2008; CONANP, 2003). Although several ecotourism outfits operate in areas surrounding the Reserve, leading tourists on “expeditions” into the Reserve’s buffer area, there are currently only a few ranching households involved in the tourism sector (Aragón, 2008). The stunning beauty of the Reserve, its rich wildlife, and its rugged inaccessibility are all attractive to tourists wanting an “authentic” experience in the natural wonder of Baja California Sur. Currently, at least two Reserve residents rent out pack animals for trips into the Reserve, and at least one small family restaurant caters to tourists staying at a local ranch during such treks. The success of these small businesses may serve to encourage other ranchers to try ecotourism enterprises. Advertising an ecotour as an opportunity to see puma (or, more likely, their sign) may attract wildlife enthusiasts who would otherwise not consider such a tour.

Ecotourism, especially if operated in conjunction with cultural tourism programs (Aragón, 2008), may also address demographic considerations within the Reserve. Young people are currently leaving the Reserve to pursue employment opportunities in major population areas (Davis, 2008). Increased ecotourism activities (and resulting employment opportunities) could result in the retention of younger generations if they are trained to be naturalist guides, potentially bolstering an age structure that is beginning to weaken and encouraging population growth.

Those individuals who choose to migrate to major tourism centers like the Los Cabos region could still retain a connection with their home communities by serving as key contacts that arrange trips to the Reserve. In situations where contacts arrange trips to protected areas from tourist centers, local communities providing the services sometimes receive a disproportionate amount of payment, where the contact keeps most of the money (Weber et al., 2006). If local residents who have migrated to tourist centers were to be in charge of organizing the trip, there may be less likelihood of corruption in the management of proceeds.

Ecotourism strategies could also involve young people in puma management programs by getting them to take part in educational efforts, not only targeted at foreign
tourists and Mexican national tourists, but also among their own neighbors. A trained
naturalist who guides tourist groups would have the cross-over skills necessary to then lead
educational programs within his or her own community. Such programs could include
community workshops, focus group activities, and the insemination of educational materials
to individual ranches.

Education is often considered a valuable part of human-carnivore conflict solutions
(Messmer, 2009). Not only can education contribute to the suite of variables that can help to
predict human behavior in the face of conflict, but it can also lead to increased participation
in conservation programs (Reed, 2008). From my conversations with people in the Reserve, I
would posit that educational opportunities focused on the ecology of the puma would be most
successful. I rarely spoke about puma ecology or conflicts in other parts of the animal’s range
during the questionnaire administration. However, respondents often asked me questions
about those topics after the questionnaire was completed, and were very interested in certain
aspects of puma behavior and management. Some wanted to know if puma could be
relocated from the area if they were causing damage, and some wanted to know what
biologists think about the relationship between puma and coyote. Many were very interested
in hearing about trophic pyramids and the possibility of large carnivore removal leading to
ungulate population increases and water quality decreases (water, or in the case of the
Reserve the lack of water, is an important concern to area ranchers). Ranchers in the Reserve
seem knowledgeable about puma natural history, correctly stating that puma bury their prey,
that they travel a route around their territory and return to an area after a period of time, that
they like to stay in caves near a water source, and that they don’t like to eat adult cattle.
Further education about puma may enable ranchers to take a more active role in puma
management efforts (Reed, 2008).

**Modifying Husbandry Practices**

Many authors have recommended the modification of livestock husbandry practices
as the best way to mitigate losses incurred by livestock predation (e.g., Hoogesteijn, 2005;
Kissling et al., 2009; Zarco-Gonzales et al., 2012; Zarco-Gonzales et al., 2013). Free ranging
livestock are more susceptible to attack by large felids (Linnel et al., 1999; Zarco-Gonzales et
al., 2012), and most ranches within the Reserve practice some form of free range grazing
(Davis, 2008). If it is not possible for ranchers to keep livestock close to their homes, they can try to graze animals at least two kilometers away from topographical features that are associated with puma attack, such as cliffs and gullies (Zarco-Gonzales et al., 2012). This might be a challenge in a landscape that is full of cliffs and gullies. A strategy for preventing livestock predation of young animals is to keep them sheltered for the first three months of life (Michalski et al., 2006).

The best solutions for REBISLA ranchers to avoid livestock predation would involve substantial changes to husbandry practices, such as constant shepherding of goat and cattle herds as they graze, or the utilization of flock-protecting dogs. The challenge would be in convincing ranchers to adopt the new practices.

### Financial Compensation Programs

Financial compensation programs are often used to address the conservation of large predators that prey on livestock, where livestock owners are compensated for their livestock losses if they agree not to hunt the offending predator (Dickman, Macdonald, & Macdonald, 2011). Although some programs have achieved some measure of success in wildlife conservation and socioeconomic development indicators, many others have resulted in unequal distribution of program benefits and the propagation of poverty traps for local stakeholders (Dickman et al., 2011; Weber et al., 2006).

