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When Human-Leopard Conflict Turns Deadly: A Cross-Country Situational Analysis

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WHEN HUMAN-LEOPARD CONFLICT TURNS DEADLY: A CROSS-COUNTRY SITUATIONAL ANALYSIS

by

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Abstract

WHEN HUMAN-LEOPARD CONFLICT TURNS DEADLY: A CROSS-COUNTRY SITUATIONAL ANALYSIS

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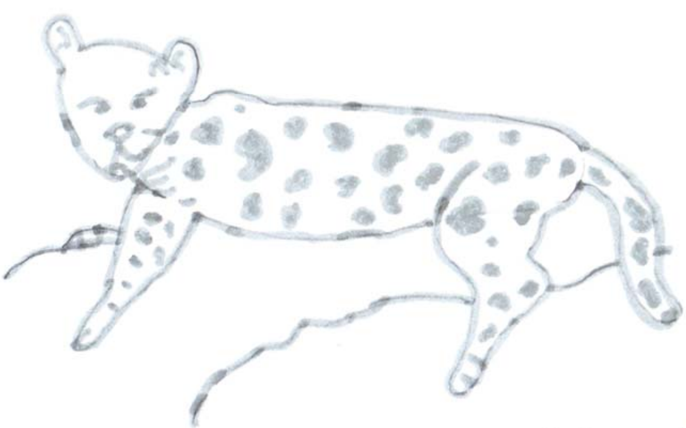
Habitat destruction and pollution are two of the main causes for the decline of the planet's biodiversity. Yet environmentalists are now recognizing that illegal wildlife killings, both poaching and retaliatory killings due to human-wildlife conflict, are perhaps the next major threat. Biologists have researched illegal killings and their effect on species conservation, but few researchers have applied criminological principles of crime reduction to them. This research will explore the situational factors that drive retaliatory leopard killings in parts of South Africa, Kenya, and India. These factors, human and environmental, include local expectations from wildlife, sensitivity to environmental issues, communication between conservation actors, leopard abundance, land-use overlap between humans and leopards, and poor leopard habitat conditions. A combination of qualitative and quantitative methods (interview and media article content analysis and logistic regression and non-parametric tests) are used to understand which factors best predict where human-leopard conflicts will arise and deteriorate into retaliatory leopard killings. Strategies to reduce the incidence of retaliatory leopard killings are suggested based on the 25 techniques of situational crime prevention.

Acknowledgements

"When spider webs unite, they can tie up a lion."
-Ethiopian proverb

To the many "spiders" who helped in this endeavor; you know who you are. We managed to tie this dissertation up remarkably well.

And to one "spider" in particular, Lucy Lima (John Jay College custodial assistant, 1988 to 2015), who always saved a smile for me at the end of a long workday.



Sophia Nanian March, 2015.
Age 6

Table of Contents

List of Tables

List of Illustrations

Chapter 1: Introduction

Problem Statement

Human-encroachment on wilderness and pollution from industrial activities are two of the main causes for the rapid decline of the planet's biodiversity. Yet, environmentalists are now recognizing that illegal wildlife killings, including poaching, are perhaps the next major threat to biodiversity (Al-Johany, 2007, p. 1; Clarke & de By Rolf, 2013; Ghoddousi, Hamidi, Ghadirian, Ashayeri, & Khorozyan, 2010; The Huffington Post, 2012, January 24; Wikramanayake et al., 1998). Accurate figures on how much illegal wildlife and wildlife products are smuggled internationally are hard to come by because of the secretive nature of the trade, but a 2011 estimate by the Center for International Policy suggests these products bring in $7.8 to $10 billion U.S. dollars annually (Haken, 2011, February).

Biologists have researched illegal killings and their effect on species conservation, but few researchers have applied criminological principles of crime reduction to them (Green, 2011; Mfunda & Roskaft, 2010; Pires & Moreto, 2011). The few criminologists who have studied illegal wildlife killings have tended to focus on the markets for poached goods, arguing that stopping the demand for such goods would take away the incentive for illegal killings (Schneider, 2008). Unfortunately, this framework only applies to offenders wishing to sell or trade the animal they illegally kill.

Illegal leopard killings do not entirely fit this profile. Although leopards are illegally killed for the traditional medicine trade and trophy hunting (where leopard parts end up on a market), human-wildlife conflict (H-WC) appears to drive the majority of leopard killings. For

H-WC cases, the goal is to get rid of a “problem” leopard and destroy any evidence a kill took place.

This research will explore the situational factors that drive retaliatory leopard killings in parts of Kenya, South Africa, and India and determine whether the majority of these killings in the study areas are a result of H-WC. These situational factors, human and environmental, include local expectations from wildlife, sensitivity to environmental issues, communication between conservation actors, leopard abundance, land-use overlap between humans and leopards, and poor leopard habitat conditions. They have ecological significance for leopards and represent human and environmental conditions under which human-leopard conflicts (H-LCs) are likely to occur. A combination of qualitative and quantitative methods (interview and media article content analysis and logistic regression, spatial analysis, and non-parametric tests) are used to understand which factors best predict where H-LCs will arise and deteriorate into retaliatory leopard killings. This study will use small-scale collared leopard data from a local conservation non-profit organization (NPO) for its spatial and statistical modeling, one of the few reliable and systematic records of unnatural leopard deaths. The ultimate goal of this research is to use the techniques of situational crime prevention (SCP) to reduce the number of illegal leopard killings driven by H-WC in the study areas.

Table 1.1. Table of abbreviations and acronyms

Phrase or organization	**Abbreviation or acronym**
Case-control design	CCD
Community-based conservation	CBC
Human-leopard conflict	H-LC
Human-wildlife conflict	H-WC
International Union for the Conservation of Nature	IUCN
Kenya Wildlife Service	KWS
Non-profit organization	NPO
Situational Crime Prevention	SCP
South African National Biodiversity Institute	SANBI
The Convention on International Trade in Endangered Species	CITES
The National Vegetation Map of South Africa Project	VEGMAP
The Wildlife Protection Act of 1972 (India)	WPA
World Wildlife Fund	WWF

Defining illegal killings

Illegal killings are part of the broader category of environmental crime just beginning to be recognized within the field of criminology (Pires & Moreto, 2011). Interpol defines “environmental crime” as “any breach of a national or international environmental law or treaty that exists to ensure the conservation and sustainability of the world's environment, biodiversity, or natural resources" (Interpol, 2010-2011). This type of crime includes the illegal wildlife trade, illegal logging or fishing, environmental degradation through pollution and negligence, and theft of natural resources.

Within environmental crime, the term “illegal killings” refers to two separate phenomena: poaching and retaliatory killings. Although the two words refer to the same action, killing wildlife illegally, they represent different reasons for the behavior.

The New Oxford American Dictionary (2007) defines poaching as “illegally hunting or catching (game or fish) on land that is not one's own, or in contravention of official protection." This definition does not include whether the killing or catching is for profit, but the word's connotation suggests the poacher benefits financially from the behavior (hence the motivation to kill). The term can also be applied to flora, as is the case for illegal cacti trading for xeriscaping in the Chihuahuan Desert regions of the United States (U.S.) and Mexico (Green, 2011; Robbins & Barcenas, 2003, January).

The definition originates from the first recorded discussion of poaching which took place in feudal England under the early Saxon Kings (Farnsworth, 1980). At the time, landowners owned the wildlife passing on their land. The King owned any remaining non-cultivated land and its wildlife. Wealthy merchants living in town could not hunt because they did not own large rural lands on which to do so. Discussions and on-going rebellions eventually led to rule changes to accommodate the hunting needs of the more powerful urban political and economic figures of the time (Farnsworth, 1980).

Although this definition provides a basic understanding of the word, it overlooks different forms of poaching. The term "poaching" can be applied to a range of behaviors, from a tourist buying an ivory figurine in a country where ivory sales are illegal, to a smuggler carrying hundreds of live reptiles in his suitcase through customs with the intent to sell them to collectors. Lin (2005) groups poaching behaviors into four categories:

- (1) Low volume, low value tourist poaching cases
- (2) High volume, low value opportunistic poaching/smuggling
    - Example: parrot poaching by local residents in Bolivia (Pires & Clarke, 2011)
- (3) High volume, high value poaching/smuggling by organized crime syndicates

    - Example: abalone poaching in South Africa (Wildlife warden 1, personal communication, August 4, 2011)
- (4) Low volume, high value “poaching to order” cases for collectors
    - Example: the exotic “status pet” trade for big cats in the Middle East (Warchol, Zupan, & Clack, 2003)

Retaliatory killings are illegal wildlife killings undertaken in retaliation for some form of H-WC, generally animal attacks on livestock or people or destruction of crops. Some examples of retaliatory killings include crop farmers who attack elephants that trample their fields or livestock farmers who illegally kill wolves in North America or leopards in Asia or Africa when they eat their livestock (Bakano, 2011; Bjorge & Gunson, 1985; Ogra, 2008). Retaliatory killings also take place after animal attacks on humans, including leopard attacks on humans in Indian villages (Gupta Kashyap, 2012, March 6).

In contrast to “poaching”, retaliatory killings are not done for profit. Individuals who engage in these H-WC driven killings do not consider themselves poachers because they kill to get rid of a problem animal (or “pest,” as they call them), not to profit from its carcass (NPO worker 1, personal communication, July 31, 2011). Most often they dispose of the animal’s carcass in the bush to get rid of any evidence of the killing. Their objective tends to be self-preservation, to avoid future crippling losses of farm animals, and/or anger at being attacked or having their property attacked (Farmer 1, personal communication, August 17, 2011). Some NPOs suggest that leopards killed in retaliation are trafficked for profit, but these cases remain anecdotal (NPO worker 2, personal communication, September 2013) (World Wildlife Fund & Global Species Program, N.d.).

The impact of illegal killings

Illegal killings tend to have large measurable economic costs for communities and countries because of lost revenue from natural resources (Gettleman, 2012b; Interpol, 2010-2011; Lin, 2005). Environmental impacts, though, are also a major concern, especially as citizens, governments, and industries are now coming to the conclusion that "it is impossible to separate economic development from the environment and that environmental degradation can undermine economic development" (U.S. Geological Survey, 2007, p. 1). A simple example of this is that decreasing numbers of leopards due to illegal killing results in less tourism revenue as fewer tourists go on safari and visit reserves where wild animal populations are dwindling. Less tourism means fewer job opportunities for local residents while tourism profits cannot be used to build up the nation's economy. The following section describes some of the economic costs of poaching, which have been measured in the literature (while the costs of retaliatory killings have not), and then moves on to the less tangible environmental costs of both poaching and retaliatory killings.

How much does poaching bring in?

The trade in wildlife and wildlife products is, first of all, a legal trade (TRAFFIC, 2012c). In the 1990s, TRAFFIC (2012c) calculated the value of legal wildlife products imported globally to be around $160 billion U.S. dollars, but, as of 2009, it had grown to over $323 billion.

It is difficult to accurately estimate of how much poaching takes place worldwide because it is an underground economy. Even when estimates are made, they tend to differ widely. A 2011 estimate by the Center for International Policy suggests that the sale of illegal wildlife and wildlife products (excluding timber and fisheries) brings in between $7.8 and $10 billion U.S. dollars in annual profits (Haken, 2011, February). Other estimates put that number at anywhere between $5 billion U.S. dollars and $20 billion U.S. dollars a year (Wyler & Sheikh, 2008) and $30 billion U.S. dollars a year (Bauerlein, 2005, August/July).

Illegal leopard killings and species conservation

The current main threats to leopards are habitat loss and fragmentation through human encroachment and illegal killings, primarily retaliatory killings, both of which are intrinsically linked since encroachment contributes to H-WCs that trigger retaliatory killings (Al-Johany, 2007; Ghoddousi et al., 2010; Wikramanayake et al., 1998). As with many other species, the impact of these threats on leopard populations is difficult to assess because they often occur conjointly and aggravate each other (Pires, 2011; Poudyal, Rothley, & Knowler, 2009).

Studies of the consequences of illegal leopard killing have long overlooked its broader ecosystem impact. These broader ecosystem impacts include infanticide[1] and less successful breeding (Balme, Hunter, & Slotow, 2007; Chapron et al., 2008; Packer et al., 2009). Leopards depend on stable long-term inter-leopard relationships to maintain their territories and insure

[1] The killing of a female leopard's litter by an incoming and non-related male. This behavior ensures that only a dominant male's genes will be passed on to the next generation. After an episode of infanticide, female fertility drops until they are sure no new male take-over will occur (Balme & Hunter, 2013).

their own survival. The poaching of a male (or female) leopard leaves a territory vacuum that increases strife among surrounding leopards and can have serious consequences for population survival (partly because of infanticide) (Balme, Slotow, & Hunter, 2009).

Illegal leopard killing can also impact the survival of co-dependent species in the food web and ecosystem (Packer et al., 2009). Current research has only looked at single predator-prey dyads to determine the ecological consequences of poaching within the food chain (Graham, Beckerman, & Thirgood, 2005), but Graham et al. (2005) suggest that poaching likely has consequences for trophic[2] and symbiotic[3] species that researchers should explore.

Adding to the biological difficulties of determining the impact of illegal killings on leopards and their ecosystem is the lack of reliable leopard population counts (Al-Johany, 2007; Liberg et al., 2011). A few researchers, including Ghoddousi et al. (2010) & Hussain (2003), have documented leopard densities in specific areas, but accurate leopard population estimates do not exist for many other locations, including South Africa (NPO worker 3, personal communication, July 2011). The International Union for the Conservation of Nature's (IUCN) Red List of Threatened Species currently rates the leopard (*Panthera pardus*) as "near threatened" with population numbers "decreasing," but their evaluation dates from 2008 and is based on population counts from existing research studies (Henschel, Hunter, Breitenmoser, Purchase, et al., 2008).

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[2] Trophic species eat the same prey and are eaten by the same predators (Martinez & Dunne, n.d.).

[3] Symbiotic species are species that need to interact with each other to survive. Symbiotic relationships can include mutualism (where both species gain something), parasitism (where only one species gains something and the other is harmed), neutralism (where neither species gains or loses anything) and commensalism (one species benefits and the other is not harmed) (Meyer, 1998; Theme, 2011).

Beyond ecosystem impacts though, researchers are now realizing that concern for the fate of species and their ecosystems, on which society relies for resources, is no longer limited to earth scientists and environmentalists (U.S. Geological Survey, 2007, p. 1). Governments are now realizing that the flow of poached goods between nations has serious economic and social consequences beyond localized degradation of ecosystems (Gettleman, 2012b; Interpol, 2010-2011; Lin, 2005). For example, Security Council members officially recognized “the harm caused by wildlife poaching and trafficking to conservation efforts, rule of law, governance and economic development” at the United Nations’ General Assembly in September 2012 (TRAFFIC, 2012b, p. 1).

Where do illegal killings occur?

The majority of poaching occurs in third-world countries where biodiversity is high and enforcement of export laws is low (Duffy, 2010; Lin, 2005). Yet, more than half of poached wildlife then ends up in large industrialized countries and regions like Europe, Japan, and the U.S., which account for 60% of the market (Bauerlein, 2005, August/July). Another 25% of market is in Southeast Asia because of the region’s strong reliance on animal and plant-based traditional medicine and its large population (Bauerlein, 2005, August/July; Lin, 2005). In addition, many wildlife rich countries also have their own national trade, such as the illegal parrot trade for pets in Bolivia (Pires, 2011).

Retaliatory killings also tend to occur primarily in third-world countries where wild land is rapidly being developed because of industrialization and population growth (Schaller, 2011). In these countries, wild animals are being pushed out of their natural habitat and rural populations are ill equipped for living with these displaced animals (Alexander & Winter, 2011). With no or little infrastructure in place to deal with H-WCs and limited law enforcement resources to enforce environmental laws, retaliatory killings can become commonplace.

Where do illegal leopard killings occur?

Leopard poaching and retaliatory killings occur throughout the leopard's range in mid to southern Africa, parts of the Middle East, and Southeast Asia (see figure 1.1) (Henschel, Hunter, Breitenmoser, Pruchase, et al., 2008; Kurvits et al., 2011). In parts of this range, leopard killings are opportunistic and clustered in areas of H-WCs between farmers/villagers and leopards (J. C. Ray, Hunter, & Zigouris, 2005, December). Seizure information compiled by the wildlife trade monitoring network TRAFFIC suggests that there is a commercial trade for leopard skins and parts, especially in Southeast Asia, but also in parts of Africa (Henschel, 2008; Henschel, Hunter, Breitenmoser, Pruchase, et al., 2008; Roberts, 2010, October 10; TRAFFIC, 2011). In the KwaZulu-Natal Province of South Africa, religious groups like the Shembe, use leopard skins for religious ceremonies (Roberts, 2010, October 10). For example, in Eastern Africa, military personnel are known to buy leopard skins and illegally import them into Europe (Henschel, Hunter, Breitenmoser, Pruchase, et al., 2008).

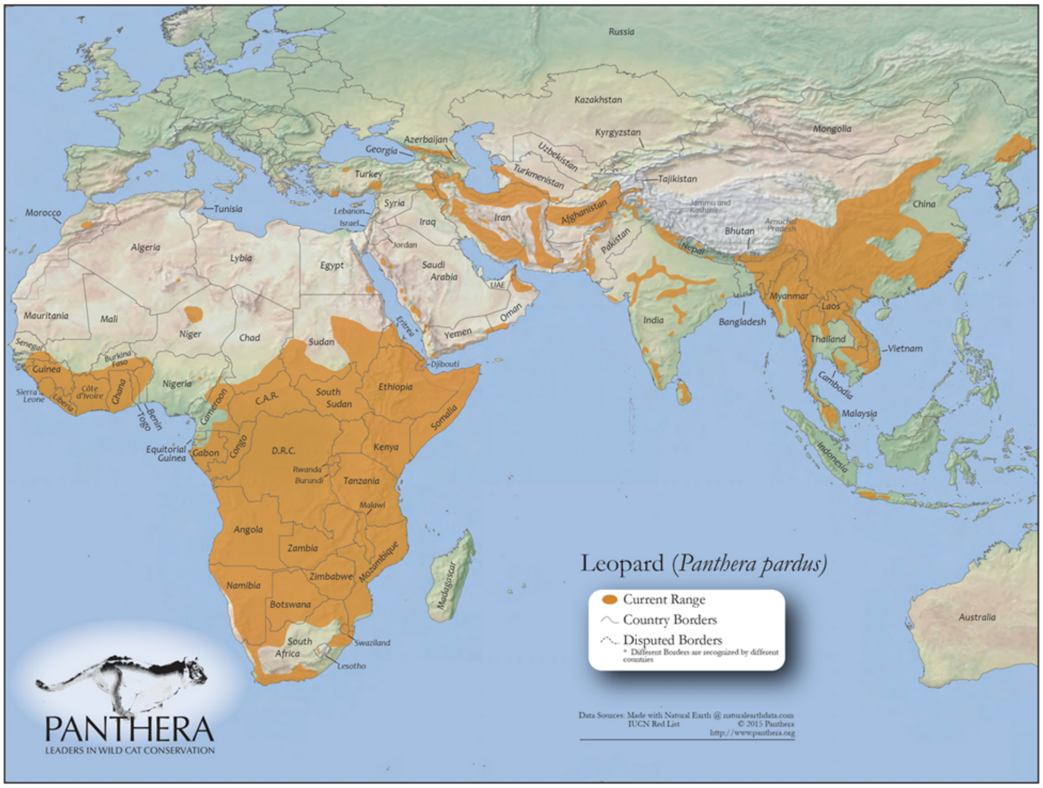

Figure 1.1. Leopard (*Panthera pardus*) range (Panthera, 2015)

Chapter summary

Illegal killings are currently one of the major threats to this planet's biodiversity. The term "illegal killings" refers to two separate phenomena with different objectives: poaching and retaliatory killings. Poaching generally refers to the illegal killing or catching of fauna and flora for profit. Its severity can range from opportunistic poaching of a few parrots by local residents to organized crime syndicates smuggling 40 rhino horns through customs. Retaliatory killings are not for profit and take place in retaliation for some type of H-WC, like wildlife attacks on crops, livestock, or humans.

Illegal leopard killings occur throughout the leopard's range but not all these cases fit the traditional "poaching to sell model." A large part of illegal leopard killings are retaliatory killings for livestock predation where the leopard carcass is destroyed to avoid prosecution. This study will focus on identifying the human and environmental factors that influence where retaliatory leopard killings occur and propose SCP measures to reduce their occurrence.

Chapter 2: Factors contributing to illegal killings generally and illegal leopard killings

The following chapter is separated into sections based on the main motivations for poaching versus retaliatory killings. The latter part of the chapter then discusses how these motivations play a role in illegal leopard killings.

Motivations for poaching

Bushmeat hunting

Rural populations illegally hunt a number of species to eat and sell. This phenomenon is mainly documented for Africa and Southeast Asia (Bikya Masr, 2012; Mfunda & Roskaft, 2010; Watson, Becker, McRobb, & Kanyembo, 2013). The meat of wild ungulates is less fatty than that of domestic livestock and its annual weight varies less. It therefore provides a richer and more stable food source for rural populations (Carpaneto & Fusari, 2000). For some local agro-pastoralists, the number of livestock they own is a token of wealth and they invest any money they make into buying more livestock. These families would never kill their livestock for food and obtain all their protein from bushmeat (Mfunda & Roskaft, 2010).

Fuller and Johnson (2005) also found that Zambians consume bushmeat as a show of status and respect for tradition, much like westerners will pay extra for free-range chicken. In Zambia, bushmeat is surreptitiously sold door-to-door to trusted customers (along with ivory) (Fuller & Johnson, 2005). Depending on the location and the cultural practices of its population, bushmeat hunting can therefore be a strong motivator for poaching.

The pet trade

Certain species are illegally harvested primarily for the pet trade. These include a large number of reptiles and amphibians destined for collectors, but also a range of other species that are sold as part of the exotic pet trade (Webster, 1997, February 7). For example, a 2011 seizure at Los Angeles International Airport revealed 55 turtles hidden in snack food boxes in two men's carry-ons and meant to be sold in the United States (Ng, 2011). Certain species, like the Mangshan pit viper, are even exclusively poached for the pet trade because they are such a hot commodity among collectors, bringing in about $1800 to $3250 U.S. dollars per specimen (TRAFFIC & IUCN, 2008). During CITES' 40th anniversary meeting in March 2013, delegates increased the protection of a number of turtle species illegally caught for the pet trade, noting that the demand for exotic pets is on the rise and that this trade involves more species than the traditional medicine trade and bushmeat hunting (Bottollier-Depois, 2013).

The traditional medicine trade

The traditional medicine trade drives a large demand for poachers' illegal wildlife products in many countries. Traditional healers view health issues as being related to supernatural forces, social relationships, and relationships with ancestors and use traditional medicine to cure both medical and symbolic[4] ailments (Bye & Dutton, 1991; Whiting et al., 2011). It is this faith in supernatural forces and the lack of reliable access to Western medicine in

[4] Symbolic ailments include ancestral conflicts, relationship problems, poor fortune etc. (Bye & Dutton, 1991; Whiting, Williams, & Hibbitts, 2011).

many areas that guarantees a continuous and lucrative demand for poached wildlife (Interpol, 2010-2011). About 80% of the world's population relies on traditional medicine (Akerele, 1993; Botha, Witkowski, Shackleton, & Fairbanks, 2004), 27 million of which live in South Africa (Botha et al., 2004; Mander, 1998), and that number is increasing (Botha, 1998).

What animal species are poached for the trade depends on the beliefs of local populations. At least 232 species of wild vertebrates and several species of marine mollusks are used in South Africa for the traditional medicine trade (Whiting et al., 2011). Rhino horn thefts in Africa, Asia, and in European museums, for example, are driven by the Asian belief that powdered rhino horn can cure cancer, as well as act as an aphrodisiac and increase men's sex drive (Agence France Presse, 2011c; BBC News, 2011, July 25; Lyall, 2011, August 26; Thomet, 2011). This belief is especially difficult to dispel as it has existed in Asian culture for more than 1,000 years (Agence France Presse, 2011b). Currently, the price of a pound of rhino horn powder is higher than the price of gold and cocaine.

The pelt trade

A number of animal species are poached for their pelts. These include alligators, big cats, otters, and snakes, among others. Some are hunted for the fashion industry while others are hunted for traditional costumes used in religious or cultural rituals, or as signs of status. Tibetans, for example, use otter pelts as trim on traditional costumes and also make a warm jacket called a "bhatta" out of them (TRAFFIC, 2011). Crocodiles, on the other hand, are primarily poached to make crocodile handbags and other derivative products, but their numbers in the wild have stopped declining since the creation of legal crocodile farms that raise the species solely to sell its skin to the fashion industry (Santini, 2013).

Trophy hunting

Trophy hunting is another reason for poaching. Many big game “status species” that hunters get a thrill out of shooting are now endangered (IUCN, 2012). Game farm owners must therefore find creative and illegal ways to continue these hunts. A recent South African scandal, for example, revealed that a game farm owner was buying rhinos and other wild animals from zoos, auctions, and private owners for poachers and tourists to shoot on his game farm (Agence France Presse, 2011d; Bangkok Post, 2011, September 25). Captive lion breeding is common in South Africa where 60% of lions live in captivity to be released into the wild for trophy hunts (Liou, 2012). Although this constitutes a much smaller threat to species because of stricter regulations for hunting permits and trophy exports, illegal trophy hunting still exists as game farms and hunters find loopholes to circumvent enforcement (Bangkok Post, 2011, September 25; CITES Secretariat, n.d.; Service & Authority, 2003).

Motivations for retaliatory killings

Human-Wildlife Conflict

Perhaps the most problematic motivation for illegal wildlife killings is H-WC. These conflicts can result in retaliatory killings that endanger species' survival. Population growth and expanding industrial activities bring humans and wildlife into increasing contact, sparking competition between them for limited natural resources, including land (Graham et al., 2005). The most common types of H-WC include human encroachment on or destruction of wildlife habitat and the destruction of crops or the killing of humans or livestock by wildlife. Elephants, for example, cause extensive damage to crops when they trample fields looking for food and become aggressive when approached or chased off, sometimes killing or injuring villagers (Bakano, 2011; Watts, 2013).

Previous management of these conflicts has been heavily biased towards the social and economic needs of humans, with little regard for its impact on wildlife (Graham et al., 2005). For example, the logging of rainforests, which has benefited local human populations financially, is also causing numerous wildlife species to become extinct (Polidoro et al., 2010, April). Some other examples include the hunting of bears in New Jersey when they stray near human houses to eat garbage (Petty, 2012) or the killing of sharks after shark attacks or sightings near tourist-laden beaches in Australia (Coots, 2012).

In the past, H-WCs have been limited to small geographic regions and therefore have only had localized impacts on global biodiversity. The growing expansion of human activities means that these conflicts are now occurring all over the world and, if managed incorrectly, have the potential to wipe out a much larger number of species (Secretariat of the Convention on Biological Diversity & United Nations Environment Programme, n.d.). The retaliatory killing of "problem animals" could become one of the biggest causes of species extinction given its geographical scope and the number of species it affects.

Factors that contribute to H-WC and retaliatory leopard killings

Several factors increase the likelihood that humans will enter into conflicts with wildlife. These include ecological factors that shape animals’ behavior so they are more likely to encounter humans and human factors where humans behave in ways that increase contact with wildlife. Human factors include habitat destruction and fragmentation, economic strain, and misguided expectations of predation losses. Ecological factors include the large home ranges of carnivores, their opportunistic hunting patterns, and fluctuations in natural prey.

Habitat destruction and fragmentation

The first way in which humans can exacerbate H-WC is through direct habitat destruction[5] (Al-Johany, 2007). For example, in a study in the Annapurna Conservation Area of Nepal, local residents caused damage to the fauna by cutting firewood in the area, making it harder for the snow leopard to find cover when it hunts[6] (Oli, Taylor, & Rogers, 1994). By cutting firewood, local Nepalese reduced the size of functional snow leopard habitat. As a result, more snow leopards have to successfully hunt food in a smaller geographical area with less prey, since a smaller habitat supports less prey. Furthermore, a reduction in habitat size makes it easier

[5] There are multiple components to wildlife habitat integrity: these include the size of habitat, the degree of degradation, fragmentation, and the connectivity to other habitat blocks (Wikramanayake et al., 1998). Human activity and high human densities can affect every one of these aspects of habitat integrity.

[6] Although the focus of this research is on leopards (*Panthera pardus*), snow leopard (*Panthera uncia*) research is included because the two species are genetically very similar and suffer from the same H-WC and conservation issues (Yu & Zhang, 2005).

for poachers to find snow leopards because they have less ground to cover, putting an added strain on the species (Henschel, 2008).

If Nepalese snow leopards are not able to find enough food in their new reduced habitat, they will choose one of two options. One, they will move to another more suitable habitat, if it exists, or two, they will start roaming human-inhabited areas in search of food. For leopards, the problem with moving to a more suitable habitat is that they are running out of them. Recent evidence from researchers with the World Wildlife Fund (WWF) shows that changing weather patterns due to climate change are pushing forests further into the mountains and causing alpine habitat losses for leopards (this added to the existing losses from human destruction) (Agence France Presse, 2012a; Forrest et al., 2012).

Direct destruction, though, is not the only thing reducing the leopard's habitat. The world is experiencing large amounts of indirect habitat loss through human encroachment and disturbance (Gill, Norris, & Sutherland, 2001). Al-Johany (2007) describes how, in Saudi Arabia, leopards have left several areas where they once used to live because of human influences like roads and the continuous hunting of ibex and hyrax (their prey) by local residents. The effect of such indirect habitat destruction can be seen in Kenya. The "critical human density" for leopards is the human density at which there is a 50% probability of leopard extinction. For Kenyan areas with no bushmeat hunting, this number is 900 inhabitants per square kilometer. Having more than 900 human inhabitants per square kilometer in those areas will drive out leopards because there will not be enough resources to sustain both. This "critical human density" value is even lower in areas where residents depend on bushmeat for protein and thereby dip into the leopard's prey population (Woodroffe, 2000 in (Henschel, 2008)).

Moving to another habitat to avoid human disturbance also has a higher cost for species like leopards that feed on migratory prey because their prey species may not move with them (Gill et al., 2001). Different species have different "critical human density" values. Wildebeest for example, might be able to survive in an area with more than 900 humans per square kilometer when leopards cannot. If the leopard moves to avoid human disturbance, it will no longer have access to the wildebeest population it usually feeds on. With less food, a leopard has lower chances of both survival and reproductive success. Interference competition[7] only aggravates these problems when, for example, tigers living in the same areas as leopards also depend on the same food source (Odden et al., 2010).

Furthermore, a leopard that moves to a new habitat because of habitat destruction or encroachment (assuming such a habitat is both suitable and available) has to carve itself a new territory by fighting territorial battles with current leopard residents or rival species (i.e. tigers or lions) (du Preez, Loveridge, & Macdonald, 2014). Although rival species can live in the same habitat with sufficient cover to avoid each other, they can also force leopards to move to marginal and less suitable habitat (Hamilton, 2014). The stress of human disturbance, less suitable habitat, and fighting for new territory can have severe fitness costs for a leopard. These costs include reduced prey intake, increased vigilance levels, higher risk of falling ill, and reduced levels of parental care, all of which can contribute to less reproductive success and possibly death (Gill et al., 2001).

Habitat fragmentation also has direct implications for population health. The more fragmented leopard habitat is, the higher the risk of patch distribution, where leopard populations

[7] A form of resource competition between species where "one species imposes a cost on another by limiting its foraging ability" (Odden, Wegge, & Fredriksen, 2010, p. 875).

exist in different areas without any contact with each other because no corridors remain between habitats (Zeller, Nijhawan, Salom-Perez, Potosme, & Hines, 2011). This leaves a leopard population even more vulnerable to extinction through illness, environmental disaster, or simple genetics because of a lack of genetic diversity (Yiming, Zhongwei, Qisen, Yushan, & Niemela, 2003; Zeller et al., 2011). Leopard populations in the Eastern and Western Cape Provinces of South Africa are already at risk of extinction because of this lack of genetic diversity (McManus, Dalton, et al., 2015).

If a leopard cannot move to a less fragmented and disturbed habitat, it must turn to alternative prey. Unfortunately, fragmented and disturbed habitats support smaller amounts of wild prey because of size constraints and the out migration of prey species that can find alternative habitat. Since human encroachment is a common reason for habitat fragmentation, and humans often bring livestock and pets with them, a leopard stuck in a disturbed habitat will often turn to those animals for food (Athreya & Belsare, 2007). Livestock and pets make excellent prey because they have limited survival instincts; these were bred out of them after generations of human dependence (Farmer 1, personal communication, August 17, 2011). By introducing livestock and pets into the leopard's shrinking habitat, humans have engineered the main reason for H-WC, livestock predation.

Economic strain

Livestock predation, although a problem, would not aggravate agro-pastoralists as much as it does if it was not for the economic strain under which they live (Butler, 2000; Erasmus, 2011, January 21). In agro-pastoralist communities, the loss of even a small number of livestock a year to carnivores can have serious economic consequences[8] and can result in negative attitudes toward wildlife and conservation in general (Mishra, 1982; Upreti, 1986 in (Oli et al., 1994)).[9] Near Serengeti National Park in Tanzania the mean annual livestock loss per affected household was 5.3. The cash value for this amount of livestock is about two-thirds of the local average annual income (Holmern, Nyahongo, & Roskaft, 2007). In Zimbabwe, the average livestock loss for households was $13 U.S. dollars or 12% of a family's annual income (Butler, 2000). In Nepal, that same value for the winter months, the harshest for subsistence livelihoods, represented a quarter of the average Nepalese' annual income (Oli et al., 1994). This level of economic impact is not limited to carnivores: elephants in Uttarakhand, India, cause crop farmers to lose an average of 20 to 50% of their anticipated crop yield (Ogra, 2008).

Unfortunately, leopards tend to kill some of the most expensive livestock, like cattle and donkeys (Butler, 2000), meaning agro-pastoralists resent them even more than other conflict-causing species. Hill (2004) notes that people's perception of how much danger a species poses depends on the species' visibility (i.e. size), the degree to which it is dangerous to humans, and the degree of control that people feel they can have over its activities. Leopards invite resentment from farmers on all these levels because they are larger animals, can easily kill a human, and are

[8] Losses to wildlife, though, are not just economic. They can include loss of education for children who end up having to guard their parents' fields or livestock, or loss of life or health if one is attacked by wildlife or develops a disease like malaria from increased night work to guard crops or livestock (Hill, 2004; Ogra, 2008).

[9] Surprisingly, in Sweden and Norway, attitudes towards carnivores were not related to carnivore abundance or experience of livestock losses but rather to the country's environmental policies and local resident's trust in government authorities. The more suspicion of government authorities, the more anthropogenic the attitudes (Gangaas, Kaltenborn, & Andreassen, 2015).

hard to track and hard to control because wildlife officials are often unwilling to cull them because of their protected status.

Belief that predation should not occur

The economic strain that livestock losses from carnivores place on farmers causes them to develop a “leopard or I” survival mentality that fosters their belief that retaliatory killings are legitimate (Farmer 1, personal communication, August 17, 2011). Agro-pastoralists’ belief that livestock predation by carnivores should not occur fosters this mentality and increases the motivations for retaliatory leopard killings. Even though carnivore livestock killings represent a small percentage of stock losses compared to those from disease (especially tick fever in South Africa) (Hemson, Maclennan, Mills, Johnson, & Macdonald, 2009), livestock owners emphasize that they are a true bane to their livelihood and should not occur (Farmer 2, personal communication, August 5, 2011; Farmer 1, personal communication, August 17, 2011).

Part of the reason for this rancor is farmers’ belief that the government should do more to stop “its” animals from killing their livestock. This feeling is especially strong in communities with no farming subsidies (Farmer 1, personal communication, August 17, 2011). When conservation policies stop farmers from taking direct action against crop-raiding species, they expect that the government will step in and prevent H-WCs (Hill, 2004). The fact that hunting permits are now required to hunt animals in many countries reinforces this belief that the government “owns” the local wildlife (Hemson et al., 2009). For example, Hill (2004) documented that farmers believed that “the Ugandan government behaves like an irresponsible livestock owner" when it does nothing to prevent wildlife from destroying their crops and does not compensate them for damage, because if a domestic animal were to do the same, its owner is lawfully required to compensate the injured party (Hill, 2004, p. 282).

Expectations of how leopards should or should not behave often do not take into account basic ecological principles. To expect no livestock losses to carnivores is unrealistic knowing that livestock are easy prey and new husbandry methods require less direct supervision of animals, giving a leopard the opportunity to catch one (Graham et al., 2005). Similarly, agro-pastoralists are often so enraged by livestock losses that they fail to distinguish signs of leopard predation from signs of other predators (Government wildlife official 1, personal communication, July 31, 2011) or make no distinction between the between proximate and ultimate cause of livestock death (i.e. leopards will often go after sick or weak animals that would have died anyways) (Butler, 2000; Graham et al., 2005; Oli et al., 1994).

Large home ranges of carnivores

Leopard ecology is partly responsible for making their retaliatory killings more likely. Their large home ranges (also true for most carnivores) guarantee overlap with human activities (Graham et al., 2005). The leopard’s adaptable nature also increases the likelihood that it will come into conflict with humans. Examples of this uneasy co-habitation include leopard attacks on humans in India when villagers enter the jungle just outside their village to defecate or collect firewood (Nayak, 2013; Raina, 2011).

Opportunistic hunting by leopards

The leopard's opportunistic hunting also makes it more likely to conflict with humans because humans have introduced livestock, an opportunistic hunters' dream prey, into the ecosystem while refusing to recognize that this may result in livestock predation. Leopards will look to expend the least amount of energy to catch their prey when hunting for the 3 kg of daily meat they eat (Al-Johany, 2007). Livestock provide an easier food source than wild prey because they have few instincts to flee (cattle huddle in a pack to protect themselves from predators) and are usually corralled with no means of escape. Leopards in a location with livestock will therefore choose it over wild prey. This penchant only increases during the dry and/or winter season when lack of vegetation cover and decreased availability of seasonal prey can result in lower hunting success for leopards (Butler, 2000; Oli et al., 1994).

Furthermore, humans have accelerated this prey shift to livestock by hunting the leopard's wild prey for bushmeat and legal hunting (Schaller, 2011). Kurvits et al. (2011) state that the loss of natural prey due to poorly managed hunting is one of the primary threats to snow leopards and Graham et al. (2005) & Henschel (2008) note that this same problem exists for leopards. Leopards require medium and large-sized ungulates to eat, types of species that are often poached for bushmeat in densely populated areas (Henschel, 2008). They cannot subsist on small-bodied prey alone, although they will shift their prey choice and size when their preferred prey is not available (Butler, 2000; Henschel, 2008). Part of this shift in prey choice involves eating non-wild species (i.e. livestock and pets) if this is the next best thing to their preferred prey (Graham et al., 2005).

Introducing livestock into the leopard's habitat can change predator-prey activity patterns because the leopard will sync its behavior to mirror that of livestock instead of wild prey to increase its foraging efficiency (Eriksen et al., 2011). This choice of food can then be passed on to future generations when raising cubs. In Zimbabwe and Namibia, Stander (1990) (in Butler (2000)) documented the existence of such "rogue individuals" that consistently attack livestock rather than wild prey once they have discovered livestock as a food group[10]. To date, there is no conclusive evidence that only a small number of rogue leopards attack and kill livestock. When farmers introduce livestock into an area, leopards will start to eat livestock, especially if wild prey numbers are declining. Killing leopards in retaliation for livestock losses is ineffective because solving the problem would require killing the entire leopard population and all other carnivore populations in the area (Linnell et al., 1999).

Surplus killing

Surplus killing is, for example, when a leopard enters a sheep corral and kills 10-15 sheep but eats only one or two (Al-Johany, 2007). Farmers in the Western Cape Province of South Africa describe this phenomenon by saying leopards are thirsty for blood and go into a killing frenzy at the sight/smell of it (Farmer 1, personal communication, August 17, 2011). Linnell et al. (1999), though, suggests that this behavior is adaptive and occurs in other large carnivore species like wolves, cougars, and grizzly bears, and among small carnivores that cache carcasses

[10] Stander (1990) (in Butler (2000)) and Linnell, Odden, Smith, Aanes, and Swenson (1999) suggest that these individuals tend to be males but find no evidence that these individuals have less hunting skill because they are young, injured, or old.

for later. This behavior is not often seen in the wild for lack of opportunity because wild prey rarely cluster together when attacked (unlike livestock). Agro-pastoralists, though, are further angered by the waste and high cost such surplus killings cause (Al-Johany, 2007). Surplus killings foster a deep resentment of leopards among affected farmers, which can then degenerate into retaliatory killings.

General illegal killings versus species-specific illegal killings

The main problem with looking at illegal wildlife killings as a general phenomenon is that each species is illegally killed for very specific reasons. Looking at illegal killings as a whole is therefore ineffective in coming up with a targeted solution to the problem. For example, rhinos are primarily killed for the traditional medicine trade, with the profits from this trade going towards all sorts of organized crime activities (Gettleman, 2012a). Although rhino poaching is, theoretically, a subset of general poaching, looking at it from this perspective is simply too broad, resulting in general solutions that are ill suited to rhinos. Solutions like preemptively dehorning rhinos or covering their horns in fluorescent dye that shows up at customs checkpoints (Agence France Presse, 2011a; Gerardy, 2010), are not transferable to say, Mangshan Pit Viper poaching, which is done primarily for the pet trade and where the whole snake is smuggled out of China alive (TRAFFIC & IUCN, 2008).

Even among animals illegally killed for the same reason, like H-WC, the solutions for each species are different. Compare, for example, retaliatory elephant killings where farmers kill elephants that trample their crops[11] (Bakano, 2011; Chadwick & Winter, 2010; K. Ray, 2012; Watts, 2013) and retaliatory lion killings in Kenya where livestock owners shoot livestock-eating lions (Hunter, 2012; Lion Guardians, 2012). For the elephants, the Kenya Wildlife Service (KWS) chose to remove them from the Narok region, which could no longer support such a large pachyderm population, and transport them to a wilder location, Maasai Mara National Park (Bakano, 2011). For the lions, an NPO chose to train local Maasai warriors to monitor lion movements using radio-collars and educate their fellow villagers about how to prevent livestock losses using predator proof corrals and better husbandry techniques (Hunter, 2012; Lion Guardians, 2012).

The choice to relocate the elephants but not the lions stems from the difference in the ecology of each species. Lions are territorial while elephants are not (African Elephant Specialist Group, Species Survival Commission, & IUCN, 2011; Funston, Mills, & Biggs, 2001). Relocating lions to a different habitat is fraught with risk because of the high chance of death and stress from fighting for a new territory with the current lion residents of that area (Dloniak, 2012). Second, there are two different ecological phenomena driving the H-WCs here. H-WC can occur when a species' population is too large to survive in a particular habitat, like with the elephants in Kenya (Bakano, 2011), but it can also occur because humans introduce an easier prey into an ecosystem, like with lions and livestock in Kenya (Al-Johany, 2007). Each scenario requires a different response. Although the motivation to illegally kill lions and elephants appears to be the same (i.e. H-WC), the complexity of the environment in which these killings take place requires different solutions for each species.

[11] In Sumatra, elephants knock down palm trees to eat heart of palm, a favorite food and end up destroying farmers' palm oil plantations (Watts, 2013).

Even among carnivore-human conflicts, the ecology of each carnivore species makes cross-species comparisons difficult and questionable without studying each individual carnivore first. Leopards, for example, are some of the most versatile big cats in terms of habitat (Bailey, 2005; Panthera, 2015). This makes them more likely to adapt to human encroachment on their territory than lions, for example. As a result, you would expect leopards to move, if possible, before they remain near humans and resort to eating their livestock from lack of wild prey. Lions, on the other hand, may have a harder time finding an alternate appropriate habitat and so may resort to eating local pastoralists' livestock earlier than leopards. Female lions also tend to hunt in packs (Funston et al., 2001), while leopards hunt alone. An incident of lion predation can therefore result in more dead livestock and can have a larger impact on local livestock operations than a case of leopard predation.

All these ecologically driven differences in carnivore-human conflicts are hypothetical because no comparison studies have yet been done. Given this lack of research, though, it seems unwise to group carnivore-human conflicts together. In fact, previous research suggests that extrapolation of solutions from one species to another is often ineffective (Chapron et al., 2008). Furthermore, SCP, the framework on which this study is based, emphasizes the need to look at specific crimes when coming up with crime prevention techniques to better target the prevention methods (Clarke, 1983; Cornish & Clarke, 1987). As such, a researcher using SCP would differentiate between burglaries of retail establishments vs. burglaries of single-family houses (Center for Problem-Oriented Policing, 2013). Given all of the above, this research will focus only on illegal leopard killings.

Motivations for illegal leopard killings

Although illegal leopard killings occur across the leopard's range, many motivations for illegal killings are locally driven either because the motivation only exists in a small geographical area or because offenders only kill a limited number of leopards. As such, the following section separates motivations into minor threats to leopard conservation versus major threats. A minor threat is any threat that is geographically limited or affects such a small number of leopards that it does not seriously threaten the species. This assessment of the scope of leopard poaching is based on the current literature from the fields of biology, anthropology, criminology, and agricultural studies.

Small-scale threats to leopards by illegal killing motivation

Bushmeat hunting (Africa and India)

Although leopards live in areas where bushmeat hunting is documented (Africa and India) and they would provide adequate lean meat for consumption (Bikya Masr, 2012; Carpaneto & Fusari, 2000; Mfunda & Roskaft, 2010), they tend not be sought after for bushmeat. Carpaneto and Fusari (2000) found that most hunters in central-western Tanzania ate or sold about 73% of their catch while the remaining 27% of their catch were from animals they hunted to protect their crops or livestock and was not meant for human consumption. Carnivores tended to fall into the latter category. They are rarely killed for bushmeat because of cultural taboos associated with eating them and the fact that many local residents do not like the taste of their meat. The only exception is the African civet (*Civettictis civetta*), eaten by local residents in Tanzania (Carpaneto & Fusari, 2000). Thus, leopards are not directly at risk from bushmeat hunting, but they are indirectly hurt when hunters kill their prey species.

The pet trade (Middle East)

Big cat poaching for the exotic pet trade does exist but is of limited conservation impact for leopards because of the small numbers of animals involved. Warchol et al. (2003) found evidence of a “status pet” market for large cats and reptiles in the Middle East. This trade also seems to exist in New York City, where a Harlem man was arrested in 2003 for keeping a full-grown tiger in his apartment that he had raised from a cub (CNN, 2003). Occasional stories like this crop up in the news, but no comprehensive study has been done to determine the extent and locations of this trade. Given how impractical it is to keep an aggressive large cat as a pet, though, this motivation for poaching leopards is probably limited.