In the state of Sonora, researchers worked with local ranchers to establish a UMA wherein hunting permits are sold to tourists (usually Americans) for the take of white-tailed deer on privately-owned land (Rosas-Rosas & Valdez, 2010). The funds paid to landowners from the sales were enough to convince them not to persecute livestock depredating jaguars. It should be noted that the program detailed in Rosas-Rosas and Valdez (2010) used a private hunting outfitter to organize trips, and that the owner of this business had previously been a research assistant on jaguar studies. This connection to researchers and the local ranching communities probably resulted in ranching communities receiving a more equitable distribution of proceeds than has been realized in other areas of Mexico (Weber et al., 2006).

The establishment of such enterprises in the Sierra La Laguna Biosphere Reserve is limited by the prohibition of most extractive activities, but if someone were to provide sound evidence for such a program to be considered a sustainable extractive activity, it may be a...
viable opportunity. The opportunity for corruption within such a program, however, may make it better suited as a future project to undertake when other programs have proven successful.

**DIRECTIONS FOR FUTURE RESEARCH**

The data collection instruments utilized in this study were designed to capture a general picture of the human-puma relationship in the Sierra La Laguna Biosphere Reserve. As such, the results of this study can be used as a navigational tool to direct future research efforts. Such efforts might include participant observation studies, a deeper investigation of the predictability of ranchers’ behavior in regard to puma, attitudes about other livestock predators in the Reserve, and comparison studies in other protected and non-protected areas.

As with any human-wildlife conflict, the relationship between puma and ranchers in the Reserve is complex and multi-faceted. A truly holistic understanding of the situation would involve deep knowledge of rancher behaviors that cannot be uncovered in a questionnaire-based study. Long-term participant observation research that records ranching practices and reactions to livestock predation events would contribute valuable insights into the Reserve’s human-puma conflict. I was unable to locate any such formal research in the literature, and such information would have contributed greatly to my discussion.

Quantifying the actual rate of livestock depredation would enable ranchers and Reserve managers to determine the actual economic impact of puma predation. Ranchers often over-estimate the number of livestock lost to large predators, and the actual loss to livestock predators is usually much smaller than losses to disease or abnormal birthing (Rosas-Rosas et al., 2008). Having an empirical understanding of livestock losses may suggest to ranchers that puma predation is not as big a problem as they thought, or that it is a problem that can be corrected by changing husbandry techniques. This type of study could be performed in conjunction with a stakeholder acceptance capacity study, where researchers quantify the level of ranchers’ acceptance to livestock depredation (e.g., Manfredo et al., 1998).

One aspect of the human-puma conflict that this study did not address is the predictability of stakeholder behavior toward pumas. Although attitude surveys have been touted by researchers as a tool to predict stakeholder behavior, it is not in reality always
possible to do so (McCleery et al., 2006). There is a suite of psychological variables that should be taken into consideration when attempting to predict human behavior (McCleery et al., 2006), and although this study did address variables such as level of experience with puma, future studies might use questionnaires to assess past behaviors related to puma and other livestock predators to predict future behaviors. The inclusion of items with higher specificity on questionnaires may also capture a more accurate measure of behavioral predictability (Manfredo et al., 1998). For instance, some items could address spatial specificity (e.g., “Pumas are a threat to humans in the Reserve” and “Pumas are a threat to humans in general”) or temporal specificity (e.g., “Puma are currently a threat to livestock in the Reserve” and “Puma used to be a threat to livestock in the Reserve”). Situationally specific items might appear as “Pumas are a threat to humans if they have rabies”.

Research that investigates attitudes and behaviors related to other livestock predators may be instructive to Reserve managers in resolving human-wildlife conflicts within the Reserve. For instance, many questionnaire respondents complained about coyote and bobcat attacks on livestock. An understanding of how residents are addressing these conflicts could shed light on how they deal with puma conflicts.

Puma conflicts are currently occurring in other parts of Baja California Sur and other parts of Mexico. It would be instructive to large predator conservation projects across the country to be able to compare human-puma conflicts in different areas. Doing so may allow for the extraction of common themes that may serve as focal points for predator conservation programs. Some areas of the Baja Peninsula are rich with opportunity for investigation into human-puma conflicts. For instance, in the Sierra La Giganta and Sierra Guadalupe, puma are currently preying on livestock with some frequency, and ranchers are currently retaliating against puma (personal observation). Both areas are being proposed as biosphere reserves this year (M. de la Cueva, personal communication, 10 March 2014), so anthropological and biological studies of this human-puma conflict would be timely.