The traditional medicine trade (Africa and Southeast Asia: primary receiving countries)

Some leopards may be illegally hunted for the traditional medicine trade. Leopard skins and body parts are traded for traditional medicine because users believe owning these items will provide them with the animal’s strength (Whiting et al., 2011). Henschel (2008) described a regional market in the Congo Basin for leopard skins, claws, and canine teeth for the traditional medicine trade, as did Al-Johany (2007) in Saudi Arabia. John (2014) also found this to be true for leopard claws, skulls, canine teeth, and pelts in Southeast Asia. Reports of search and seizure by government authorities suggest that middlemen in Southeast Asia smuggle leopard parts for the traditional medicine trade to countries where demand is high.

Several pieces of information, though, suggest that leopard poaching for the traditional medicine trade is limited and may not be a major threat to leopard survival. Whiting et al. (2011)'s study of the Faraday market in South Africa found that most of the 32 traders who offered leopard products sold small pieces of leopard skin or bones/claws/teeth, rather than whole carcasses. These traders tended to run small cash-strained businesses where their ability to obtain leopard products depended on proximity to leopard habitat or available disposable income to buy inventory or travel to hunt a leopard (Botha, 1998; Botha et al., 2004; Whiting et al., 2011). Furthermore, not all leopard parts they sold came from illegally killed leopards, some came from animals that died of natural causes (Whiting et al., 2011).

This suggests that the number of leopards being poached specifically for the traditional medicine trade may be relatively small, as hundreds of small pieces of leopard skin could have come from one carcass. In addition, most traders indicated that, although they knew of commercial gatherers for traditional medicine ingredients (an inevitable by-product of its lucrative profits), they generally did not buy from them, because they were unsure their products were genuine and/or purified according to traditional rituals (Botha, 1998). Since most traders do not have the financial resources to travel long distances to collect specimens (Botha, 1998; Botha et al., 2004), it appears that traditional healers are only a small-scale threat to leopards. Traditional healers' belief that they are conservationists meant to "carry the medicinal plants and animals into the future" reinforces this (Botha, 1998, p. 631).

The pelt trade (Southeast Asia and South Africa)

Poaching for pelts is perhaps one of the more common motivations for illegal leopard killings given the numbers of pelts intercepted by law enforcement authorities, primarily in Southeast Asia (TRAFFIC, 2011). Large numbers of leopard pelt seizures have taken place in India, China, Thailand, and Nepal with smaller numbers occurring in select African countries (see table A1 in the Appendix) (Tsabedze, 2011, November 25). Poaching for pelts is common in large parts of India and Myanmar for leopards (Deccan Chronicle, 2012, January 6; John, 2014; Platt, 2012) and in Baltistan, Pakistan, in winter for snow leopards (Hussain, 2003). Snow leopards are caught in leg snares and clubbed to death or starved so their pelt is not damaged. The pelts are then taken to a market in Peshawar for domestic buyers and in the Arab Gulf states and Europe for foreign buyers. A well-kept snow leopard pelt can fetch $400 U.S. dollars in Skardu, Pakistan, an amount equal to a year's cash income for most local families (Hussain, 2003). Tibetans also collect snow leopard skins to use as trim or be sown into the backs of traditional costumes worn in Sichuan Province, China (TRAFFIC, 2011). In India, leopards are killed in similar ways to snow leopards but are also poisoned with over-the-counter pesticides like carbofuran (Hindustan Times, 2013). Their pelts can sell for $10,000 to $14,000 U.S. dollars (Platt, 2012).

Members of the Shembe religious group in the KwaZulu-Natal Province of South Africa also kill leopards illegally to wear their skins during religious ceremonies as a sign of their love of nature (Roberts, 2010, October 10). They do not believe they are diminishing leopard populations because their leader, Isaiah Shembe, has the power to create more leopards. Since leopard skins cost about 6,000 South African Rand (about $730 U.S. dollars), owning one is viewed as a sign of wealth and respect, increasing their demand (Roberts, 2010, October 10). Members of the Zulu tribe also wear leopard pelts as a symbol of power, as do Congolese rebel army military officers (Roberts, 2010, October 10; Salopek & Olson, 2005). These traditions present a threat to leopard populations in areas with Shembe and Zulu tribesmen, but this threat is decreasing as NPOs are successfully working with these communities to replace leopard pelts with alternatives, including dyed kudu hide (Dickerson, 2011; Mabuse & Ko, 2012; Panthera, 2012).

Trophy hunting

There are two ways in which trophy hunting can contribute to leopard poaching: 1) when a hunter wants to “bag a leopard”, 2) when a game farm owner shoots a leopard to protect his legal trophy hunting species. The first is less documented, but a few researchers found evidence that the historical practice of leopard trophy hunts continues today on a small-scale. Al-Johany (2007) found that local residents in Saudi Arabia organize hunting parties to kill leopards as a source of personal pride/honor and to gather their pelts. The CITES leopard export permit quotas, 150 permits for South Africa in 2012 for example, also suggest that leopards are still subject to trophy hunting (CITES Secretariat, n.d.; Mabuse & Ko, 2012; Quammen, 2005). Warchol et al. (2003) found that a small number of adult African cheetahs and leopards are actually caught alive and sold to game farms for trophy hunting.

The second is a by-product of species-focused conservation policies for the promotion of trophy hunting (Hussain, 2003). Part of wildlife tourism revolves around trophy hunting on commercial game farms or through government-regulated hunts, where legislation conserves certain species to guarantee thriving game populations for hunts. These ventures attract hunters based on how easily they can shoot wild game, mainly large ungulates. This gives game farm owners and local community members, who benefit from the proceeds of a hunt, a reason to shoot leopards or other carnivores on their property to stop them from eating wild game that customers/hunters can hunt (Graham et al., 2005; Hussain, 2003). The fact that most large carnivores are not legal to hunt or are almost impossible to obtain hunting permits for reinforces this behavior because leopards have no cash value in the eyes of game farm owners.

Large-scale threats to leopards by illegal killing motivation

H-WC and retaliatory killings

The biggest current threat for leopards in Africa and Southeast Asia appears to be retaliatory killings triggered by H-WC[12]. This phenomenon is recognized as one of the biggest threats to wildlife conservation because of the cost preserving wildlife imposes on people in rural areas (Hill, 2004; Holmern et al., 2007; Wikramanayake et al., 1998). For example, local residents living near a national park or prime leopard habitat are more likely to experience livestock losses from leopards or risk being killed by them. A May 2012 newspaper article in The Star of Kenya described how residents of Gilgil vowed to kill a leopard that killed 24 sheep

[12] Retaliatory killings are illegal unless the shooter obtains a permit from the relevant wildlife authority to kill the "problem leopard."

and injured 6 others during a midnight attack (Murage, 2012, May 13). Another article published in The Tribune of India discussed how a shopkeeper from the Chopda area of Didihat was killed by a leopard who was later found clutching his body by the neck not far from his shop (Khanna, 2012, January 26). The outcome of these types of incidents can be retaliatory leopard killings. A March 2012 article in The Indian Express, for instance, reported on a series of leopard killings in the Assam area where residents, angry after a series of leopard attacks on humans, retaliated by killing two leopards and eating their meat (Gupta Kashyap, 2012, March 6).

Livestock predation as triggers of retaliatory killings

The main type of H-WC that triggers retaliatory leopard killings is leopard predation on livestock, which causes serious economic losses for small-scale meat farms (Athreya, Odden, Linnell, & Karanth, 2010; Kgathi, Mmopelwa, Mashabe, & Mosepele, 2012; King, 2006; Kurvits et al., 2011; Snow, 2006) (see table 2.1a below for a summary of the events and conditions necessary for retaliatory leopard killings motivated by leopard livestock predation). Butler (2000) found that leopards are responsible for 12% of livestock killings in areas bordering wildlife reserves in Zimbabwe, mainly by jumping into fortified kraals (enclosures) at night. In South Africa, “Farmers Weekly” magazine (the oldest agriculture magazine in the country) reported that sheep farms lose 9% of their flock to predators (compared to 6% in the U.S.), while 90% of sheep losses are due to predation (37% for the U.S.) (Bezuidenhout, 2010, August 20).

Agro-pastoralists’ retaliatory behavior can range from direct retaliation by killing a suspected “problem animal” to indirect retaliation by opposing the creation of wildlife sanctuaries or the implementation of other conservation initiatives (Graham et al., 2005). Some illegal leopard killings fall into the former category of direct retaliatory killings (Kurvits et al., 2011; Oli et al., 1994). Agro-pastoralists sometimes poison the carcasses of dead livestock to kill any returning predators. This method is particularly effective for most carnivores because almost all species return to their kill within 24 hours, and if not, there is always another predator/scavenger willing to eat the remains (Al-Johany, 2007).

Agro-pastoralists, though, will often not care what animal killed their livestock and will retaliate against whatever species or individual animal they believe, rather than know, is at fault (Government wildlife official 1, personal communication, July 31, 2011). In the Western Cape Province of South Africa, some farmers that have experienced stock losses to predators shoot any leopard that comes onto their property. Since leopards are stealthy and hard to catch, these farmers will call upon a local community member with specially trained hunting dogs to organize a leopard hunt (Government wildlife official 1, personal communication, July 31, 2011). In Gabon, local residents resort to snaring leopards on the edges of national parks, where leopard livestock predation is common. (Henschel, 2008). Both arbitrarily shooting and snaring leopards are ineffective responses to livestock predation because they indiscriminately target all leopards. They do not guarantee that the problem leopard has been dealt with and can have strong negative consequences for leopard population survival (Henschel, 2008).

Table 2.1a. Summary of events and conditions necessary for an illegal leopard killing driven by leopard predation on livestock

	Leopard	**Cattle Farmer**	**Environment**
Pre-leopard shooting	Roaming far distances for food	Struggling to make a living	Seasonality of vegetation cover
	Trying to avoid human activity	Shooting small prey for bushmeat	Human encroachment destroying habitat
		Leaving cattle to graze unsupervised in fields	Overlap of foraging area with cattle
	Struggling to find food because of low wild prey numbers	Believes should have 0 losses from predators	Small corridors with no buffer near human activities
			Creation of national parks sparking H-WC at park boundary
	Wants to expend the least energy to eat		Presence of cattle with no wild instincts (easy prey)
	Kills cattle	Feels abandoned by government	Female leopard struggling to stay/get pregnant because of malnutrition
	Feeding frenzy and kills more than eats		
The shooting	Leopard returns to kill within 24 hours	Wildlife service too slow or has no resources to respond	Leopard behavior guarantees return to kill
	Cornered by farmer	No trust in methods of wildlife service	
	Reacts defensively and attacks	Knows of other farmer who shot a leopard without consequence	Leopard's mountainous habitat makes it harder to kill after it discards cattle carcass permanently
		Knows farmer with leopard hunting dogs	

		Shoots leopard	
Post-leopard shooting	N/A	Dumps carcass in bush to destroy evidence	Loss of breeding female affects breeding for that season and/or results in death of her current cubs
	N/A	Sells carcass to middle man (Shembe tribesman, traditional medicine user, or smuggler)	Loss of alpha male means new male comes in and kills previous offspring
	N/A	Profits off leopard kill if carcass sold	Increase in "pest species" until food chain balance is restored
		No prosecution / occasional small fine	New leopard moves into open territory

Leopard attacks on humans as triggers of retaliatory killings

A different retaliatory killing problem exists in India where leopards attack humans in or near rural villages (see table 2.1b below for a summary of events and conditions necessary for retaliatory killings of leopards motivated by leopard attacks on humans). In March 2012, in the town of Kamrup, villagers killed a leopard that attacked 8 people in a local field (Gupta Kashyap, 2012, March 6). Not all these cases of human attacks, though, have resulted in the death of the leopard. A surprising number ended with local residents calling the Indian wildlife service for help removing the leopard to more remote wilderness (Khanna, 2012, January 26). The reality of a growing world population and industrialization is that untouched wilderness is growing scarce, making it more common for humans and animals to co-exist in semi-wild terrain. Learning to manage these interactions in non-lethal ways for both humans and leopards will ensure that H-WC does not result in widespread species extinction.

Table 2.1b. Summary of events and conditions necessary for an illegal leopard killing driven by a leopard attack on a human

<table>
<tr><th></th><th>Leopard</th><th>Villagers</th><th>Environment</th></tr>
<tr><td rowspan="8">Pre-leopard shooting</td><td>Roaming far distances for food</td><td>Living without running water or indoor plumbing</td><td>Seasonality of vegetation cover</td></tr>
<tr><td rowspan="3">Trying to avoid human activity</td><td>Travel into forest for water and urination/defecation</td><td>Overlap of foraging area with human habitation</td></tr>
<tr><td rowspan="2">Travel into forest to shoot small prey for bushmeat or collect firewood</td><td>Human encroachment destroying habitat</td></tr>
<tr><td>Small corridors with no buffer near human activities</td></tr>
<tr><td>Struggling to find food because of low wild prey numbers</td><td rowspan="4">Feel abandoned by government resources</td><td>Nearby national park with higher concentration of leopards</td></tr>
<tr><td>Wants to expend the least energy to eat</td><td rowspan="3">Presence of easy prey like cattle (no wild instincts) and feral dogs (no guardianship) near villages</td></tr>
<tr><td>Roams near villages because of stray animal concentration</td></tr>
<tr><td>Encounters human</td></tr>
</table>

The killing	Startled by human encounter	Wildlife service too slow or has no resources to respond	Territorial nature of leopards guarantees human perceived as threat
		No trust in methods of wildlife service	
	Reacts defensively, attacks and/or kills human	Know of others who killed a leopard without consequence	Leopard aggression towards crowd and human presence fuels villagers' anger
		Crowd's anger at leopard fuels urge to kill	
		Crowd beats or shoots leopard to death	
Post-leopard shooting	N/A	Crowd feasts on leopard meat, celebrates	Loss of breeding female affects breeding for that season and/or results in death of her current cubs
	N/A	Dump carcass in bush to destroy evidence	Loss of alpha male means new male comes in and kills previous offspring
	N/A	Profit off leopard kill if carcass sold	Increase in "pest species" until food chain balance is restored
		No prosecution / occasional small fine	New leopard moves into open territory

Chapter summary

Studying illegal wildlife killing as a broad phenomenon is misguided because the reasons for illegally killing each species are so specific. Illegal killings require targeted solutions that are non-transferable between species. Some motivations for illegally killing leopards are locally driven and affect only a small geographical area or number of leopards. These minor threats to leopard survival include bushmeat hunting, the pet trade, traditional medicine, the pelt trade, and trophy hunting.

Major threats to leopard survival include retaliatory killings for livestock predation and human attacks. These H-LCs are exacerbated by leopard ecology, such as large home ranges and opportunistic hunting patterns, and human behaviors, like habitat destruction and misguided expectations of predation losses.

Chapter 3: Attempts to reduce illegal leopard killings

Prevention methods for illegal leopard killings take many forms and can be tailored to specific killing motivations. For example, international treaties forbidding the trade in certain species are primarily meant to control poaching and illegal wildlife trafficking by stopping the import and export of wildlife. National laws, though, outlaw the catching or killing of wildlife irrespective of the perpetrator's motivation, targeting both poaching and retaliatory killings. Tourism initiatives fulfill the same purpose by giving wildlife value in the eyes of local residents and dis-incentivizing both poaching and retaliatory killings. Only predation prevention methods focus solely on limiting H-WC, the immediate precursor event to retaliatory killings.

Few evaluations exist of these prevention methods for illegal killings (Pires & Moreto, 2011). Nevertheless, it is possible to describe some of the successes and failures of wildlife crime legislation, law enforcement responses, and grass-roots prevention internationally. The following section begins by describing the prevention efforts that currently exist, then goes on to explain their pros and cons. Special emphasis is placed on measures that prevent H-WC induced retaliatory leopard killings because, as discussed in chapter 2, this is deemed to be the biggest threat to leopard survival.

Legal protection of wildlife

Several basic laws regulate the trade in leopards and their parts and prohibit hunters from killing leopards without a permit. These laws exist both on the international and the national/provincial level. Below is a brief description of the main international agreement, CITES, and the country-specific laws relevant to this work:

The Convention on International Trade in Endangered Species (CITES)

CITES is an international treaty between willing countries that regulates the movement of wild flora and fauna to prevent the extinction of these species from international trade (CITES Secretariat, n.d.). All species that are part of CITES (over 30,000) are subject to certain controls and require specific licenses when they are imported, exported, re-exported, and introduced from member nations either alive, dead, or as derivative products.

These species are listed in three appendices based on the amount of protection needed. Appendix I species are at high risk of extinction and cannot be traded barring exceptional circumstances. In such cases, an export and an import permit are required and the importer must prove the import will not be detrimental to the survival of the species. Appendix II species are not necessarily threatened by extinction but their trade needs to be monitored to avoid unsustainable use. Appendix III species are protected in at least one member country that has requested the help of other nations in controlling the species' trade (CITES Secretariat, n.d.). Each member country is responsible for creating the management structure needed within their borders to provide these licenses and monitor what effects the trade has on species population levels.[13] This is perhaps one of the major weaknesses of CITES: its enforcement is only as good as the amount of effort a country puts into creating and monitoring this infrastructure. The

[13] South Africa joined CITES in July 1975, India in July 1976, and Kenya in December 1978.

leopard is part of Appendix I and has been since January 7th, 1975.[14] The following countries have obtained permission to export a select number of leopards in 2012 and 2015 (UNEP-WCMC & CITES Secretariat, 2015):

Table 3.1. Number of leopard export permits by country for 2012 and 2015 (no CITES exports permits given for leopards in 2014)

Country	**2012 export quota***	**2015 export quota***	**What products can be exported**
Botswana	130	0	Trophies & skins
Democratic Republic of Congo	5	0	Skins
Central African Republic	40	0	Trophies & skins
Ethiopia	10	50	Trophies
Kenya	80	0	Trophies & skins
Malawi	50	0	Trophies & skins
Mozambique	120	0	Trophies & skins
Namibia	250	250	Trophies (2012, 2015) & skins as personal effects (2012)
United Republic of Tanzania	500	500	Trophies (2012, 2015) & skins (2012)
Uganda	28	0	Trophies & skins
South Africa	150	0	Trophies & skins
Zambia	300	0	Trophies & skins
Zimbabwe	500	0	Trophies & skins

* # of specimens.

The National Environmental Management Biodiversity Act of 2004: Threatened or Protected Species Regulations (South Africa)

The National Environmental Management Biodiversity Act of 2004 consolidated existing

[14] This does not mean poaching prevention measures have been successful overall. The IUCN Red List of Threatened Species explains that, although the leopard is highly adaptable compared to other big cats and remains widespread in certain parts of its habitat (sub-Saharan Africa), in other areas (North Africa), leopard subpopulations are on the verge of extinction. There is a general decline in leopard numbers since 1986 (Henschel, Hunter, Breitenmoser, Purchase, et al., 2008).

South African biodiversity legislation and created national standards for how the country's different wildlife management authorities should deal with wildlife (Endangered Wildlife Trust & South African National Biodiversity Institute, 2008). Its provisions for damage causing animals (including leopards) require the provincial conservation department to decide between capturing and relocating the animal or culling it. Either option can be carried out by the department or by an individual to whom they issue a permit for the procedure[15]. The holder of this permit can then choose to hunt the damage causing animal using the following methods: poison, bait and traps (including gin traps), dogs, darting, or shooting (Southern African Legal Information Institute, 2007). The skins of leopards killed using a damage causing animal permit cannot be exported outside South Africa (Balme et al., 2009).

Under this legislation, leopards can also be legally hunted for trophies if a hunter possesses a CITES permit issued by the Province's conservation department. Only a limited number of these permits are issued based on how vulnerable the local leopard population is to extinction (Balme et al., 2009; UNEP-WCMC & CITES Secretariat, 2015). In South Africa, leopards may not be killed without a permit unless killed in self-defense (where there is an immediate threat of death) (Southern African Legal Information Institute, 2007).

The Wildlife Conservation and Management Act of 2013 (Kenya)

The Wildlife Conservation and Management Act of 2013 is the long awaited major

[15] "In principle, destruction permits are issued only to landowners who demonstrate that a leopard represents a threat to life or property, and that no alternative non-lethal solutions is available" (Balme et al., 2009, p. 2683).

overhaul of the original act of 1976 (Kahumbu, 2013; National Council for Law Reporting, 2013). The act came into effect on January 10^{th}, 2014 (Republic of Kenya, 2013). Its major revisions include stringent penalties for poaching and restructured governance of wildlife resources where the regulation and management functions are separate from research (World Wildlife Fund, 2014).

Under this law, no wildlife can be killed in Kenya without a valid permit, unless in self-defense. A problem animal, one causing harm to human life or property, can only be killed by a KWS official with permission from the land owner on which the animal resides (Republic of Kenya, 2013). If a family experiences a death, an injury, or loss of property as a result of H-WC and they have taken reasonable measures to protect themselves, they can submit a compensation claim to the county wildlife conservation authority. The authority will then award fair market value for damaged property or anywhere from 2 to 5 million Kenyan shillings in death or injury cases (about $22,000 to $55,000 U.S. dollars) (Republic of Kenya, 2013).

Penalties for illegal hunting, possession of illegal wildlife products, or wildlife trafficking range from 2 years to life in prison or fines of 1 million to 20 million Kenyan shillings (about $11,000 to $220,000 U.S. dollars) depending on the conservation status of the animal killed (Republic of Kenya, 2013). Killing black and white rhinoceros, African elephants, and critically endangered species results in the harshest penalties. Leopards are a category below this group as "endangered mammals" (category B). Penalties for killing a leopard without a permit are a fine of 5 million Kenyan shillings (about $55,000 U.S. dollars) or imprisonment of five years or both (Republic of Kenya, 2013). The law establishes an inter-agency security team with members of KWS and the Police Service to apprehend poachers in protected areas. It requires that any KWS official conniving with poachers be sacked and property obtained through poaching proceeds be seized (Kahumbu, 2013).

This act also outlaws livestock grazing in protected areas and bushmeat/subsistence hunting without a permit, although the penalties for both these offenses are much lighter than for poaching, usually a fine of up to 100,000 Kenyan shillings (about $1000 U.S. dollars) or imprisonment for up to 6 months (Republic of Kenya, 2013).

The Wildlife Protection Act of 1972 (India)

The Wildlife Protection Act of 1972 (WPA) was the first piece of wildlife and environmental conservation legislation passed in India after its independence from British colonial rule (Misra, 2005). It prohibits the hunting and trafficking of wild animals and their parts (including trophies), except in cases where the Chief Wildlife Warden believes a wild animal is dangerous to human life or disabled or diseased beyond recovery (Indian Ministry of Environment, 1972). The WPA also appoints authorities to manage national parks and wildlife sanctuaries and prevent illegal killings. Protected species are separated into "schedules," with schedules I and II focusing on endangered species (Misra, 2005).

The WPA has been revised multiple times since 1972 to keep pace with changing times (1982, 1986, 1991, 1993, 2002, 2006, 2010, 2013). Revisions included adding more species to protected lists as they become endangered. India banned all exports of wildlife from the country in 2000, making its regulations even stricter than that of CITES (Misra, 2005). In 2002, India upped the penalties for wildlife crimes from 1 to 7 years in prison and a 5000 rupee minimum fine (about $80 U.S. dollars) to 3 to 7 years with increased fines based on the severity of the offense (Indian Ministry of Environment and Forests, 2015). The majority of wildlife trafficking offenses now require a 5 to 7 year prison sentence (Indian Ministry of Environment and Forests, 2013).

Although public awareness of the legislation has increased, the specifics of what is legal or illegal under the WPA are poorly understood among the general public (Misra, 2005). Enforcement is still sporadic with little inter-agency communication, consultation, or joint action against offenders between the forestry, police, customs, and judiciary departments (Misra, 2005). Training of enforcement personnel is also limited, especially when it comes to species identification.[16]

The effectiveness of laws

Although these laws exist, their effectiveness is highly dependent on how well they are applied by local law enforcement. Many countries have lacked the political will and public pressure for enforcing them (Schaller, 2011). For example, a study of ivory trading by Martin (2010, July-December) found that even though laws prohibit the sale of all ivory in Ghana (even antique pieces), you still frequently find ivory carvings for sale at markets. Only when law enforcement actively raided markets for illegal ivory, did sellers stop selling it (Martin, 2010,

[16] Another challenge posed by this legislation is how to manage animal species whose populations have recovered and are now beginning to cause H-WCs where they have surpassed their habitat's carrying capacity. This is complicated because some of these animals, like leopards, are problem animals in certain locations but are also victims of widespread poaching in other parts of the country.

July-December).

Previous studies have identified several factors hampering the proper implementation of wildlife protection laws. Firstly, law enforcement agents must be knowledgeable enough about these laws and have the proper skills to determine when they have been broken. For example, customs officials must be able to identify if a species is protected under CITES or local legislation (Warchol et al., 2003). It can sometimes be very difficult to differentiate between protected versus non-protected species, especially when few customs officials have the biological knowledge to do so. The ASEAN-WEN Wildlife Enforcement Network and the Wildlife Trade Monitoring Network TRAFFIC have created “Identification sheets for wildlife species traded in Southeast Asia” (see figure 3.1 for an example). These give detailed illustrated instructions on how to identify each protected species (or their byproducts) and differentiate them from their non-protected counterparts (TRAFFIC & ASEAN-WEN, 2012).

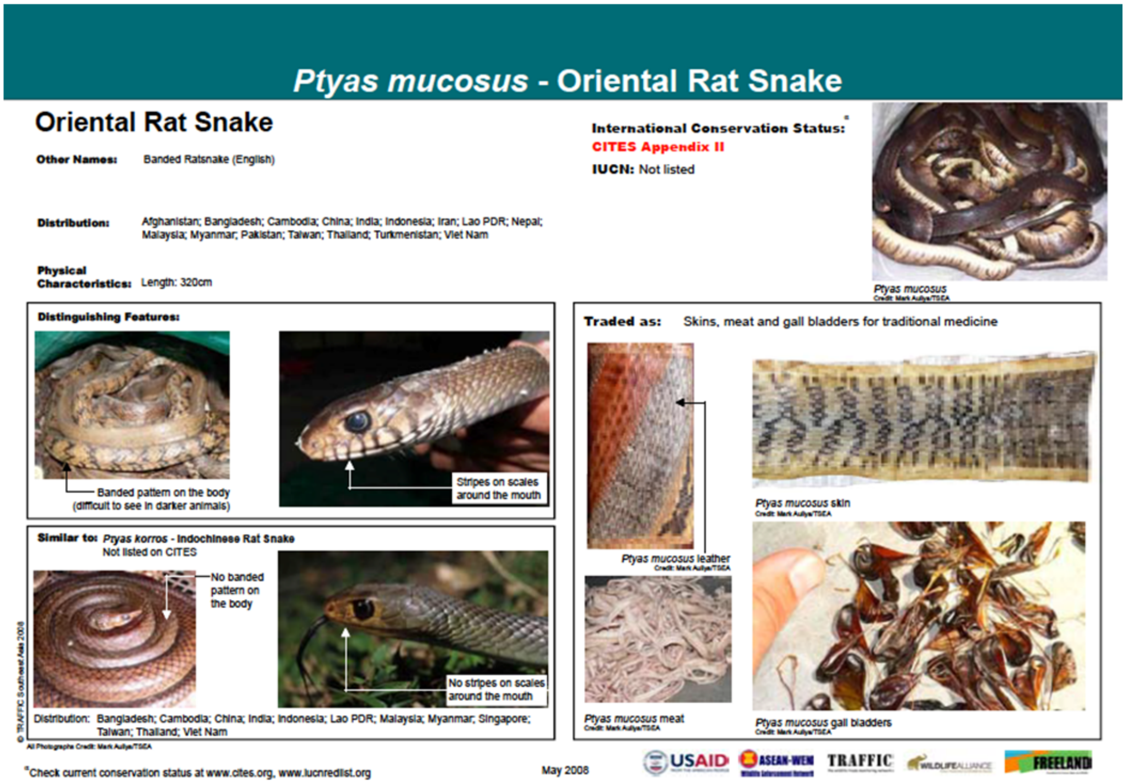

Figure 3.1. Example of an identification sheet for the oriental rat snake produced by ASEAN-WEN and TRAFFIC

Second, many wildlife laws lack legitimacy or importance in the eyes of both the public and the courts. As a result, the public feels no moral obligation to obey the laws and courts impose light if any punishment, reinforcing the public’s behavior. For example, in rural Pakistan, illegal leopard killings occur with the consent of the whole village, despite its illegality. This collusion makes it all the more difficult to eradicate the custom (Hussain, 2003). In Nepal, the village elder in a small Gurung village has overruled the countries’ ban on killing leopards and bears after a leopard killed 21 goats in a day (Adhikari, 2012). Since the government has no presence in this part of Nepal, retaliatory leopard killings are likely to continue among villagers. Law enforcement and NPO efforts at the local level should focus on changing mentalities in such areas, so local residents understand the importance of abiding by environmental laws for their region's economic and biological survival (Pires & Moreto, 2011; K. Ray, 2012).

Even if an offender is reported and caught, most courts do not impose harsh sentences for wildlife crimes because judges are often unfamiliar with environmental law or are unwilling to prosecute neighbors in rural areas (Martin, 2010, July-December; Warchol & Johnson, 2009). For example, an elephant poacher in Ghana received only a small fine and had his rifle confiscated for killing two elephants in Kakum National Park in 2003 (Martin, 2010, July-December). A farmer who illegally killed two brown hyenas in the Barrydale region of South Africa (a very rare species) received only a $115 U.S. dollar fine for the killing because the presiding judge empathized with his stock losses (Government wildlife official 2, personal communication, August 19, 2011). This sort of behavior from the courts only bolsters local belief that obeying wildlife laws is unnecessary and opens the door for organized poaching operations. These operations are more than willing to accept such mild penalties as "the cost of doing business" because the profits from their hunts generally far outweigh their potential costs if caught (Leader-Williams & Milner-Gulland, 1993).

Thirdly, there is a lack of coordinated effort between actors in law enforcement at the local, national, and international level that hampers proper implementation and enforcement of wildlife laws (Kurvits et al., 2011; Lin, 2005). Since illegally poached species often travel across state lines to their buyers, international cooperation is essential to stop the wildlife trade (Schaller, 2011). Many countries are already collaborating to stop the illegal trade in endangered species. Vietnam and South Africa, for example, recently signed a Memorandum of Understanding pledging to work closely on biodiversity management, conservation, law enforcement, and compliance with CITES and other relevant legislation and conventions (TRAFFIC, 2012a). This agreement primarily came about because of the voluminous illegal trade in rhino horn from South Africa to Vietnam (TRAFFIC, 2012a).

Yet, regardless of how well countries are able to block the import or export of illegally poached species, it is important to remember that a domestic market can still exist (Lemieux & Clarke, 2009). To tackle the illegal trade in wildlife effectively, countries must strengthen their local and national enforcement of laws while also increasing international law enforcement cooperation. Preventing poaching is in large part about safeguarding the world’s biodiversity, which is essential to all species’ survival, including humans’. The best way to meet this goal is to prevent species from being killed in the first place. Species that are not traded live are dead by the time they reach international borders (Hussain, 2003; TRAFFIC, 2011). Even for live trade specimens, a large percentage of them will have died in transit by the time they reach the border (Pires, 2011). Preventing wildlife killings is therefore best done on the local level at the point of capture. Working at the local level also has the added advantage of targeting retaliatory killings because efforts focus on preventing the taking or killing of wildlife regardless of motive, not on preventing their transport.

Some local enforcement efforts have proven to be effective at reducing wildlife crime. Several studies have shown that higher game warden to land mass ratios have reduced illegal killings as have better monitoring of patrol efforts that promote increased ranger time in the field (Ghoddousi et al., 2010; Martin, 2010, July-December). Better international cooperation will make it easier for countries to share these local successes with other nations so that they may improve their own law enforcement efforts.

Reactive versus preventive responses to illegal leopard killings

Based on the previous section, current laws often seem to fall short of preventing wildlife crime. Local prevention efforts may be more effective because they have the potential to prevent wildlife deaths and tackle the root beliefs and habits that facilitate illegal killings in rural communities. In fact, some researchers are suggesting that the reactive-policing model is not effective for wildlife crime and that law enforcement responses should focus on prevention rather than response (Pires & Moreto, 2011).

Prevention methods have obvious advantages when trying to stop wildlife deaths, but it is important to note that market raids (a reactive rather than preventive method) have shown some promise in reducing ivory trading in Ghana and that similar methods may prove useful in reducing wildlife killings for profit (Martin, 2010, July-December). The key to successfully implementing such reactive methods is knowing when and where to use them instead of preventive action.

This research focuses on H-WC driven leopard killings, which, unlike poaching, do not result in a wildlife byproduct (like pelts or bones) being sold. A reactive method is ill suited to this type of illegal killing since there is no market to shut down or raid. For retaliatory killings, prevention methods are far more useful than reactive ones for two reasons: 1) the ultimate goal is finding a non-lethal outcome to the conflict to prevent the killing of the problem animal and 2) the perpetrators are too focused on the immediate survival of their flock (and livelihood) to consider the long-term outcomes of their actions[17].

The sections below describe two types of preventive response to retaliatory leopard killings that are currently used internationally. The first is predation reduction methods that attack the root cause of retaliatory leopard killings: leopard livestock predation. The second is green tourism whose goal is to convince local residents that live leopards have a monetary value because they bring in tourist dollars that benefit the community.

Predation reduction methods

Selective removal and relocation

One of the main approaches to preventing retaliatory leopard killings has been to reduce leopard predation on livestock thereby eliminating agro-pastoralists' reason to kill leopards. Predation reduction methods tend to focus on controlling predator abundance[18], but Graham et al. (2005) suggest that this approach is misguided because losses appear unrelated to predator density but related to prey availability.

Selective removal and relocation is one of the methods used to reduce predator abundance in an area and spread predator numbers out more evenly over the landscape. One of

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[17] Leader-Williams and Milner-Gulland (1993)'s research explains that in developing countries, where the future is uncertain and so valued less than the present, concentrating on detection/prevention is better than increasing penalties since most citizens are not thinking about hypothetical future penalties.

[18] An exception to this is diversionary feeding, but this option has many downsides. It can only be used short-term because of the cost and effort involved. It also encourages leopards not to hunt and so decreases their ability to survive in the wild (Graham et al., 2005; Kurvits et al., 2011).

the only evaluations of this method by Athreya et al. (2010) in India, though, seems to support Graham et al. (2005)'s claims that controlling predator abundance is ineffective at reducing leopard predation on livestock. Athreya et al. (2010) found that translocating leopards led to a sharp increase in the number of leopard attacks on humans and a 56% increase in livestock predation events. Their findings indicated that leopards did not remain where they were translocated. These researchers suggested that the leopards' increased aggression towards both humans and livestock was due to the stress of the translocations and return through unfamiliar landscapes back to their home territory, as well as a loss of fear of humans from their constant proximity during the translocation. These findings support those of Dr. Craig Packer, director of the Serengeti Lion Project, who found that, in Kenya, moving livestock-killing lions only shifted the problem to another area, because translocated lions were forced to the human-dominated boundaries of translocation areas by their existing lion population (Dloniak, 2012).

Selective culling

Selective culling of "problem leopards" is another popular solution in many areas, but it assumes that only certain leopards are prone to eating livestock and that these individuals can be successfully removed without other leopards taking their place as livestock eaters[19] (Linnell et al., 1999). As this has yet to be proven (Linnell et al., 1999) and as there have been cases of farmers and even governments abusing laws that sanction the removal of problem animals (Coniff, 1999 in (Hussain, 2003)) (Geldenhuys, 2011, December 4; Hussain, 2003), this method

[19] A process akin to "offender replacement" in the criminological literature.

remains suspect. Furthermore, the reduction in leopard numbers from poaching makes wildlife officials wary of issuing cull permits, causing tensions with local people suffering from livestock predation (Erasmus, 2011, January 21; Liberg et al., 2011).

Another risk with selective culling is the consequences it has for other ecologically dependent or related species in the food chain. Previous efforts to cull predators through strychnine poisoning for wolves (Bjorge & Gunson, 1985) and poisoned livestock carcasses for hyenas (Al-Johany, 2007) ended up killing non-target species and did not stop wolves and hyenas from attacking livestock. Hunting the jackal to extinction because it preyed on farmers' livestock also failed because it caused spikes in pest species populations lower in the food chain, like rabbits (Government wildlife official 1, personal communication, July 31, 2011). All three of these examples show how policies like selective culling can have unforeseen negative effects on other species because they are poorly thought through. Even now, researchers do not fully understand all the links between species in an ecosystem (U.S. Geological Survey, 2007). Selective culling should therefore be used only as a last resort, if used at all, until all of its consequences are fully understood.

Selective culling also does not encourage community tolerance for predators, which is a key component to the future conservation of leopards (Packer et al., 2009; K. Ray, 2012). Culling indirectly reinforces the idea that killing leopards is an acceptable method to reduce livestock predation. Reinforcing this idea can then lead individuals, like Oli et al. (1994)'s Nepalese subjects, to try and completely eradicate predators in their area and refuse to consider other options like selective removal of problem animals and changes in husbandry practices.

Innovative husbandry techniques

Some of the more promising (although not widely implemented or researched) methods to combat H-WC induced poaching are innovative husbandry techniques like predator-proof corrals and Anatolian sheep dogs or donkeys for more effective guardianship (Aryal, Brunton, Ji, Barraclough, & Raubenheimer, 2014; Gusain, 2014; Linnell et al., 1999; McManus, Dickman, Gaynor, Smuts, & Macdonald, 2015; Romans, 2014; Snow, 2006; World Wildlife Fund & Global Species Program, N.d.).

Predator-proof corrals (see figure 3.2) are specially made enclosures that prevent predators from reaching livestock. Maasais in the Maasai Mara area fortify their livestock enclosures with two feet of underground wire fencing and six to ten feet high wire walls to prevent lions from pushing through the fence, leopards from jumping over, and badgers and hyenas from digging under (Westberg & Westberg, 2012). These types of fortified corrals are a commonly used husbandry technique to prevent predation. In Botswana, for example, the government will only compensate livestock farmers for their predation losses if they can prove they keep their livestock in a predator-proof corral at night (Kgathi et al., 2012).

Figure 3.2. Example of a predator proof corral in Ulley Village, India (Panthera, 2014)

Bell collars are placed on livestock to scare away predators. They ring when predators startle livestock, scaring the predator away. Anatolian sheep dogs or donkeys also ward off leopards from grazing livestock. Once they live with a herd, the dogs bond with it and attack any predator that tries to eat a member of their flock (Landmark Foundation, n.d.; Stannard, 2006). Anatolian sheep dogs work well in conjunction with bell collars because the sound from the bell collars alerts the dog to a problem in the herd.[20] In South Africa, donkeys can provide a good alternative to Anatolians because of their low cost. An adult donkey, if sufficiently angered, can kill a leopard by kicking it with its hooves (Gusain, 2014; Romans, 2014) (Farmer 1, personal communication, August 17, 2011).

[20] Note that The Landmark Foundation states that innovative husbandry techniques should be used “holistically as part of an adaptive and dynamic management plan. No single method is 100% effective on its own. They work best when applied in combination” (Landmark Foundation, n.d., p. 1).

Figure 3.3. Example of a bell collar (Landmark Foundation, n.d.)

The main problem with these measures has been convincing farmers to try them and apply them properly. This is even before the hurdle of finding funding to subsidize their implementation (Kurvits et al, 2011) (NPO worker 1, personal communication, July 31, 2011; Government wildlife official 3, personal communication, August 23, 2011). Hemson et al. (2009), for example, found that Botswana cattle post owners were not willing to improve husbandry techniques to protect their livestock, but were willing to kill lions. Few had attempted it, but the ones who had killed 20% of the lion population during the study.

Convincing farmers to use innovative husbandry techniques is difficult in South Africa as well because farmers believe proponents of these new techniques have insufficient animal farming experience and are basing their recommendations on limited research and isolated success stories (Bezuidenhout, 2010, August 20). Part of this belief may stem from unrealistic expectations of what these methods should do. Farmers sometimes believe that innovative husbandry techniques should eradicate livestock predation completely, which is unrealistic. They can reduce livestock predation substantially, but are not a miracle cure and come with some downsides.

Bell collars, for instance, have had mixed success based on how well they are used (King, 2006; Landmark Foundation, n.d.) (NPO worker 1, personal communication, July 31, 2011). To use them effectively, farmers must commit to putting them on their flock one day, then returning to the grazing site the next day and removing them, and continue this pattern for several weeks at a time during periods of livestock vulnerability, like lambing season. Unfortunately, this process is time consuming and puts added pressure on the farmer (NPO worker 4, personal communication, August 21, 2011) (King, 2006).

Donkeys require less careful monitoring, but farmers must still check on their flock regularly because some donkeys never bond with the herd. Donkeys also do not protect animals that stray from the pack, like pregnant cows that wander away to give birth. One interviewed farmer reported that that 2 out of 4 of his donkeys never bonded with his livestock, leaving them unprotected (Farmer 1, personal communication, August 17, 2011). Those that did bond with the herd were effective guardians, but farmer supervision is still required to determine if a donkey has bonded with its herd. A guardian animal does not replace the vigilant eye of a shepherd.

As for Anatolian sheep dogs, they must be properly bred and stopped from bonding with humans. Ideally, a farmer should check on his dog once a day and feed him then to insure baboons or other opportunistic wild animals do not eat his food. Stolen food can cause dogs to hunt wild game instead of protecting the herd (Farmer's Weekly, 2009, May 22). Poor breeding can also result in dogs having a “game hunting drive” that makes them ill suited to guard livestock (Government wildlife official 3, personal communication, August 23, 2011). Finally, Anatolian sheep dogs can suffer from tick-borne illnesses that reduce their effectiveness as guardians if their owners do not properly groom them (Government wildlife official 3, personal communication, August 23, 2011).

Despite their defensive attitudes towards innovative husbandry techniques, farmers have valid reasons for their complaints. The head of the African Large Predator Research Unit at the University of the Free State (South Africa), H.O. de Waal, argues that little scientific research has been done on the efficiency of predator management (de Waal, 2009, July 3). Many non-lethal methods of deterring predators, like donkeys and bell collars, have proven to be only temporarily effective until predators learn to outwit them (de Waal, 2009, July 3). He cites the example of livestock protection collars[21] (also known as “dead stop” or “King collars”, see figures 3.4a and 3.4b) that have shown some success against carnivore livestock attacks, but have failed to prevent jackal predation because jackals adapted to the collars and learned to attack animals from behind instead of at the throat. Instead of automatic death, this resulted in farmers finding sheep and goats with their abdominal cavities gaping and entrails trailing, left to die of infection (Landmark Foundation, n.d.).

[21] This can either be a hard plastic collar placed around a sheep’s throat or a wire one that looks like a cage around the throat. The hard plastic version generally contains poison to kill the predator in addition to stopping its attack on a sheep. See figures 3.4a & 3.4b for photos.

Figures 3.4a & 3.4b. a) Example of a livestock protection collar with poison inside it (Retrieved from http://www.livestockprotection.net/collar01.htm); b) example of a dead-stop collar that protects an animal's throat from injury (Landmark Foundation, n.d.)

Existing efforts to study the problem of predator management tend to be too fragmented with resources inefficiently managed, in part because too many actors are involved in the process (the agricultural department, the environmental affairs department, and numerous provincial departments) (Bezuidenhout, 2010, August 20; Farmer's Weekly, 2010, October 29). These departments often have limited research funds (insufficient to sustain large research projects) and lack experts in predation and livestock management to help research and evaluate effective solutions to livestock predation.

In addition, the absence of national norms for dealing with predation issues means that each province or department implements its own policies without regard for what others have done and what has worked elsewhere (Farmer's Weekly, 2010, October 29). Coordinating the efforts of all these parties more efficiently would produce better results. It would also lower the frustration of livestock farmers trying to work with this bureaucracy and increase their trust in suggested predation prevention methods (Farmer 2, personal communication, August 5, 2011; Farmer 1, personal communication, August 17, 2011) (Bezuidenhout, 2010, August 20; K. Ray, 2012).

NPOs seem more motivated to research innovative husbandry techniques to prevent livestock predation by leopards (Landmark Foundation, n.d.). The Landmark Foundation is currently working on an evaluation of husbandry techniques in the Western and Eastern Cape Provinces of South Africa (Landmark Foundation, n.d.). Their results, just published in the journal Oryx, show that non-lethal predator management methods (like Anatolian sheep dogs, donkeys, and livestock collars) proved cheaper for start-up and running costs per year and more effective than past lethal methods (McManus, Dickman, et al., 2015).[22]

One problem with these findings is that NPOs are advocates for leopard conservation and, as such, are not unbiased evaluators of innovative husbandry techniques. Their research therefore remains suspect until the academic community does its own assessment. At this point, the mixed reviews of innovative husbandry techniques, with their intermittent successes, suggest they have potential but need further assessment before they can be touted as effective for

[22] These methods are probably best applied on an individual basis as their effectiveness varies from farm to farm based on flock size and the location of farm land, hence the preliminary results' widespread range of 56 to 97% percent reductions in livestock predation (Moberly, White, Webbon, Baker, & Harris, 2004).

predation prevention. Ideally, future evaluation efforts will include government departments and researchers not affiliated with NPOs. This will bolster the methods' credibility with farmers and the research community.

Tourism and "diffusion of benefits" measures

Green tourism and community-based conservation (CBC) programs continue to be championed for promoting conservation by giving the profits from wildlife viewing back to local populations (C. Mishra et al., 2003; Pires & Moreto, 2011). The theory behind green tourism is that this diffusion of benefits helps local people view wildlife as valuable when alive, with a cash value versus an ecological value, and gives them an incentive to protect local species.

Reviews are mixed as to whether or not CBC programs are effective (Schaller, 2011). A study by Hemson et al. (2009) of tourist facilities around Botswana's Makgadikgadi Pans National Park found that, despite these facilities paying large sums of money to Botswana, few local residents felt that tourism was valuable and benefited them. The majority of those interviewed believed that the government, not their communities, saw most of the profits (Hemson et al., 2009).

Hemson et al. (2009)'s research suggests that tourism brings in large amounts of money but that its distribution to local communities is flawed or, according to Schaller (2011), inexistent. One of the ideas behind CBC is that those who suffer the costs of cohabitating with wildlife should receive the benefits from wildlife tourism, even a non-homogenous sharing of benefits that is proportional to each family's loss. Yet, local residents near Makgadikgadi exclusively benefited from local tourist ventures through employment, with only 17% of families benefiting, while 65% of families experienced livestock predation losses (Hemson et al., 2009). Examples like these confirm the following quote from Botha et al. (2004) that:

> "Although there has been limited success in achieving the twin goals of biodiversity conservation and improving local livelihoods in CBC programs worldwide, most reviews concur that this is due to the complex local and global environments in which they operate, rather than the underlying premise being at fault."