CONCLUSION

The Sierra La Laguna Biosphere Reserve presents a unique opportunity for large felid conservation. Although some livestock depredations have been reported, they are not nearly as common or as frequent as conflicts have been in the past. The attitudes of ranchers in the
Reserve toward puma are neutral to slightly positive, which means that there may be room for movement on attitude scales. The near future may be the best time to attempt to effect change toward more positive attitudes that lead toward a concerted puma conservation effort. The systematic inclusion of local stakeholders into decision-making processes early on in a conservation program can contribute to its success, and the opportunity to do so exists in the Reserve. Natural resource managers will have to make it worth the ranchers’ while to participate, however, as theirs is a tenuous day-to-day survival and they are very focused on providing for their households. However, if managers can show ranchers that puma conservation is in their best interests, then there is real hope for positive collaboration between the two stakeholders, and promise for puma conservation in the Reserve.
REFERENCES


APPENDIX

DATA COLLECTION INSTRUMENTS
**INTERVIEW GUIDE**

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<tr>
<td>Site</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Type of livestock</td>
</tr>
<tr>
<td>No. Livestock</td>
<td>Married?</td>
</tr>
<tr>
<td>No. Children</td>
<td>No. of people in house</td>
</tr>
</tbody>
</table>

1. Has your ranch been in your family for many years?
2. a. Have you seen a puma in this area?
   b. Have you heard of other people who have seen a puma in this area?
   c. Can you tell me about the last time you saw a puma?
      i. Who was with you? How did you feel when you saw the puma?
3. a. What are some negative impacts about the existence of puma here?
   b. What are some positive impacts about the existence of puma here?
4. Have you lost livestock to puma?
   a. Ow many times has that happened in the last five years? Ten? Twenty?
   b. Can you tell me what happened? For example, how did you find the animal and how did you know the puma was responsible?
5. Have you ever hunted for or killed a puma?
   a. Why did you hunt it?
   b. Do you know other people in the area who have killed puma?
6. What did the government do when the puma killed livestock?
   a. How did you feel about the government actions?
   b. What type of help would you like from the government in regard to livestock depredation?
**QUESTIONNAIRE**

<table>
<thead>
<tr>
<th>ID</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Site</td>
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<tr>
<td>Age</td>
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</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Married?</td>
<td></td>
</tr>
<tr>
<td>No. of children</td>
<td>No. of people in house</td>
</tr>
<tr>
<td>Time to town/city</td>
<td></td>
</tr>
</tbody>
</table>

**Type of livestock**

<table>
<thead>
<tr>
<th></th>
<th>Donkeys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burros</td>
<td>Cattle</td>
</tr>
<tr>
<td>Horses</td>
<td>Goats</td>
</tr>
<tr>
<td>Sheep</td>
<td>Chickens</td>
</tr>
<tr>
<td>Pigs</td>
<td>Other</td>
</tr>
</tbody>
</table>

**Experience with puma**

<table>
<thead>
<tr>
<th>Has seen a puma</th>
<th>Si</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read about or hears that a puma was killed by someone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A puma has threatened or attacked their pet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A puma has threatened or attacked their livestock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read about or Heard that a puma had attacked someone’s pet or livestock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heard about or read that a puma had threatened or attacked a person</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knows a friend, family member, or neighbor who had been threatened or attacked by a puma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has hunted for puma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has been threatened or attacked by puma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has no experience with puma</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attitude/knowledge/risk</strong></td>
<td>Agree</td>
<td>Don’t know/no opinion</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1. The presence of pumas means that the ecosystem is healthy.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2. Each ranch should solve its own problems with puma.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3. Pumas are an important part of my culture.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4. I admire the men who have killed pumas.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5. Pumas destroy the equilibrium of an ecosystem.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6. Pumas help to maintain the equilibrium of deer populations.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>7. I would like to receive help from natural resource agencies to deal with problems with puma.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>8. I worry that I puma could harm me or someone in my family.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>9. Puma should be removed from the countryside.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>10. Pumas have the right to live wherever they might occur.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11. Pumas should be allowed to exist naturally in the countryside.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>12. Pumas are an acceptable threat to livestock.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>13. If there were a bounty program for puma, I would participate.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>14. Pumas are a threat to humans.</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
15. Pumas are a threat to livestock.  

16. There are more pumas now than 20 years ago.  

17. It would be okay with me if there were more pumas in the future.  

Please tell me some animals that cause damage, and what they do:  

<table>
<thead>
<tr>
<th>Negative</th>
<th>Most important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kill or harm livestock.</td>
<td></td>
</tr>
<tr>
<td>Can harm humans.</td>
<td></td>
</tr>
<tr>
<td>Can hurt pets.</td>
<td></td>
</tr>
<tr>
<td>Can hurt other wildlife species, like deer.</td>
<td></td>
</tr>
</tbody>
</table>

Puma impacts  

¿What are some impacts of puma? ¿Which is the most important?  

<table>
<thead>
<tr>
<th>Positive</th>
<th>Most important</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel proud that we have pumas here.</td>
<td></td>
</tr>
<tr>
<td>I believe that foreigners admire us because we have pumas here.</td>
<td></td>
</tr>
<tr>
<td>Pumas have an important role in the ecosystem.</td>
<td></td>
</tr>
<tr>
<td>I appreciate the beauty of pumas.</td>
<td></td>
</tr>
</tbody>
</table>