Compensation programs

One widely accepted and implemented measure to reduce retaliatory killings is compensation programs where victims of carnivore predation can file a complaint and receive money for their dead livestock (Hemson et al., 2009; Hill, 2004; Oli et al., 1994; Schaller, 2011). Some conservation organizations, like the Corbett Foundation, have even created programs that disburse funds immediately to local residents while they wait for their compensation claims to filter through the government bureaucracy. In India, this can take between 16 and 18 months (World Wildlife Fund, 2010, December). For the Corbett program, the owner must report the kill within 72 hours and inspect the carcass with a Foundation employee. Cash payment is made upon inspection and owners keep this cash in addition to the government’s compensation. Informers who report a kill before an owner are also compensated, incentivizing aggrieved livestock owners not to poison carcasses in retaliation and to call the Corbett Foundation themselves (World Wildlife Fund, 2010, December).

An alternative to this type of compensation is monetary incentive programs where a conservation organization enters into a contract to buy local handicraft or crops and provide a cash bonus if no illegal killings occur on community land. Any violation of the no illegal killing clause, regardless of whether the violator is a community member or an outsider, results in the loss of the bonus for all participants and the expulsion of community member violators from the program (C. Mishra et al., 2003). The added benefit of this program is that it encourages local people to protect wildlife from poachers outside their community.

Although these types of programs are popular with local residents, they have high costs and generally do not sustain themselves (Schaller, 2011). They are also expensive to expand past the local level (C. Mishra et al., 2003). Furthermore, unless compensation for livestock losses is dependent on livestock owners using predation prevention methods on their farms, compensation programs can lead to neglect of good husbandry practices (Hemson et al., 2009). Incentives to use predation prevention methods are undermined if a farmer is reimbursed for all livestock losses regardless of context. Given all this, these programs are probably not the most cost-effective or long-lasting solutions for H-WC driven illegal leopard killings.

The importance of community engagement

The mixed success of predation prevention and “diffusion of benefits” measures suggests that stopping the illegal killing of leopards is fraught with difficulties. Even when the type of intervention needed is clear, “good science and good laws do not necessarily result in effective conservation” (Schaller, 2011, p. 91). The wildcard in conservation is the community. To achieve continued success according to Schaller (2011, p. 91), “communities must be directly involved as full partners in conservation by contributing their knowledge, insights, and skills.”

The problem is that communities are not always willing to prevent illegal leopard killings. Human tolerance for carnivores and H-WC is essential to conservation efforts and must be developed for wild animals outside of protected areas (K. Ray, 2012). The focus should now be on creating a “conservation landscape” where you merge protected areas and human-dominated land. The reality is that most countries no longer have the space to set up large conservation areas. Protected areas are small and the isolated populations of big cats in them are at higher risk of extinction from inbreeding, disease, and natural disasters (Schaller, 2011). Creating a core set of protected areas within human-dominated land, with wildlife corridors of viable habitat where animals can travel is essential, but requires human cooperation. Humans must agree to keep habitat between protected areas viable and shoulder the costs of increased human-wildlife contact.

Creating these conservation landscapes requires using predation prevention methods skillfully to reduce H-WC to its absolute minimum, while teaching humans to accept that no method will be 100% effective and that poaching and retaliatory killings will not produce a better outcome (Hunter, 2012). To teach this, though, one must understand the cultural context in the region. A community’s previous experience with wildlife and natural resources informs how willing they are to conserve them. So do their previous interactions with wildlife conservation officials and NPOs (Kideghesho, Roskaft, & Kaltenborn, 2007). Building a “conservation landscape” requires integrating the ecological, economic, and cultural realities of the area (Hemson et al., 2009; Schaller, 2011).

South Africa, for example, has a history of not subsidizing local agriculture. Small farmers, primarily white farmers, have felt slighted by this lack of support in difficult economic times (Farmer 1, personal communication, August 17, 2011) (Wilson, 2009). Building a "conservation landscape" in parts of South Africa would require taking their anti-government feelings into account and recognizing that farmer-generated conservation efforts rather than government-dictated conservation requirements will be most effective. Positive incentives will also be more effective in an area filled with resentment of wildlife and where wildlife generates little revenue (Farmer 3, personal communication, August 18, 2011). Failure to consider this cultural subtext can alienate the community when their support is vital to the success of any long-term conservation effort.

NPOs can help implement a strategy to stop illegal killings, but, ideally, they will then hand over the running of the operation to the local community for long-term development. For this to happen seamlessly, the different actors in the process must not act as separate entities but must believe they are part of a whole (Zahler & Schaller, 2014). Too often, factions develop within a community because black and white labels are applied: he is a "conservationist", she is a "farmer", he is a "government official." For example, the passion that drives conservation NPO workers can sometimes lead them to exclude the value of local farmers' opinions (NPO worker 4, personal communication, August 21, 2011). Local farmers may distrust conservationists because, in their minds, they are only there to save the leopards without concern for their livelihood. Every effort must be made to avoid such splintering. Community empowerment is, in the long run, the most cost-effective method for conserving local wildlife (Gettleman, 2012b; Lion Guardians, 2012).

Next steps

The current trend when dealing with retaliatory killings of leopards and other carnivores seems to be creating innovative predation reduction methods to reduce the motivation for killings. Several articles have recently been published in the press about livestock owners who have created or are using new gadgets to protect their livestock. The French newswire Agence France Presse, for example, published an article about a South African sheep farmer who equipped one sheep in each of his herds with a cell phone tracking device that calls him when the herd runs away from something, usually a sheep stealer or a predator (Agence France Presse, 2012b). CNN also published an article about a 13-year-old boy in Kenya who noticed lions in the area feared flashing lights like the flashlights shepherds carry to check on their flock. He created a flashing light display, called a "Lion Light" system, around his livestock corral to prevent lion predation (Kermeliotis, 2013).

Anecdotal stories like these, in combination with successful efforts by NPOs with bell collars and livestock protection animals, suggest that future research should focus on bettering these predation reduction methods. This focus seems particularly appropriate since top-down initiatives from government entities often fail to gain traction with local residents, while local inventions like the "Lion Light" system catch on quickly in these areas (Kermeliotis, 2013).

This research will help improve these grass-roots methods for leopard livestock predation by understanding where retaliatory leopard killings occur and why. Livestock owners can then more accurately predict where they should implement these predation reduction methods for maximum effect.

Chapter summary

The effectiveness of poaching and retaliatory killing prevention methods remains for the most part in doubt. Laws are only as effective as the efforts to enforce them, which often fall short. Some researchers suggest that law enforcement should focus on prevention rather than response. Table 3.2 below summarizes the pros and cons of each method discussed in the chapter. Further research is needed to determine when and where each method is most effective, but grassroots predation reduction methods currently seem the best approach to preventing retaliatory leopard killings.

Table 3.2. Methods to reduce retaliatory leopard killings and their pros and cons

Method to Reduce Retaliatory Leopard Killings	**Impact**	**Problems with Method**
Predation reduction methods		
Translocation of problem leopards	Displaces predation problem to another location (at least temporarily)	1) Livestock losses unrelated to predator density[23] 2) Leopards did not remain where translocated[24]
Selective culling	Quick fix until a new predator takes the place of culled individual	1) Unknown consequences for other ecologically dependent species[25] 2) No proof that new livestock eating leopard does not replace culled individual[26] 3) Does not encourage tolerance for predators[27]
Innovative husbandry techniques		
Bell collars for livestock (to scare leopards) Livestock protection animals (donkeys, Anatolian sheep dogs)	Show more ecologically sound and promising results than other methods[28]	1) Convincing local farmers to try these methods difficult[29] 2) Little research to prove their effectiveness[30] 3) Some predators learn to outwit bell collars[31] 4) Requires monitoring to ensure that protection animals bond with the flock[32]
"Diffusion of benefits" measures		

[23] Graham et al. (2005).
[24] Athreya et al. (2010); Dloniak (2012).
[25] U.S. Geological Survey (2007); Bjorge and Gunson (1985); Al-Johany (2007); Government wildlife official 1 (personal communication, July 31, 2011).
[26] Linnell et al. (1999); Coniff, 1999 in Hussain (2003); Geldenhuys (2011, December 4); Hussain (2003); Erasmus (2011, January 21);Liberg et al. (2011).
[27] Packer et al. (2009); K. Ray (2012); Oli et al. (1994).
[28] King (2006); The Landmark Foundation (n.d.); Landmark Foundation (n.d.); Linnell et al. (1999); Cheetah Outreach (2011); Moberly et al. (2004); Farmer 1 (personal communication, August 17, 2011).
[29] Kurvits et al. (2011); Hemson et al. (2009); Bezuidenhout (2010, August 20); NPO worker 1 (personal communication, July 31, 2011); Government wildlife official 3 (personal communication, August 23, 2011).
[30] de Waal (2009, July 3); Bezuidenhout (2010, August 20); (Farmer's Weekly, 2009, May 22).
[31] de Waal (2009, July 3); Landmark Foundation (n.d.); King (2006); NPO worker 4 (personal communication, August 21, 2011).
[32] King (2006); The Landmark Foundation (n.d.); Farmer's Weekly (2009, May 22); NPO worker 1 (personal communication, July 31, 2011), NPO worker 3, NPO worker 4 (personal communication, August 21, 2011), Farmer 1 (personal communication, August 17, 2011).

Green tourism	1) Gives monetary value to live wildlife in the eyes of local residents that benefit[33] 2) Invests money in local communities[34]	1) Distribution of tourism revenue to local residents often flawed and unequal[35] 2) Proper implementation of schemes highly dependent on local dynamics[36]
Compensation programs for livestock losses	Reduces livestock owners' resentment of carnivores[37]	1) High costs to implement[38] 2) Rarely sustain themselves[39] 3) Only effective if require use of predation prevention methods for compensation[40]
Laws		
CITES and others	Provide a structure from which to combat illegal killings once they have already occurred	1) Law enforcement not always knowledgeable enough to enforce properly 2) Laws lack legitimacy or importance in the eyes of the public and courts 3) Lack of coordination between law enforcement actors prevents effective implementation 4) Localized prevention efforts better than uncertain sanctions for deterrence

[33] C. Mishra et al. (2003); Pires and Moreto (2011).
[34] C. Mishra et al. (2003); Pires and Moreto (2011).
[35] Hemson et al. (2009); Schaller (2011).
[36] Botha et al. (2004); Alpert (1996) in Botha et al. (2004); Newmark and Hough (2000) in Botha et al. (2004).
[37] Hill (2004); Oli et al. (1994); World Wildlife Fund (2010, December); C. Mishra et al. (2003); Schaller (2011); Hemson et al. (2009).
[38] C. Mishra et al. (2003); Schaller (2011).
[39] Schaller (2011).
[40] Hemson et al. (2009).

Chapter 4: Theoretical framework

The previous chapters described the main motivations for illegal leopard killings, concluding that H-WC is the most pressing threat. More importantly, they have identified factors that contribute to retaliatory leopard killings and methods tried to mitigate these factors, including predation prevention methods. These factors include ecological characteristics that shape leopard behavior and bring them in contact with humans and human behaviors that generate conflict with wildlife.

The purpose of this research is to understand where retaliatory leopard killings are most likely to take place and why. Identifying the situational factors that contribute to retaliatory leopard killings will help determine where to best target solutions. The following sections will discuss rational choice theory, choice-structuring properties, SCP, and informal guardians as they apply to this analysis. Rational choice theory and choice-structuring properties give the context for understanding where and how retaliatory leopard killings occur. SCP provides a framework for solving the problem.

Rational Choice Theory

Traditional criminological theories have long focused on what Cornish and Clarke (1986) call the "initial involvement model" of crime: what personal traits make individuals more likely to choose to engage in crime. Rational Choice Theory, rather, focuses on an individual's decision to commit a specific criminal act (Felson & Clarke, 1998), what Cornish and Clarke (1986) call "the criminal event model." It argues that, although offenders may commit crimes because of long-seated motivations and predispositions (i.e. low self-control, weak social bonds etc.), their decision to engage in a particular crime is based on "the opportunities presented to them during their normal patterns of social and economic life" (Felson & Clarke, 1998; Lilly, Cullen, & Ball, 2007; Petrossian, 2012, p. 24).

According to Rational Choice Theory, when offenders plan a crime, they weigh the costs and rewards of the crime in a rational manner so as to maximize its rewards and minimize its costs (Felson & Clarke, 1998). As a result, offenders are more likely to choose crimes that have a low risk of detection, are easy to commit, and provide what they consider a worthwhile reward. As stated by Cornish and Clarke (1987, p. 935), "decisions to offend [...] are influenced by the characteristics of both offenses and offenders, and are the product of interactions between the two."

Choice-structuring properties and "bounded" rationality

In their 1987 paper, Cornish and Clarke (1987, p. 935), identify what they call "choice-structuring properties" of offenses that "provide a basis for selecting among alternative courses of action and […] effectively *structure* the offender's *choice*." They are the characteristics of a crime that make it attractive to one offender but not another at different times and based on his or her goals, character traits, background, and/or expertise. Examples of choice-structuring properties include the type and amount of payoff, the perceived risks, the skills and resources needed, and the availability of targets (see table 4.1 for a list of choice-structuring properties for thefts involving cash, adapted from Cornish and Clarke (1987)).

Choice-structuring properties are classified into two types: static or variance properties (Pires, 2011). Static properties explain the opportunity structure of a crime and its potential for displacement to similar types of crime. Variance properties are the factors that an offender who decides to commit a crime weighs to select a particular target, modus operandi, and/or location (Pires, 2011). Some static choice-structuring opportunities for retaliatory leopard killings are the fact that law enforcement rarely prosecutes individuals for illegal killings and that farmers do not consider killing a leopard in retaliation for livestock losses a crime. Variance properties include the availability of over-the-counter pesticides and leopards' habit of caching their kill and returning to eat it within 48 hours, both of which make it easy to poison a livestock carcass and kill a leopard.

Although choice-structuring properties shape the offender's choices, he or she may not be fully aware of the range of choice-structuring properties involved in his or her decision or of the part they play (Cornish & Clarke, 1987). This ties in with Clarke and Cornish (2001)'s belief that offenders exhibit "bounded rationality" because their cost-benefit analysis for engaging or not engaging in crime is limited by their cognitive abilities and emotions, the time they have to make the decision, and the availability of relevant information. The concept of "bounded rationality" acknowledges that "real world action often has to be taken on the basis of decisions made under less than perfect circumstances" and that individuals are more or less skillful at interpreting what information is available prior to committing a crime (Cornish & Clarke, 2008, p. 25).

Table 4.1. Choice-structuring properties for thefts involving cash (Adapted from Cornish and Clarke (1987))

Choice-structuring properties for thefts involving cash
Availability (numbers of targets; accessibility)
Awareness of method (i.e. pickpocketing vs. insurance fraud)
Likely cash yield per crime
Expertise needed
Planning necessary (pickpocketing vs. bank robbery)
Resources required (transport; equipment)
Solo vs. associates required
Time required to commit
Cool nerves required (bank robbery vs. computer fraud)
Risks of apprehension
Severity of punishment
Physical danger
Instrumental violence required
Confrontation with victim (mugging vs. burglary)
Identifiable victim
Social cachet (safecracking vs. mugging)
“Fencing” necessary
Moral evaluation

Several criminological studies have used rational choice theory and choice-structuring properties to understand both the location and target of poaching. Pires (2011) used choice-structuring properties to explain how nearby illegal wildlife trafficking markets and the physical traits of certain parrot species influenced the likelihood they would be poached for the pet trade. Marteache, Viollaz, and Petrossian (2015) studied how factors like the concealability of vessels and illegally caught fish, convenience of ports, strength of fisheries monitoring, control, and surveillance measures, effectiveness of country governance, and commitment to wildlife protection regulations influenced illegal fishing vessels’ decision to offload their catch in certain countries. Both studies then offered solutions to tackle illegal parrot poaching and fishing using the SCP framework.

Situational Crime Prevention

Clarke has identified 25 techniques of SCP based on rational choice theory and choice-structuring properties' assumptions about the offender decision-making process (Clarke, 2008b). The premise of SCP is to block the opportunities that make the commission of a crime possible. This framework therefore helps develop targeted solutions that reduce the opportunities to commit a crime by increasing its risks and difficulties (Clarke, 1995). Understanding the choice-structuring properties involved in an offender's decision to commit a crime helps devise effective solutions to dissuade offenders. Since, according to rational choice theory, people choose to commit crime when and where they are more likely to succeed, they will avoid committing a crime if the environment is not favorable and they are likely to be caught.

SCP gives equal importance to opportunity and motivation for a crime to occur. Opportunity is an important cause of crime (Clarke, 2008b). An abundance of opportunities can lead both criminally predisposed and non-predisposed individuals to commit crime and continue doing so. The more opportunities for crime, the more it will occur and the more criminally disposed individuals will seek out other opportunities to commit crime (Clarke, 2005). Clarke (1983) argues that reducing these opportunities will reduce specific forms of crime. SCP techniques are meant to achieve this.

SCP also emphasizes the “situational determinants” of crime, those situational factors that determine whether or not an offender will commit a crime at a particular location and time (Clarke, 1983). These situational factors can be part of the physical environment, like the number of lights in a parking lot when stealing cars, or the way the environment functions, such as whether or not security guards check bags for stolen items when exiting a museum. Knowing these factors allows policy makers to predict where crime will occur and prevent it by making the environment in which it takes place less attractive and rewarding for offenders (Clarke, 2008a). SCP solutions to prevent crime fall under 25 techniques divided into 5 categories: 1) increasing the effort and 2) the risks to committing the crime, 3) reducing its rewards, 4) reducing the provocations that motivate someone to commit a crime, and 5) removing the excuses for carrying it out (Clarke, 2008a) (see figure 7.1 in chapter 7 for a more detailed description of these techniques).

At the intersection of human-wildlife conflict, retaliatory killings, and poaching: Tolerance for leopard killing

Although widespread, retaliatory leopard killings are not random; they occur where there is an opportunity to do so, at specific locations for specific reasons. Rational choice theory suggests that farmer’s decision to kill a leopard in retaliation for livestock losses will be influenced by several factors. These factors are the “situational determinants” of the retaliatory leopard killing. In this case, they can be both human (i.e. cultural) and environmental (see table

4.2 for examples of each). These situational factors help understand where and why leopard killings are most likely to occur.

Table 4.2. List of the major situational factors linked to retaliatory leopard killings

Human determinants	**Environmental determinants**
Expectations from wildlife	Land-use overlap
Sensitivity to environmental issues	Leopard abundance
Local history (colonialism, pastoralism)	Poor leopard habitat
Relationship between local actors	

Human-leopard interactions are part of a process that involves H-WC and outcomes like retaliatory leopard killings and leopard poaching. At each end of this process is the concept of guardianship (see figure 4.1 below). H-WC is the result of a number of situational factors discussed in the previous chapters, with habitat loss/fragmentation and increased competition for resources because of population growth at the forefront. Other ecological characteristics of leopards and human behaviors contribute to H-WC as well (see section titled "Factors that contribute to H-WC and retaliatory leopard killings" in chapter 2). A lack of guardianship, mainly in the form of maladapted husbandry practices and a lack of predation prevention methods, often results in H-WC like leopard predation on livestock or attacks on humans.

The possible responses to H-WC are three-fold: 1) retaliatory leopard killings, 2) leopard poaching, and 3) a concerted effort to use and improve husbandry and predation prevention methods. The latter is about increasing guardianship of livestock and/or humans through target hardening. The choice of response is based on local residents' tolerance for leopard killing. In locations where H-WC has incited anti-conservation feelings, leopard poaching may be common because there is no willpower or collective efficacy to prevent illegal leopard killings (lack of guardianship) (Hill, 2004; St. John et al., 2012). Local residents may not actively hunt leopards, but they also have no interest in protecting wildlife that attacks their livestock and neighbors. In places where H-WC has resulted in an active hunting culture, retaliatory leopard killings are more likely because local residents will take matters into their own hands and kill leopards in retaliation for livestock losses and/or human attacks (Hill, 2004; St. John et al., 2012). In some locations, though, H-WC will not result in illegal leopard killings of any kind. Rather, local residents will strive to increase guardianship of livestock and humans. This is the case, for example, in Java, Indonesia, where rural communities often suffer from H-WC but rarely resort to or allow illegal leopard killings (Government wildlife official 4, personal communication, November 26, 2013).

Figure 4.1. The human-leopard interaction process and the link between poaching and retaliatory leopard killings

The link between places where leopard poaching and retaliatory leopard killings occur is a tolerance for leopard killing (see figure 4.1). This research uses opportunity theories, like rational choice theory, to explain what situational factors create this tolerance. It is about determining why H-WC does not always result in a tolerance for leopard killing and, ultimately, in illegal leopard killings. The situational factors can be the local human context or environmental characteristics (including a lack of guardianship). They occur at multiple parts of the human-leopard interaction process, either by increasing the likelihood of H-WC (H-LC situational factors) or by encouraging tolerance for leopard killing after a H-WC conflict occurs and the victims have a choice of responses (retaliatory killing situational factors).

The 25 techniques of SCP are helpful in designing interventions to mitigate the H-LC and retaliatory killing situational factors and come up with additional guardianship solutions in places where there is tolerance for leopard killing. This research will use SCP for both these purposes and to ultimately disrupt tolerance for leopard killing. Most governments and conservation organizations currently focus on preventing poaching (TRAFFIC, 2013), yet H-WC, with its possible consequence of tolerance for leopard killing, is one of the main obstacles to getting local populations to support anti-poaching and conservation efforts (Graham et al., 2005; Gupta Kashyap, 2012, March 6). This research's use of SCP to address tolerance for leopard killing is more valuable for conservation than simply devising poaching or retaliatory killing interventions, because it targets the root cause of several types of illegal leopard killing.

Reducing tolerance for leopard killing creates opportunities to build informal guardianship to combat both poaching and retaliatory killings. Informal guardians are non-law enforcement personnel who can deter crime. According to routine activity theory, crime can only occur if a capable guardian is absent and a suitable target and a likely offender meet (Cohen & Felson, 1979). The more guardianship is available the less crime takes place (Reynald, 2009). The concept of informal guardianship suggests that, where law enforcement resources are limited and cannot be applied everywhere, it is possible to harness the goodwill of the local population to fight illegal leopard killings. Local residents' presence as informal guardians increases the effort and risks required for illegal killings, deterring offenders (Gettleman, 2012b).

Informal guardians according to Reynald (2010)

Reynald (2010) established three conditions for someone to be a strong informal guardian: 1) availability, 2) knowledge of context, and 3) willingness to intervene. Availability means guardians must be present in a location to guard it (Cohen & Felson, 1979). The presence of a guardian is sometimes sufficient to deter an offender. Furthermore, they must be willing to monitor local activity for illegal behavior (Reynald, 2009, 2010). By doing so, they enhance their capability as guardians by building their knowledge of context. Knowledge of context is important because a person's ability to act as a guardian depends on whether they can identify who is and is not a threat (Reynald, 2010). This requires knowing a neighborhood well enough to see who or what is out of place. A person's ability to recognize this is enhanced if they have a strong community network because community members tell each other what suspicious activity to look for (Reynald, 2010).

A key characteristic for a strong informal guardian is the willingness to act if they see a crime occur. The action can be direct, i.e. physically confronting the offender, or indirect, i.e.

calling the police (Reynald, 2010). The average guardian is willing to intervene as long as their personal safety is insured, but most prefer taking indirect action.

A guardian's willingness to intervene and choice of intervention hinges on four factors (Reynald, 2010). The first is the guardian's sense of responsibility toward the target. Guardians are more willing to protect targets that are theirs or with which they are intimately connected. The second is the guardian's physical competence to intervene. The more physically competent a guardian feels the more likely he or she is to intervene and do so directly. The same applies to the third factor, the availability of tools for the guardian's protection. Finally, the more severe the incident observed, the less likely the guardian is to intervene and the less direct the intervention.

Informal guardians are physically present and have knowledge of the context at most locations where H-LC and retaliatory leopard killings occur, but the willingness to intervene is generally missing. That willingness is often missing because of ill feelings toward wildlife or conservation efforts. Most local residents do not feel any sense of ownership towards wildlife in their community; they believe it belongs to the government. Laws that tell them they cannot kill these animals without a license reinforce this belief. Furthermore, H-WCs, especially with carnivores, create an environment were local people are angry at the cost wildlife imposes on them. They would rather see these animals killed than conserved so they cannot attack their livestock. They therefore have no incentive to stop anyone from killing wildlife in their communities: they tolerate leopard killing. Understanding the situational factors of H-LC and retaliatory leopard killings helps define this tolerance for leopard killing whereby informal guardians are unwilling to intervene and protect leopards. SCP then offers a framework to reverse tolerance for leopard killing and increase informal guardianship.

Chapter summary

Criminologists have used rational choice theory, choice-structuring properties, and SCP to understand why poachers target particular parrot species and fish illegally in certain locations. Few studies, though, have focused on H-WC as a facilitator of retaliatory killings and poaching. What links both retaliatory leopard killings and leopard poaching is a tolerance for illegal leopard killing. This tolerance for illegal leopard killing creates an absence of informal guardians to protect leopards. To reverse this tolerance, one first needs to identify its situational factors, both human and environmental. These factors occur at multiple parts of the human-leopard interaction process either by increasing the likelihood of H-LC (H-LC situational factors) or by encouraging tolerance for leopard killing after a H-LC conflict occurs and the victims have a choice of responses (retaliatory killing situational factors). This research focuses on understanding these factors and their relative importance in an individual's decision to kill a leopard in retaliation for livestock or human attacks. It then uses the SCP framework to design solutions that reverse tolerance for leopard killing and increase informal guardianship.

Chapter 5: Research design and methodology

This research identifies the situational factors that contribute to H-LC and retaliatory leopard killings and where they occur. It also defines what fosters tolerance for leopard killing by exploring the relative importance of these situational factors in an individual's decision to kill a leopard. The study begins with a broad analysis of illegal leopard killings in three study areas: the Amboseli and Tsavo West National Parks area in Kenya, the Heidelberg region in the Western Cape Province of South Africa, and India. This analysis focuses on identifying what the scope and nature of illegal leopard killings within the study areas is. It also explores what forms H-WC driven retaliatory leopard killings take in those locations.

Interview data from Kenya and South Africa and media articles from India are used to learn about the human situational factors of H-LC and retaliatory killings. The next step of the analysis maps the locations of retaliatory leopard killings in the Heidelberg, Baviaanskloof, and Greater Addo Elephant National Park regions of South Africa to better understand their environmental situational factors. The focus here is on what geospatial factors contribute to retaliatory leopard killings.

Overview of the analyses

This research is divided into 4 separate analyses based on country and whether the analysis focuses on the human versus environmental situational factors of retaliatory leopard killings. Table 5.1 gives a brief description of each analysis and the data it uses.

Table 5.1. Characteristics of the 4 different analyses in this study

Analysis	**1**	**2**	**3**	**4**
Data	Kenyan interviews	South African interviews	Google Alert articles	H-LC GPS locations
Analysis	Descriptive statistics, regression	Content analysis	Content analysis	GIS mapping, non-parametric tests
Location	Amboseli National Park	Heidelberg	India	Heidelberg, Baviaanskloof, Greater Addo Elephant NP
Date	2006	2011	2013	2005-2011
# of cases	234 people	16 interviews	68 articles	13 GPS points

The reason for 4 analyses is the scarcity of illegal leopard killing data. This lack of illegal killing data is one of the main problems facing wildlife crime researchers today (Clyne, 2014). Few published studies have come up with reliable counts of illegal leopard killings (see table A2 in the Appendix for a list of existing studies) and those that have do so in two ways: law enforcement seizure data or GPS collar and carcass recovery data. Law enforcement seizure data is often publicly available (TRAFFIC, 2011), while GPS collar and carcass recovery data is usually not in the public domain. Publicly available data does not capture cases of retaliatory killings where the animal's carcass is destroyed or left to decompose in the wild to avoid retribution. GPS collar and carcass recovery data can sometimes capture this information, if the researchers are collaring the entire leopard population in an area. In such a case, a missing leopard would not go unnoticed, especially if the researchers have local informants who tell them of rumored leopard killings.

This research uses 4 different approaches and data sources to study the situational factors of H-LC and retaliatory leopard killings. The number of cases for parts 2 and 4 of this study are small, making it hard to generalize from their results. However, using multiple data sources and analytical methods allows for replication of these results, while using data from 3 different countries has the added benefit of allowing a cross-country comparison of retaliatory leopard killings.

1. Analysis part 1: Kenyan interviews

The data for part 1 of this research were gathered in April and May 2006 during a field research project with the School for Field Studies in Kimana, Kenya.[41] The project explored how communities in the Tsavo-Amboseli ecosystem benefited from local wildlife. It also examined how wildlife was imposing a cost to local farmers and how it affected their attitude towards current wildlife conservation efforts. The study area was the Loitokitok Division of Kenya's Kajiado District, in the area between Amboseli and Tsavo West National Parks, with a focus on the Kimana, Kuku, and Mbirikani group ranches and the Entonet area (see figure 5.1) (Viollaz, 2006).

The history of this area provides insight into how H-WC develops into an acute problem. The 6 group ranches in the Tsavo-Amboseli ecosystem[42] are essential dispersal areas for the wildlife found inside the two parks and, as such, are ideal locations for ecotourism ventures and community conservation initiatives (Hurt, 1999). Currently, the majority of the revenue from ecotourism comes from the two national parks and is directly appropriated by the Kenyan

[41] The project was titled "An assessment of local communities' perceptions on and expectations of conservation initiatives in select group ranches and privately owned land in the Amboseli ecosystem" (Viollaz, 2006). Eight other college students were involved in this project along with School for Field Studies instructor Salaton Tome.
[42] The Kuku, Kimana, Mbirikani, Rombo, Olgulului, and Eseleikei group ranches.

government. Amboseli National Park alone generates about $3.4 million U.S. dollars each year from tourism, but only two percent of this money reaches local communities (Lange, 2006). The region faces an overall lack of government support and also suffers from inadequate health care and educational facilities.

Meanwhile, human densities and settlements within the six group ranches are increasing because of population growth and an increase in the migration of agriculturalists to the area, putting pressure on existing resources and causing shortages in both food and water (Berger, 1993; Makonjio Okello, 2005; Makonjio Okello, Buthmann, Mapinu, & Kahi, 2011). The most prominent land-uses in the Loitokitok division, pastoralism and small-scale agriculture, are also add odds with each other for resource consumption, adding to this pressure (Ministry of Planning and National Development & Republic of Kenya, 2001). Agriculture reduces the amount of habitat available for wildlife and grazing livestock. Group ranch subdivision into individual land plots for cultivation also prevents the open grazing necessary for pastoralism (Makonjio Okello et al., 2011; Poole, 2006). Since local agricultural yield is limited by seasonal changes in rainfall, agriculturalists artificially irrigate their crops and take scarce water from livestock and wildlife.

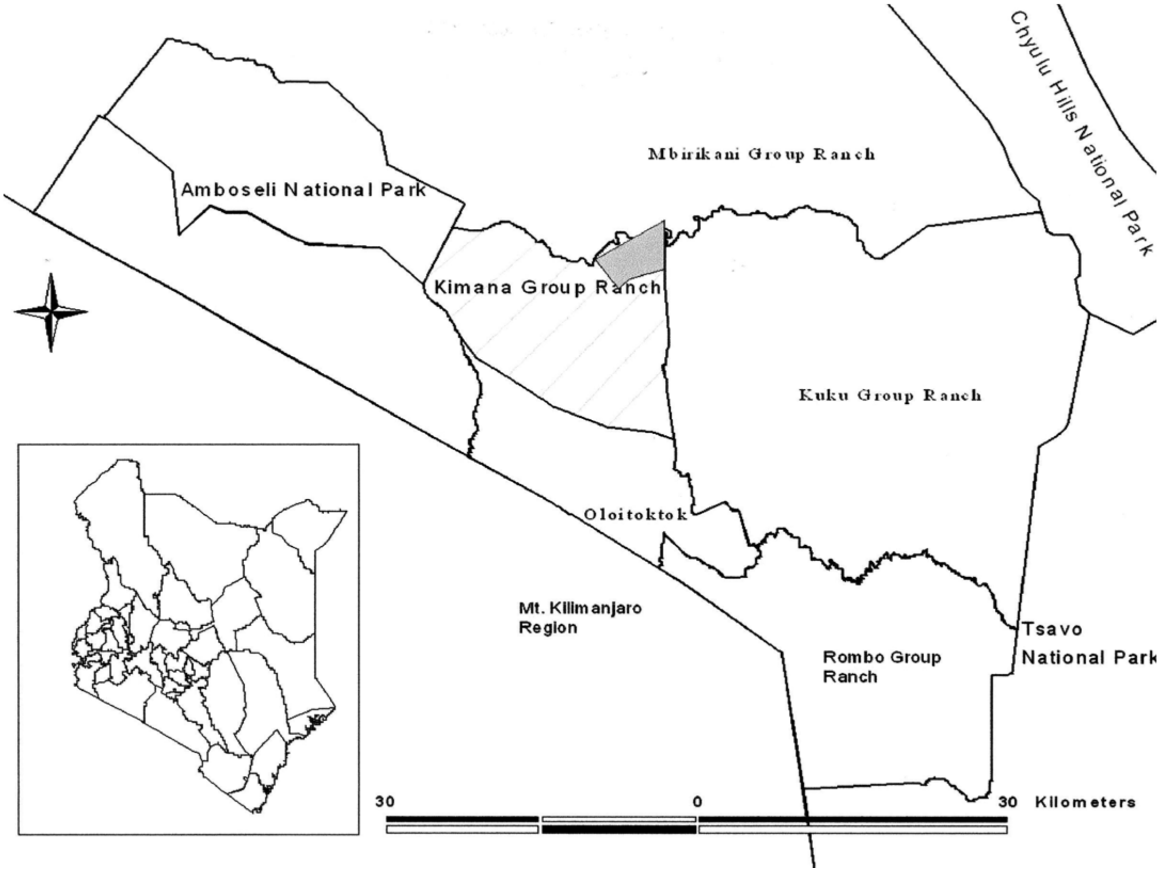


Figure 5.1. Map of the Tsavo-Amboseli ecosystem showing the group ranch locations (Makonjio Okello, 2005)

This constant competition for scarce resources pits pastoralists, agriculturalists, and wildlife against each other, as does the lack of government support. It creates H-WC and exacerbates existing conflicts. As such, the Tsavo-Amboseli ecosystem is a place with the potential for local residents to tolerate leopard killing as a release from resource competition and a solution to H-LC. Understanding the challenges local farmers face and why they do or do not support conservation efforts can help characterize what contributes to tolerance for leopard killing.

Four hypotheses drive both this analysis and parts 2 and 3 of this research.

H1: Individuals who have livestock are vulnerable to H-WC.

H2: Individuals who experience H-WC and its costs are less likely to support conservation.

H3: Support for conservation is low in areas where distrust among actors is high and government oversight is poor.

H4: If an individual has previous exposure to conservation initiatives, he is more likely to support conservation.

The School for Field Studies data consists of 234 interviews of Tsavo-Amboseli ecosystem residents (Viollaz, 2006). Residents were selected based on a cluster sampling method to increase the representativeness of the sample. Those interviewed lived in four clusters: two cluster near and two clusters far from conservation initiatives. The interviewers went door-to-door to interview participants and used semi-structured questionnaires with open-ended questions to allow some flexibility in questioning them. Translators were used to reduce any potential error in recording responses as well as to put the interviewees at ease. Translators also vouched for the researchers so interviewees would be honest about their problems with wildlife.[43]

The participants were asked about themselves, including age, sex, tribe, and membership status in the group ranch in which they lived. They were also asked a series of questions grouped around three topics:

1) H-WC;

[43] Although the reliability of interviewee responses is always a concern in qualitative research, the circumstances surrounding this project suggest that most responses here are accurate. The School for Field Studies has a long history of fieldwork in the study area and has developed strong ties with the local community. They provide jobs for local people at their facilities and the influx of students they bring is a major source of revenue for local shop owners and farmers. They also work with local communities to find solutions to H-WC and discuss local farmers' problems with the KWS on their behalf.

2) Relationship to wildlife;
3) Beliefs about conservation.

These questions included whether they benefited from local wildlife conservation efforts and what the nature of those benefits was, what impacts wildlife conservation had on them, and what their attitudes and perceptions were on the subject (see figure A1 in the Appendix for the full questionnaire).

Analytical strategy

The responses from the 234 interviewees were formatted into an SPSS database and used to run descriptive statistics on the following variables: sex, age, level of education (no education, primary, secondary +), livelihood strategy (agriculture, pastoralism, agro-pastoralism, other), job satisfaction, and economic status (low, medium, high). Job satisfaction was determined by asking residents to rate the appropriateness of their primary livelihood strategy as not sufficient, sufficient or highly sufficient.

The first set of analyses in part 1 creates an overview of the H-WC situation in the Tsavo-Amboseli ecosystem based on responses to the following questions:

1) In your opinion, what has been the biggest challenge to wildlife conservation in this region?
2) How do you benefit from the presence of wildlife in the area?
3) How is wildlife beneficial to others?
4) How is wildlife imposing a cost on you?

5) How is there a public/communal cost to wildlife?

6) If not for economic benefits/incentives, would you still support wildlife conservation?

7) Do you have any suggestions as to how the negative impacts [of H-WC] can be reduced?

A logistic regression was then used to determine what variables influenced respondents' attitude towards wildlife conservation-based income generating activities. The dependent variable was a respondent's attitude towards wildlife conservation-based income generating activities[44], coded as either "positive" or "negative" (N = 226)[45]. 233 out of 234 interviewees responded to the question. Six independent variables were included in the model (see table 5.2 for a list of these variables and how they are measured).

[44] Note that most, if not all, the conservation initiatives in the study area generate income.
[45] 233 interviewees originally responded to this question, but 7 respondents stated they were ambivalent about wildlife conservation-based income generating activities. Their answers were excluded from the analysis, resulting in a final sample size of 226.

Table 5.2. List of independent variables for part 1 of this analysis

Variable name	**Question asked**	**Coding**	**N**
Wildlife cost	Is wildlife imposing a cost to you?	0 = No 1 = Yes	234
Wildlife benefit	Do you benefit in any way from the presence of wildlife in the area?	0 = No 1 = Yes	234
Economic status	How do you rate your economic status?	0 = Low 1= Medium 2 = High	234
Education	What is your level of education?	1 = No education 2 = Primary 3 = Secondary +	233
Exposure to conservation	Generally, have you been exposed to issues touching on wildlife conservation?	0 = No 1 = Yes	233
Mismanagement	Is KWS mismanaging Amboseli National Park?	0 = Don't know 1 = Yes 2 = No	233

Wildlife cost quantifies the amount of H-WC a farmer has experienced. Economic status indicates how much of a financial toll H-WC has taken on his/her life. Wildlife benefit is included because some farmers are willing to endure H-WC if they receive financial benefits from wildlife. These benefits include compensation for lost livestock or crops, employment, or bursaries for their children's education.

Amboseli National Park is one of the main profit-generating conservation initiatives in the study area and is run by the KWS, a federal agency. Mismanagement examines local farmers' beliefs about how well KWS runs this park and captures the level of trust between them and government personnel.

A respondents' level of education suggests how much formal training they have in biology and environmental science. This form of training can have a positive effect in cases of

H-WC because a farmer can, for example, understand the biological reasons why a leopard would attack his livestock and recognize the behavior is natural instead of believing that predation is a personal affront and requires retaliation. Exposure to conservation measures what farmers may have learned from simply living near conservation efforts, which can sometimes replace school learning.

2. Analysis part 2: South African interviews

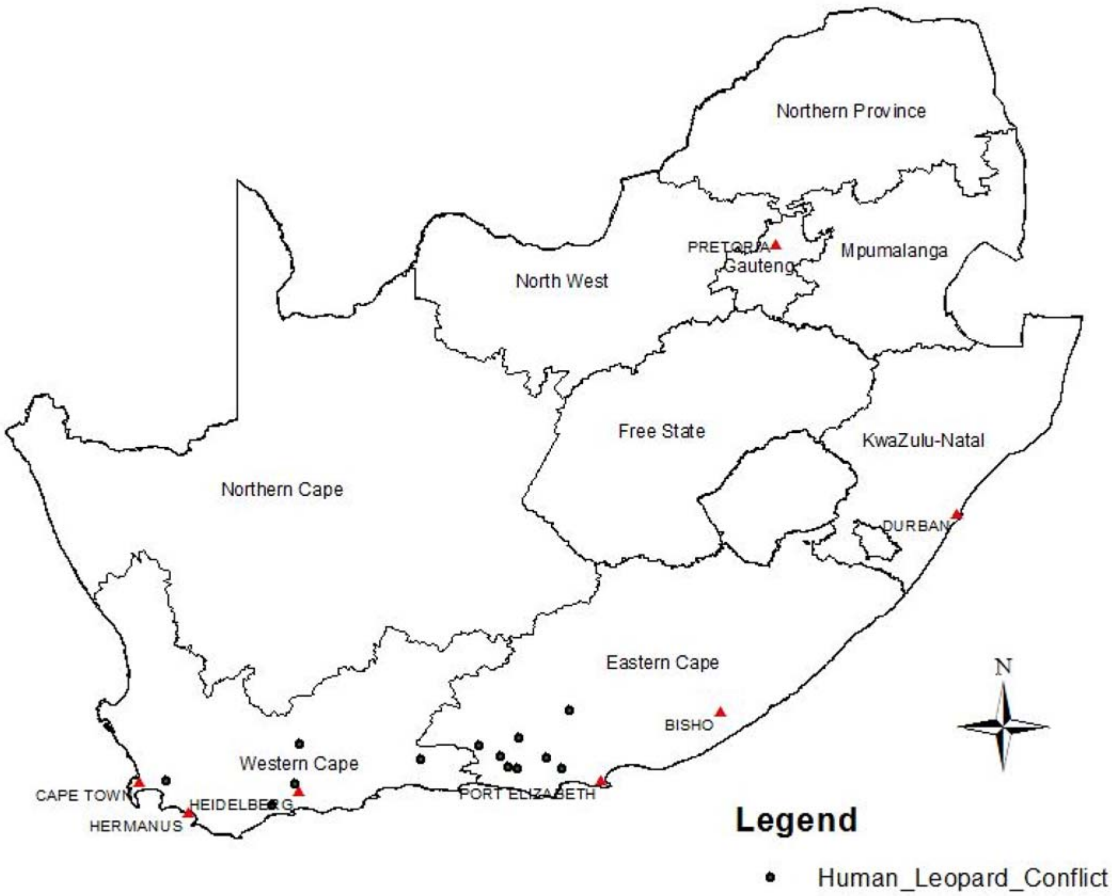
Part 2 of this research uses data from 16 interviews collected in 2011 in the Western Cape Province of South Africa. The Landmark Foundation, an NPO focused on leopard conservation, was managing the reserve at the time and provided the names of local farmers and conservationists to interview. The goal of these interviews was to understand why leopards were illegally killed in the area and to obtain contextual information to determine if the H-LC situation in the Western Cape Province was similar to that of the Tsavo-Amboseli ecosystem. A total of 7 farmers, 3 conservation NPO workers, and 6 government officials were interviewed.

15 out of the 16 interviews were conducted in proximity to Wildcliff Nature Reserve (GPS coordinates: -33.96010, 21.03500). The 16th interview was conducted at a private nature reserve near Hermanus in the Western Cape Province, located about two and a half hours east of the reserve, but with a similar fynbos habitat.

Wildcliff Nature Reserve is 955 hectares of preserved land adjacent to the Boosmanbos Wilderness Area in the Langeberg Mountains and is located about 20 minutes from Heidelberg town center. Most of the land surrounding it is divided into meat and dairy livestock farms with some crop farming, while the remainder of the land is devoted to game farms. Most landowners are white and speak English, while farm hands tend to be black and speak Afrikaans, despite a recent government initiative to give farmland to black South Africans for cultivation. The roads outside of Heidelberg town center are dirt with slabs of concrete acting as river bridges, so flooding is a significant problem during the rainy season.

The area surrounding the reserve is rife with H-LC and lacks government oversight, but unlike in Kenya, tourism is not a major source of revenue. Local farmers feel that the government provides little financial support. Reports of retaliatory leopard killings are plentiful and, as such, it is an ideal location for tolerance of leopard killing (McManus, 2009).

Figure 5.2. Map of the South African Provinces, cities relevant to this research, and locations of H-LCs



Individuals recommended by The Landmark Foundation were contacted by phone and asked if they would be willing to talk about "leopard poaching" in the region; all agreed. The semi-structured interviews lasted 1-2 hours[46]. Although a list of interview questions was drawn up prior to the interviews, the flow of conversation determined the topics covered with occasional prompts based on the questions (see figure A2 in the Appendix for the list of pre-prepared interview questions).

[46] No notes were taken during interviews to put respondents at ease. Conversations were typed up from memory immediately following the interview.

The Landmark Foundation recommended a combination of farmers applying leopard-friendly livestock farming techniques and farmers opposed to their conservation work. Even those farmers angry with The Landmark Foundation were eager to share their point of view and many went to great length to describe the challenges they faced from leopards[47]. Conservationists came from The Landmark Foundation, a local private wildlife reserve, and the Western Cape Province government wildlife service, Cape Nature. Emphasis was placed on the fact that the research was not affiliated with any local actor, that respondents' identities would be kept confidential, and that it was meant to be a fact-finding mission to benefit from respondents' insider knowledge of the situation.

At the end of each interview, participants were asked if they could recommend other people to talk to. This method of snowball sampling was essential in this tight-knit rural community. Being vouched for by a community member allowed local farmers to open up about leopard problems in the area. Ongoing tensions between farmers and The Landmark Foundation over efforts to conserve leopards and prevent retaliatory killings may have biased the responses given during the interviews, but the varying opinions and sensitive information shared by the participants suggest otherwise. Farmers were not shy in admitting they knew who had killed leopards in the community and sharing names. They also openly criticized The Landmark Foundation and their methods while, at the same time, working with them.

Government workers were also contacted via email and, when possible, in person, asking if they knew of leopard poaching cases in their area and had data on them. These email

[47] In one such case, a farmer took this researcher on his cattle rounds to show her his daily routine.

exchanges, from April to September 2011, were also added to the interview data to represent the government's perspective (see table 5.3 for government interviewees).

Table 5.3. South African government employees interviewed either in person or via email

Title	**Organization**
Conservation Services Manager	Cape Nature, Riversdale, Western Cape Province
Ecological Coordinator for the Langeberg area	Cape Nature, Western Cape Province
Program Manager, Biodiversity Crime Unit	Cape Nature, Stellenbosch, Western Cape Province
Official for H-WC	Cape Nature, Western Cape Province
Environmental management inspector & acting deputy director	Department of Economic Development, Tourism, and Environmental Affairs, Free State Province
Head, Professional Hunting Division, Wildlife Protection Services	Tourism and Parks Agency, Mpumalanga Province

Analytical strategy

A content analysis was conducted of the interview data. A series of codes were generated inductively to determine what major themes respondents discussed and what attitudes they held. An inductive method made it possible to look at the data without any preconceptions and allow novel concepts to emerge (Lewins & Silver, 2007). Open coding generated both descriptive and conceptual codes by reviewing small segments of the interviews and comparing them to each other (Lewins & Silver, 2007). These codes were then refined using axial coding where "code labels and the data linked to them are rethought in terms of similarity and difference” and only the codes that best illustrated concepts and relationships found in the data were kept (Lewins & Silver, 2007, p. 84).

Table 5.4 describes the different codes and how they were conceptualized and operationalized. The codes are separated into 5 broad categories based on the information they provide (distrust, ecological beliefs, H-LCs, illegal killings, and solutions).

Table 5.4. List of codes for content analysis of South African interviews

Code Name	**Applied when…**	**Reason for code**
Distrust		
Anger	Respondents express anger at leopards, the current state of predation, the current conservation situation, or actors involved in the area.	Shows the general state of mind and tension existing among local actors.
Fear	Quotations suggesting that local actors live in fear as a result of H-WC.	Shows how H-LC is affecting local actors' mindset and way of life.
Distrust	Quotations suggesting that third parties or even farmers themselves do not trust other farmers when it comes to leopard conservation/illegal killings. Quotes suggesting that members of the public do not trust the government and its personnel when it comes to leopard conservation/illegal killings. Quotes suggesting that third parties do not trust NPO personnel when it comes to leopard conservation/illegal killings.	Lack of trust is a major obstacle to the implementation of solutions. If it exists, it must be addressed first.
Corruption	Any reference to corruption as a factor in how leopard livestock predation and illegal leopard killings are investigated or dealt with in the area. Quote must include the word "corruption."	Perceived corruption can affect whether or not suggested H-WC solutions are embraced and gain legitimacy.
Failure of government response	Comments suggesting the government's current handling of H-LCs and illegal leopard killings is not working.	A belief that government actions are not working can breed distrust, which can then stop actors from implementing solutions.
Ecological beliefs		
Rational for predator intolerance	Quotes that give reasons why a person dislikes leopards. These include things such as "leopards have criminal intent" or "leopards kill more than they can eat; that is unnecessary and wasteful."	For solutions to H-WC to garner widespread support, people must accept that they are not 100% effective. This requires mitigating predator intolerance so people are willing to accept some level of conflict with them. Mitigating intolerance requires understanding why it occurs.
Livestock loss expectation	Quotes describing farmers' beliefs about acceptable losses of livestock. Quote must include the words "livestock loss" or any of its derivatives (i.e. "lost livestock").	If farmers believe any livestock loss to leopards is unacceptable, part of the solution must be to change that belief. Livestock losses are inevitable and any solutions offered can only limit losses.

Natural prey availability	Quotes describing farmers' beliefs about how much natural prey is available in the area for leopards to eat. Quote must include the words "prey" and "available" or any of their derivatives.	Farmers often argue that leopards should not be attacking livestock because there is enough wild prey to eat. If this mindset is prevalent, it can stop farmers from accepting losses. This would need to be addressed before offering solutions.
Unsustainable land use	Quotes describing unsustainable land uses or practices in the area.	Damaging the environment through unsustainable use is a major contributing factor for H-WC. If such practices exist, they must be rooted out for H-WC solutions to be effective.
H-LC		
Human-wildlife conflict: Cost	Examples of how H-WC imposes a cost on humans. Apply if quote discusses any interaction between humans and wildlife that is unwanted and imposes costs on either.	Knowing how wildlife imposes a cost is necessary to come up with ways of stopping or reversing these costs.
Predation prevention beliefs	Quotes explaining what methods biologists, NPOs, government officials, farmers, and the general public believe should be used to prevent leopard livestock predation.	Compare if different actors have the same beliefs about what predation prevention methods work.
Why & when predation	Quotes describing why and when biologists, NPOs, government officials, farmers, and the general public believe leopards eat livestock.	Compare if different actors have the same beliefs about why and when predation occurs.
Illegal killings		
Rational for leopard killing	Justifications individuals provide for why they believe it is acceptable to shoot a leopard.	Understanding their rational for killings can help determine how to remove excuses for their behavior.
Poaching network	Quotes suggesting that offenders had help or belonged to an organized group.	Understand if the threat to leopards is organized or opportunistic.
Leopard killing method[48]	Quotations describing how leopards are killed in the area.	Help identify the major threats to leopards (gin traps, poison, hunting dogs, etc.).
Why & when killed	Quotes describing why and when biologists, NPOs, government officials, farmers, and the general public believe leopard poaching and retaliatory killings take place.	Compare if different actors have the same beliefs about why and when it takes place.
Solutions		
Judicial outcome	Description of judicial outcomes for prosecutions of leopard killings/poaching.	Determine if illegal killing cases are being prosecuted successfully.

[48] All interviews were also coded on whether or not respondents believed leopards were being illegally killed in the region.

Solutions: Suggested & attempted	Description of any suggested or attempted solutions to prevent leopard livestock predation and illegal leopard killings.	Compile a list of all solutions to determine what exists.
Solutions: Why working	Quotes that explain or suggest why certain solutions to poaching and retaliatory killings are working. These quotes come from the organizations deploying these solutions or the people they are intended for.	Knowing why certain solutions are working can help in designing new more effective solutions.

3. Analysis part 3: Indian media articles

The data for part 3 of this research comes from a non-traditional data source, Google Alerts. Google Alerts is a notification system that sends users an email anytime the Google search engine finds new results for a set of keywords (Google, 2014). The search engine includes results from Google Web Search, Google Blog Search, and Google News. This analysis used Google Alerts results to create a database of articles on illegal leopard killings in India to better understand the human situational factors that motivated these killings.

India has a history of H-LC and tolerance for illegal leopard killings, but its retaliatory leopard killings have a slightly different modus operandi. Most Indian retaliatory killings are in response to leopard predation on humans instead of livestock. Leopard attacks on humans and cattle date back to India's days as a British colony. Statistics from the British government from 1875-1912 suggest a fluctuating pattern of H-LC conflict as population size grew and industrialization took hold (see figures 5.3 and 5.4), a pattern that continues today and on which the local news media commonly report (see figure 5.5) (Athreya & Belsare, 2007; University of Chicago, 2013).

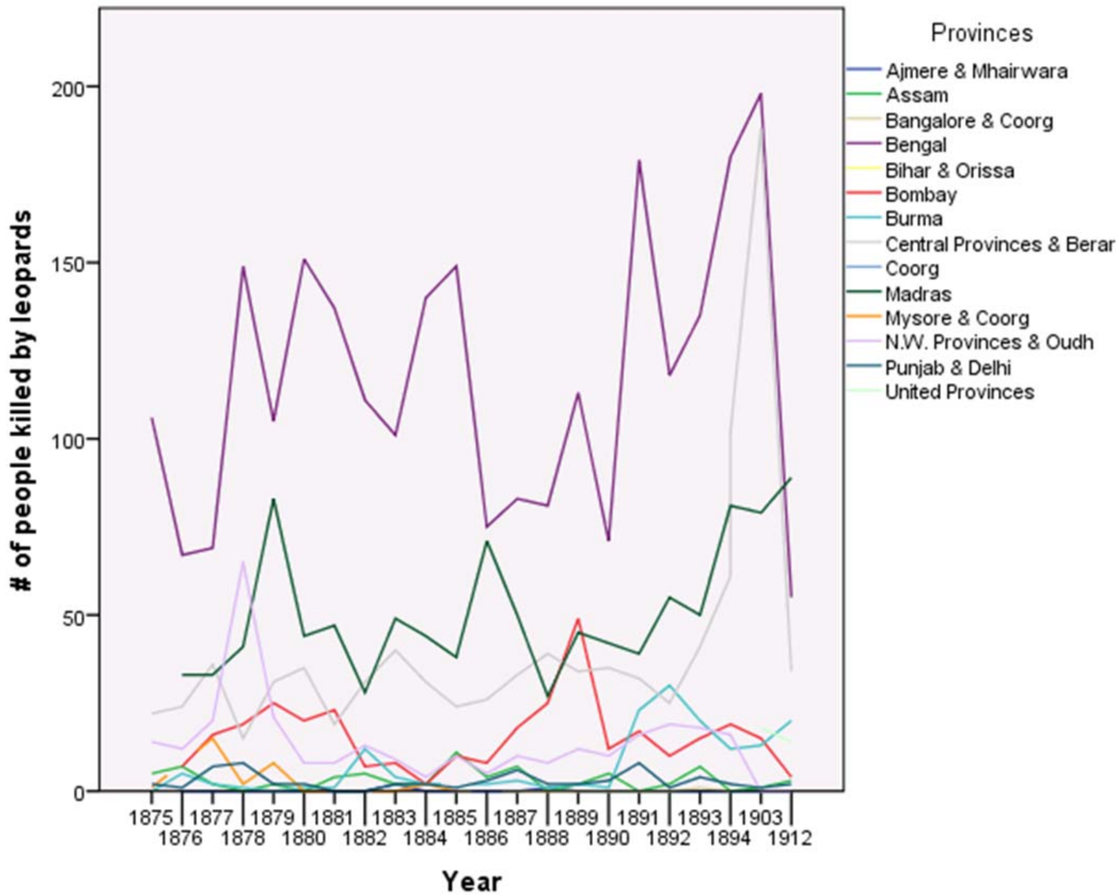


Figure 5.3. Number of people killed by leopards in India from 1875 to 1912 based on year and province (Adapted from University of Chicago (2013))

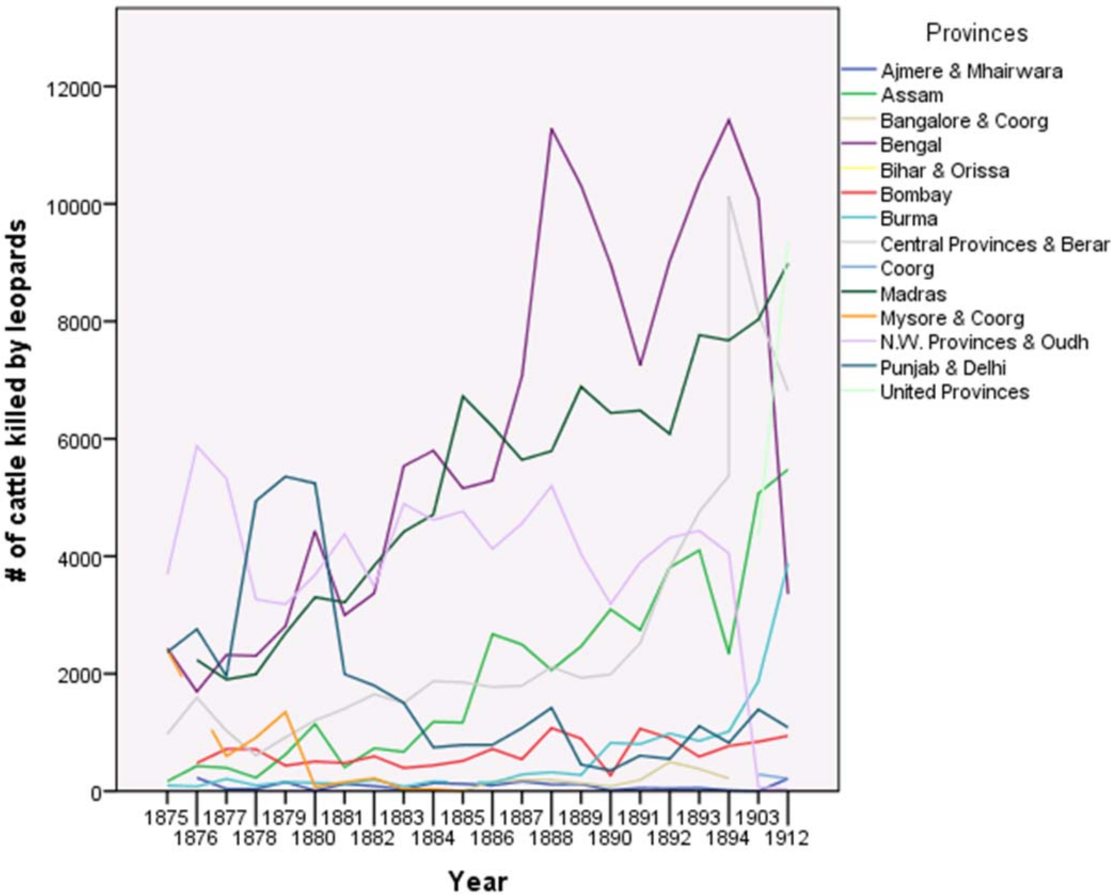


Figure 5.4. Number of cattle killed by leopards in India from 1875 to 1912 based on year and province (Adapted from University of Chicago (2013))

Table 5.5. Number of people attacked by leopards from 1990 to 2005 in some Indian states (Adapted from Athreya and Belsare (2007))

Indian state	**Conflict location**	**Type of habitat**	**# of people attacked**	**Date**
Maharashtra	Junnar Forest Division	Sugarcane fields	51[49]	2001-2003
	Sanjay Gandhi National Park	In and around protected area	97[50]	2002-2004
	Ahmednagar Forest Division	Sugarcane fields	106[51]	1997-2005
West Bengal	West & East Duars	Tea gardens	121[52]	1990-1997
Gujarat	Outside Gir National Park	Sugarcane fields and mango orchards	27[53]	1990-1999
	Vadodara Forest Circle	Tall crops	850[54]	1992-2002
Uttarakhand	Garhwal	Near villages	352[55]	1991-2003

Analytical strategy

The database articles were collected using two Google Alerts for the keywords “leopard killing” and “leopard poaching”. No quotation marks were included so that any web content with the words either separately or together would be included in the results. All results had to be in English, but were not limited by region[56]. A trademarked Google algorithm called PageRank filtered the results by assigning a score to the web page based on the following factors (Strickland, 2014):

[49] Athreya, Thakur, Chaudhuri, and Belsare (2004)
[50] Maharashtra Forest Department records.
[51] Maharashtra Forest Department records.
[52] WWF-India (1997) and Field Director, Buxa Tiger Reserve, personal communication.
[53] Vijayan and Pati (2002); Pati, Hirapara, Solanki, and Vijayan (2004).
[54] Chaudhuri (2004).
[55] Uttarakhand Forest Department records.
[56] Google Alerts in French were created on 04/03/14 for similar key words but produced no results between 04/03/14 and 07/10/14.

1) the frequency and location of key words within the page;
2) how long the web page has existed;
3) the number of other web pages linked to this one.

Older pages with higher frequencies of key words and more links to the page therefore obtain higher scores. This filtering and the Google Alerts default setting “only the best results” produced only high quality results most relevant to the keywords (Google, 2014).

The alerts found 267 pertinent articles from May 28th, 2012 to July 10th, 2014. These articles met two inclusion criteria:

1) The article discussed leopard poaching or leopard killing either in general terms or cited a specific event.
2) The main subject of the article did not have to be leopard poaching or killing, as long as it referenced either.

Of the 267 articles, only those describing events in India during the 2012 calendar year were included in the final sample, a total of 68 cases. A content analysis of these 68 articles was performed using the same codes as part 2 of this research. The reason for limiting the number of cases was two-fold. First, a preliminary analysis of the first 90 of the original 267 articles and found that their content was very similar. A subsequent comparison of the first 30 articles in the sample of 68 and the next 38 articles found no difference in their findings, suggesting that including more cases was unlikely to produce additional information. Second, leopard attacks on humans and livestock vary seasonally based on rainfall, prey availability, and the mating season (Butler, 2000; Graham et al., 2005; National Wildlife Research Center, 2010). A full year of articles was therefore necessary to draw reliable conclusions from the data.

Media data has several limitations worth noting. First, the H-LCs reported online will not be representative of all H-LCs that occur. The media tends to focus on more sensational cases so the sample for this analysis could be biased (Entman & Gross, 2008; Gordon, 2000). This is especially relevant for India where leopard attacks on humans, rather than livestock, are often reported (Raina, 2011; Singh, 2014). Second, the PageRank algorithm may rule out web pages in developing countries, which tend to be relatively new and have fewer links to them (Strickland, 2014). Results might therefore be biased towards western world sources that report on H-LCs in developing countries (for example, the New York Times published an article on Indian leopard attacks on humans on August 5th, 2011 (Raina, 2011)).

After looking at the Google Alerts results, there appears to be little western world source bias, as most of the of the articles come from developing countries in Southeast Asia. The majority of these stories come from India. As for sensational case bias, a review of the scholarly and grey literature on Indian H-LCs suggests that these articles capture the different H-LC scenarios described by Indian researchers and government personnel: leopard attacks on humans and leopard attacks on livestock (Athreya & Belsare, 2007; Athreya et al., 2010; Chauhan, 2011; Marker & Sivamani, 2009). Although leopard attacks on humans do get more column inches than attacks on livestock, both are still reported with enough frequency and diversity of scenarios that sensational case bias is not a major concern.

4. Analysis part 4: GIS analysis of South African illegal leopard deaths

The final part of this research identifies the geospatial factors that contribute to H-LCs and retaliatory leopard killings by mapping the location of killings, creating a database of locations' environmental situational factors, and then running non-parametric tests on the data. A case-control design (CCD) is used to compare locations with retaliatory leopard killings to two types of matched controls without.

The retaliatory leopard killings in this analysis took place near Wildcliff Nature Reserve and the town of Heidelberg (same as part 2, figure 5.2), and around Baviaanskloof conservation area and the Greater Addo Elephant National Park in the Eastern Cape Province of South Africa. The Baviaanskloof and Greater Addo areas are mountainous, but contain all the major South African vegetation biomes[57] except for desert (McManus, 2009). A large part of the land is split into fruit orchards and irrigation-based agriculture or sheep and goat livestock farms, with a small percentage of cattle farms. Numerous reports of leopard predation on livestock and retaliatory leopard killings in the area suggest that tolerance for leopard killing is widespread there (McManus, 2009).

The location of retaliatory leopard killings comes from GPS collar and carcass recovery data from a small-scale NPO, The Landmark Foundation, that focuses on preventing retaliatory leopard killings in rural communities. This information is in the form of a GPS point where a

[57] Biomes are groupings of plants based on dominant species and climatic factors (South African National Biodiversity Institute, 2010).

conflict was reported or a carcass was found or reported to be[58]. Research has shown that counts of observed crimes are not the same as the number of crimes actually occurring (Maxfield & Babbie, 2008). This is true of H-LCs and retaliatory leopard killings. Known cases probably reflect a small percentage of the actual number of incidents that take place every year. Retaliatory leopard killings may be at higher risk of under-reporting because offenders are able to bury or conceal any evidence. The illegality of leopard killing and the stigma and anger surrounding it in certain communities make it difficult to bypass this data problem.

One advantage of the data from The Landmark Foundation is that researchers involved with its work are so embedded in the local community that most cases of illegal leopard killing eventually surface through informants and gossip (Farmer 1, personal communication, August 17, 2011; NPO worker 1, personal communication, July 31, 2011). The Landmark Foundation researchers live in the area where they protect leopards and, as such, are part of the fabric of the community, much like beat cops involved in community policing (Lindberg, 2008; Weisheit, Edward Wells, & Falcone, 1994). As with community policing, non-profits working in rural communities succeed because they gain the trust of local residents by acting as problem solvers rather than punitive enforcement agents (Weisheit et al., 1994). Local residents share information with them on the problems in their area (including leopard poaching) and work with them to find solutions (Lindberg, 2008; Weisheit et al., 1994) (Government wildlife official 2, personal

[58] There are multiple ways to know if a leopard has been illegally killed and where this incident took place: 1) The body of a leopard is discovered showing signs of non-natural death (including poisoning which can be determined at autopsy). 2) A leopard wearing a radio collar disappears and the age of the leopard precludes death from old age and the radio collar is too far from its expiration date to have stopped working.
3) An individual reports that someone has killed a leopard.

communication, August 19, 2011). The Landmark Foundation therefore provides one of the most accurate estimates of H-LC and illegal leopard killing counts available.

Analytical strategy

The dependent variable for this analysis is whether or not a 5.5 km x 4.7 km area has experienced H-LC resulting in a retaliatory leopard killing. The number of cases is 13: 15 cases of retaliatory leopard killings in 13 different locations from November 1st, 2005 to April 1st, 2011 (see table 5.6 for a list of these cases). In table 5.6, there are four cases where a H-LC occurred but no leopard died. These cases are included in the analysis as retaliatory leopard killings because the only reason the leopard lived was that Landmark Foundation employees rescued it from either a gin trap or a farmer willing to shoot it. Had they not intervened, the leopard would have died.

All data were aggregated to a 5.5 km x 4.7 km area to map them and create the database of location characteristics[59]. This area is referred to in the remainder of the text as a "grid cell" (see figure 5.5 for a map grid cell distribution). The grid cell size is 5.4 km x 4.7 km for three reasons:

1) The biggest resolution for the data in the shapefiles is 1 km x 1 km (Arkansas Forest Resources Center & University of Arkansas, n.d.), requiring that the grid cell be at least that size.

[59] The data for this analysis were generally available as GIS shapefiles and, if not, a shapefile was manually created (see the "data sources" section, below, for more information). The shapefiles were projected with the geographic coordinate system GCS_WGS_1984 and the projected coordinate system Africa_Albers_Equal_Area_Conic.

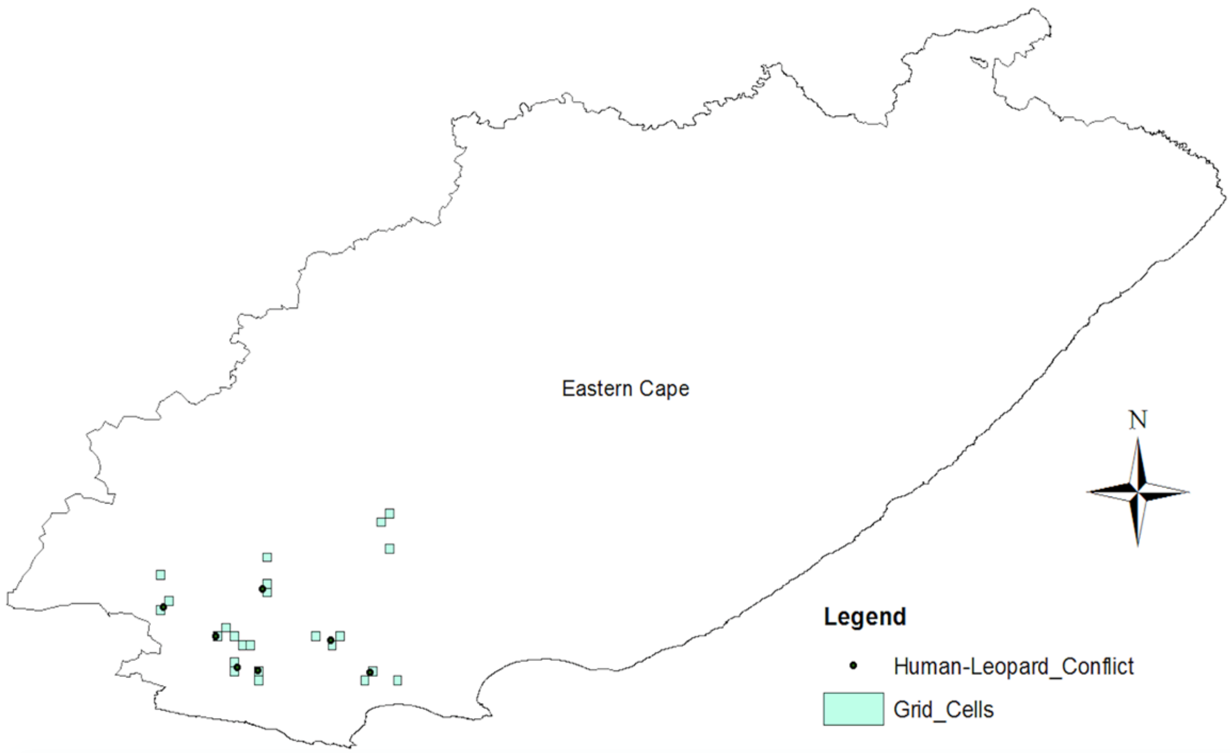
2) The GPS locations for leopard retaliatory killings were accurate, but not always exact. They sometimes corresponded to the location of the farm where the conflict or death occurred. The 5.4 km x 4.7 km size allowed for this amount of error.
3) A 5.4 km x 4.7 km grid cell provided more environmental context when running non-parametric tests.

Table 5.6. List of the H-LCs and retaliatory killing cases used for the dependent variable

Date	Location	Province	Conflict	Outcome	Leopard sex	Leopard age
4/1/11	Ladismith area	Western Cape	Unknown	Died	Male	Adult
3/9/11	Potberg/Dehoop	Western Cape	Caught ostrich on ostrich farm.	Collared	Female	Adult
Early 9/10*	Patensie	Eastern Cape	Shot by farmer on his farm.	Died	Male	Sub-adult
Mid 8/10*	Patensie	Eastern Cape	Shot by farmer on his farm.	Died	Male	Adult
Late 7/10*	Patensie	Eastern Cape	Shot by farmer on his farm.	Died	Male	Adult
6/9/10	Heidelberg	Western Cape	Fell into farm's water reservoir. Farmer wanted to shoot.	Collared	Male	Adult
6/8/10	Winterhoek Mountains	Western Cape	Caught in gin trap.	Died	Male	Sub-adult
10/08	Cockscomb	Eastern Cape	Killed.	Died	Male	Adult
4/13/08	Glenconner Stellenbosch	Western Cape	Caught in gin trap.	Collared	Male	Adult
1/29/08	Baviaanskloof	Eastern Cape	Shot by farmer on his farm.	Died	Male	Adult
11/28/07	Kammanasie	Western Cape	Caught in gin trap.	Died	Male	Adult
6/19/06	Baviaanskloof	Eastern Cape	Caught in gin trap and hunted with dogs.	Died	Male	Adult
4/1/06	Cockscomb	Eastern Cape	Caught in gin trap.	Released	Female	Adult
2/1/06	Baviaanskloof Kouga	Eastern Cape	Hunted with dogs.	Died	Unknown	Juvenile
11/1/05	Baviaanskloof Kouga	Eastern Cape	Hunted with dogs.	Died	Male	Adult

*These three cases occurred at the same geographical location and were therefore treated as one case for the analysis.

Figure 5.5. Examples of grid cells in the Eastern Cape Province of South Africa



To determine what environmental situational factors contribute to retaliatory leopard killings, it is necessary to compare the characteristics of locations with killings to those without. Case-control design (CCD) is the best method to do so for three reasons. First, CCD is meant to generate hypotheses about causal connections when dealing with causal variables that result in a rare outcome (Shadish, Cook, & Campbell, 2002; Stretesky, 2009). The outcome variable in this analysis, retaliatory leopard killings, is rare (based on sample size) in the study area (N = 13). Second, CCD is also used in cases when the outcome is rare and cannot be simulated to obtain a bigger sample size (Shadish et al., 2002). As the purpose of this research is to help determine where these killings occur, it is premature to try to simulate additional cases. Third, CCD preserves degrees of freedom necessary for statistical analyses.

Matched controls were chosen because the analysis' theoretical framework and hypotheses suggested the locations of retaliatory leopard killings are linked to environmental factors found only in these locations and not elsewhere. These matched controls are cells adjacent to the experimental grid cells where killings occurred. Yet Shadish et al. (2002, p. 129) state that a common problem with matched controls is that they "still differ from cases in unobserved ways that can be confounded with the presumed cause and can be the actual cause of the outcome." To avoid this type of error, two control groups are used: 1) controls sampled from an adjacent cell and 2) controls sampled randomly from a buffer zone of cells within 4 grid cells of the experimental cells and excluding adjacent cells (buffer length = 48.6 km, width = 42.3 km, diagonal = 64.43 km). The size of the buffer zone was chosen for two reasons:

1) It had to be equal or smaller than the average home range size of a female leopard in the region, 88.39 km^2.[60] The female home range size was used because it is smaller than a male's (157.27 km^2) and the sex of the leopard involved in H-LC in an experimental cell was not always known.
2) A smaller buffer was more appropriate because it is assumed that leopards were more likely to be in cells closer to the location of the original H-LC than in cells further away.

Two types of independent variables are used in this analysis: 1) variables relating to where a H-LC incident took place (i.e. vegetation cover) and 2) variables describing when it took place (i.e. season). Both types of environmental situational variables are important to this analysis because the characteristics of a location change over time and leopard predation on

[60] The average leopard home range size in the study area is based on research by McManus (2009).

either humans or livestock is seasonal (Butler, 2000; Graham et al., 2005; National Wildlife Research Center, 2010). The weather at a particular time of year affects variables like vegetation cover and prey availability, which then determine how suitable a location is for leopard survival and whether or not a leopard will go after non-natural prey.

Land-use overlap and bordering

Leopards generally shy away from human contact, even more so than the average wild animal (Gates, 2013). Given this, there is little opportunity for H-LC, unless the location of a leopard's food and/or its territory is adjacent to or overlaps human settlement (Bailey, 2005). Previous research has shown that leopards are threatened by habitat loss (Al-Johany, 2007; Ghoddousi et al., 2010), suggesting that land-use overlap between leopards and humans may be a growing problem. The hypotheses below describe the expected relationship between human-leopard land-use overlap and retaliatory leopard killings (see table 5.7 at the end of this section for a list of all the concepts, variables, data sources, and coding methods used in this analysis):

H4.1: Retaliatory leopard killings are more likely to occur where human settlements overlap with leopard territory or habitat.

H4.2: Retaliatory leopard killings are more likely to occur where human settlements border leopard territory or habitat.

The concept of human settlement is measured using the Global Human Influence Index database (version 2) from the Last of the Wild Project. This database calculates a Human Influence Index from nine different datasets with four types of data as proxies for human influence: population density, land transformation, accessibility, and electrical power infrastructure. It also normalizes this index within geographical biomes to control for how the type of ecosystem and human histories in different regions influenced human presence (Sanderson et al., 2002). The source data dates from 1995-2004, with the latest version of the dataset published in 2005 (National Aeronautics and Space Administration Socioeconomic Data and Applications Center & Columbia University, 2005). Human Influence Index values vary between 0 and 100 (0 = no human influence). The human influence score for each grid cell corresponds to the mean of all the Human Influence Index values found within it (one index value for each $1km^2$ of area).

Leopard territory is measured by grid cell proximity to the leopard's range as determined by the IUCN Red List of Endangered Species (IUCN, 2012). All the grid cells used in this analysis are within leopard territory. This territory is also measured by the presence or absence of protected areas in the grid cell because wildlife in general prefers wild land to semi-wild land. Grid cells with no protected areas in them are coded as 0, those where less than 50% of the cell is a protected area as 1, those where 50-90% is a protected area as 2, and those where more than 90% is a protected area as 3. GIS shapefiles indicating the location of government-controlled national parks and protected areas come from The Landmark Foundation.

Leopard abundance

Without reliable worldwide estimates of leopard numbers to determine the likelihood of human-leopard interactions (Al-Johany, 2007; Liberg et al., 2011) (NPO worker 3, personal communication, July 2011), it is necessary to rely on studies by NPOs that estimate leopard numbers in small geographical areas. The problem with these estimates is two-fold. First, their accuracy depends on how pro-active organizations were at collaring leopards and, second, if the study area is large, they do not assess where leopards are more likely to congregate and conflict with humans.

Prime leopard habitat (like mountain slopes in South Africa) will attract more leopards and can also support larger numbers of leopards per square mile than sub-par habitat. As such, the location of prime leopard habitat is a better proxy measure of leopard abundance than potentially inaccurate population counts.

Having larger numbers of leopards per square mile increases the chances of human-leopard contact. This increase in human-leopard contact creates a greater potential for livestock predation or leopard attacks on humans and can trigger larger numbers of retaliatory leopard killings. Based on this, the following hypotheses is made:

H4.3: Leopards are more likely to be illegally killed in areas of prime leopard habitat, when controlling for human settlement and road location.

For this hypothesis, the location of prime leopard habitat is based on vegetation cover and road and river location. Prime leopard habitat includes sufficient vegetation to stalk prey successfully and a water source for hydration, where prey also congregate (Bailey, 2005; Panthera, 2015). It would not include large multi-lane roads, with or without high levels of traffic, as many large cats avoid going near or crossing roads that are 2 lanes or more (Dickson, Jenness, & Beier, 2005; Schwab & Zandbergen, 2011; Schwartzstein, 2014).

Vegetation cover data come from the South African National Biodiversity Institute's (SANBI) National Vegetation Map of South Africa Project (VEGMAP). SANBI created this map of South African vegetation types in 2006 using data from 60 individual contributors (South African National Biodiversity Institute, 2006a, 2006b). It identifies 440 types of vegetation and 11 biomes. The biome type that covers the largest percentage of a grid cell is recorded as the biome for that cell.

The road and river location data come from The Landmark Foundation. The presence of a road is coded differently based on the type of road: primary, secondary, or tertiary road, and other access (i.e. driveways or farm access roads). Two different road variables were created from the data: total length of all roads in a grid cell and total length of main roads (in kilometers). Main roads were those classified as “main roads”, “street”, or “national route” in the shapefiles. The reason for this coding is that the number of roads in a grid cell is less important to leopard and human movement than the amount of road surface a leopard may have to cross to get from point A to point B or the amount of road a human can use to travel in that cell. The river variable is coded as the length of all rivers within a grid cell (in kilometers). Perennial and non-perennial rivers were included in the analysis based on the date of the H-LC for an experimental grid cell or the date randomly assigned to a control cell (see the Analytical Strategy section below for more information on control grid cells). Non-perennial rivers were excluded if the date associated with a control cell or the date of a H-LC was during the dry season.

Poor leopard habitat

An alternate explanation is that leopards living in poor habitat are more likely than leopards in prime habitat to resort to livestock predation and, therefore, that livestock owners living within poor leopard habitat are more likely to kill leopards in retaliation for livestock predation. Hence, the alternate hypothesis:

H4.3b: Leopards are more likely to be killed in areas that provide poor leopard habitat, when controlling for human settlement and road location[61].

For this hypothesis, the location of poor leopard habitat is based on vegetation cover and road and river location, but also includes prey availability and prey abundance. Availability and abundance are important to include because a wider range of available prey species implies more potential prey to eat, as does larger numbers of individuals per prey species per square kilometer.

Availability is measured as the number of prey species whose range overlaps with a grid cell, coded as a number from 0 onwards. The list of leopard prey species comes from a meta-

[61] H3 and H4 discuss the idea that leopard numbers determine the chance of an interaction and potential H-LC. H5 and H6 have to do with the ease of catching prey and the chance that a leopard will resort to livestock predation if it cannot feed itself from natural resources.

analysis of all leopard prey studies done by Hayward et al. (2006). 96 prey species were selected after excluding possible prey species that leopards never ate in the meta-analysis studies or that leopards avoided unless no other prey were available (i.e. prey of last resort). The prey range shapefiles come from the IUCN Red List of Endangered Species (IUCN, 2012). Shapefiles were found for 74 out of the 96 prey species. Of these, 47 resided within the study area.

Abundance is measured as the sum of all prey species abundance scores within a grid cell. For example, if bushbuck abundance is 15 individuals per km^2 and hyrax abundance is 30 per km^2 for a grid cell, the prey abundance score for that cell is 45. The abundance scores come from Hayward et al. (2006). They calculated mean percentage abundance scores for all leopard prey species using data from 29 published and four unpublished studies of leopard diet in 25 conservation areas in 13 countries. Both variables, prey availability and prey abundance, were tested for spatial auto-correlation since there was a risk that adjacent grid cells would have the same values.

Weather and poor leopard habitat

Poor habitat conditions are exacerbated by seasonal changes in weather between the dry and wet season. Certain seasons provide worse hunting conditions for leopards within poor habitat. There is less foliage, for example, during the dry season, making it more difficult for leopards to successfully stalk prey. Many prey species also migrate to better habitat during the dry season, leaving non-migratory leopards living in poor habitat with less prey to hunt. Given this, the following hypothesis is proposed:

H4.4: Leopards are more likely to be killed in areas that provide poor leopard habitat during the dry season, when controlling for human settlement and road location.

The South African Rain Atlas is used to determine whether or not a retaliatory leopard killing occurred during the dry season (Kratz, Zucchini, & Nenadic, n.d.). It provides simulated rainfall averages for each week anywhere in South Africa (Kratz et al., n.d.). Each grid cell was given a date based on when a H-LC occurred there or assigned a random date for control cells. Dates were classified into wet versus dry season based on whether or not a cell's monthly rainfall was above or below the monthly average (calculated using the annual rainfall value divided by 12). Grid cells where a H-LC took place during the dry season received a code of 0. They received a 1 if the H-LC was during the wet season.

After creating and uploading the shapefiles for all these independent variables into ArcGIS (see figure 5.6), a dataset of retaliatory leopard killing locations and their characteristics was produced. It includes independent variable data for the dependent variable grid cells (experimental cells) and the two types of matched control grid cells.

Non-parametric tests were then run to determine which environmental situational factors influenced where retaliatory leopard killings took place[62]. Non-parametric tests were necessary because all the independent variables were not normally distributed for at least one of the grid cell types. Non-parametric tests were also better suited to a small sample size (see chapter 6 part

[62] Exact significance was used for the non-parametric test results because of the small sample size (N = 39).

4 for further justification of the statistical test choices). Correlations were run on the independent variables to insure that none of them were correlated.

Figure 5.6. Example of an experimental grid cell with all the environmental factors mapped in ArcGIS

Legend	
	National park
	Road
	River
	Biome: Albany thicket
	Biome: Fynbos
	Prey range shapefile
	Human-leopard conflict
	Grid cell boundary
•	Human-influence index data points

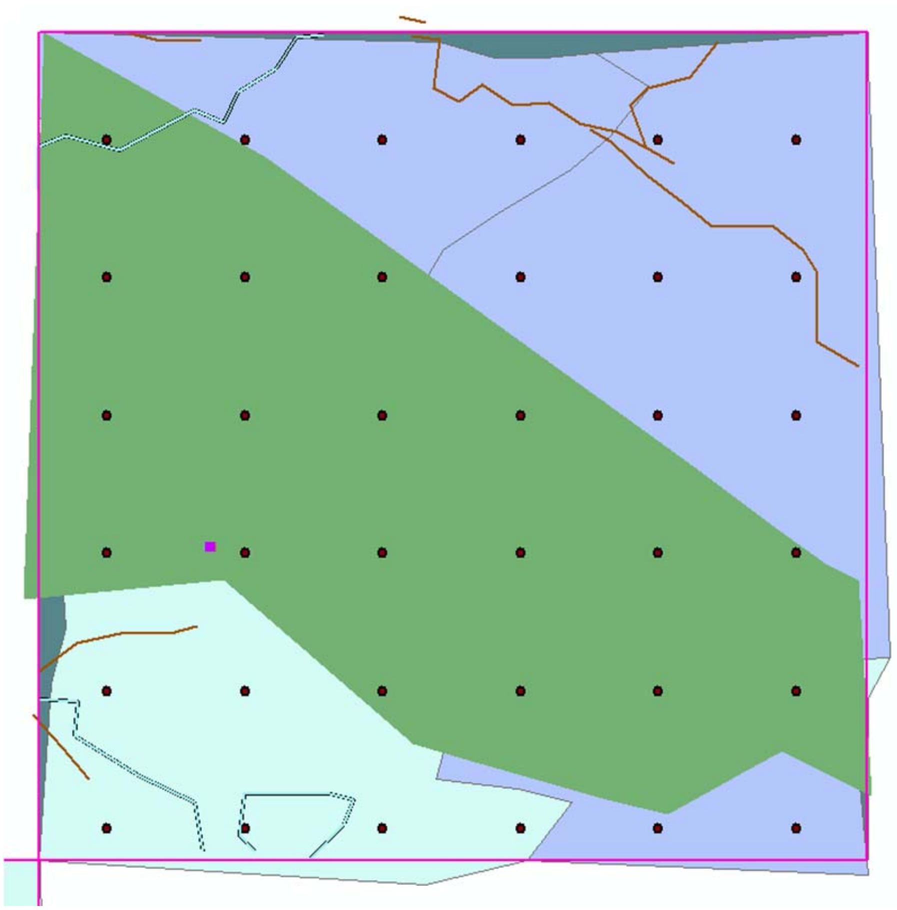


Table 5.7. List of the concepts, variables, data sources, and coding methods used in part 4

Independent variable	**Concept measured**	**Hypothesis**	**Data source**	**Data date**[63]	**Variable coding**
Human settlement	Land-use overlap & bordering	H4.1, H4.2	Last of the Wild Project	1995-2004	0-100 0 = no human influence
Protected areas			The Landmark Foundation	2009	0 = no protected areas 1 = less than 50% of cell is protected area 2 = between 50-90% 3 = more than 90%
Vegetation	Leopard abundance (proxy: prime leopard habitat)	H4.3-H4.4	South African National Biodiversity Institute	2009	11 biome types
Roads			The Landmark Foundation	2009	*Two variables (in km):* Length of all roads Length of main roads
Rivers			The Landmark Foundation	2009	Length of rivers in km
Prey availability	Poor leopard habitat	H4.3b, H4.4	IUCN Red List	2006-2011	# prey species whose range overlaps cell
Prey abundance		H4.3b, H4.4	Hayward et al	2006	Sum of species abundance scores for grid cell
Season		H4.3b, H4.4	South African Rain Atlas	NA (simulation)	0 = rainy season 1 = dry season

[63] Using data from different years can be problematic if there is temporal variation in the values for each variable. This could be the case, for example, with vegetation if a forest is being logged and no longer exists from one year to the next. Every effort was made to find data from the same year, but as this research is dependent on publicly available data sources, this was not always possible. Nevertheless, the data used are from the years during which the dependent variable was collected, 2005-2011, if not all from the same year.

Data Sources

H-LC and retaliatory killing data

Table 5.7 summarizes the variables and data sources.

The Landmark Foundation

The dependent variable data come from The Landmark Foundation, an NPO that runs small-scale leopard conservation programs and fits leopards with GPS collars to track their movements. The Foundation promotes leopard conservation and leopard-friendly livestock farming. The Landmark Foundation researcher Jeannine McManus studies the effectiveness and ecological and economic viability of non-lethal predation prevention methods on livestock farms (Landmark Foundation, n.d.). The Foundation supplies farmers with bell collars to ward off leopards and works with them to reduce livestock losses (Farmer 2, personal communication, August 5, 2011).

Foundation employees record all non-natural leopard deaths in the Heidelberg area and the areas around Baviaanskloof conservation area and the Greater Addo Elephant National Park (in the Eastern and Western Cape Provinces of South Africa) (see appendix E for an example of their data). They learn of these deaths either through informants, government officials, or when a collared leopard disappears. The Foundation's records contain the approximate date and location of death (GPS coordinates), the age and sex of the leopard (juvenile, sub-adult, adult), and the method by which it was killed (gin trap, shot by farmer, etc.). They compile GPS movement data for the leopards they collar. The Foundation provided the GIS shapefiles for local roads, rivers, and protected areas, based on research done by Jeannine McManus for her Masters thesis at Rhodes University (McManus, 2009).

Land-use overlap data

Last of the Wild Project

The Last of the Wild Project produced a dataset that calculates a Human Influence Index for each $1km^2$ of the earth and gives that location a score from 0 to 100 (0 = no human influence).[64] "The Human Influence Index (version 2) is […] created from nine global data layers (source data from 1995-2004) covering human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use/land cover), and human access (coastlines, roads, railroads, navigable rivers)" (National Aeronautics and Space Administration Socioeconomic Data and Applications Center & Columbia University, 2005) (see Sanderson et al. (2002) for a list of data layers). The Wildlife Conservation Society and the Columbia University Center for the International Earth Science Information Network produce the database. It is publicly available in ArcGIS shapefile format.

[64] See page 74 for more details on measurement.

IUCN Red List Spatial Data

The International Union for the Conservation of Nature's (IUCN) Red List of Threatened Species has researchers assess the conservation status of species based on published literature, expert testimony, population trend data, remote-sensing data on habitat loss, and direct fieldwork. These researchers compile a profile of the species with ecological characteristics, including range, and submit it to the appropriate Red List Authority for review. This assessment is done every 5 to 10 years depending on the species (IUCN, 2012). The last assessment for leopards took place in 2008. For the leopard's prey species, the assessments date from 2008 to 2011. The IUCN Red List provides publicly available GIS shapefiles of species' range (map scale 1:1,000,000). This data is used to map the leopard's range and that of its prey species to determine their availability within its range.

Leopard abundance data

National Vegetation Map of South Africa Project

The National Vegetation Map of South Africa Project (VEGMAP) is a collaborative initiative managed by the South African National Biodiversity Institute and completed in 2006 (South African National Biodiversity Institute, 2006a). It brings together 60 individual contributors from several organizations to build a comprehensive map of South African vegetation using data from individual vegetation studies throughout the region. VEGMAP identifies 440 zonal and azonal vegetation types at a working scale of 1:250,000 or better (South African National Biodiversity Institute, 2006b). It also classifies this vegetation into 11 biomes: albany thicket, azonal vegetation, desert, forests, fynbos, grassland, Indian Ocean coastal belt, nama-karoo, savanna, succulent karoo, and water bodies (South African National Biodiversity Institute, 2010).

Poor habitat data

Hayward et al. (2006) article

Hayward et al. (2006)'s article is a meta-analysis of 29 published and four unpublished studies of leopard diet that included local prey abundance estimates. The data from these studies came from 25 conservation areas in 13 countries. Based on these data, Hayward and his colleagues calculated a mean Jacobs' index value for every prey species to determine which prey leopards preferred. The list of leopard prey species used in this analysis is based on this article. The Jacobs' index value (D) was calculated using the following formula:

$$D = r - p / r + p - 2rp$$

"where r is the proportion of the total kills at a site made up by a species and p is the proportional abundance of that species for the total prey population" (Jacobs (1974) in Hayward et al. (2006,

p. 5)). Jacobs' index values range from +1 to -1, with +1 indicating maximum preference for a prey and -1 maximum avoidance.

As part of their study, Hayward et al. (2006) also calculated a mean percentage abundance for each prey species. These values are used to measure prey abundance for this analysis.

South African Rain Atlas

The South Africa Rain Atlas provides web users with rainfall-related statistics for South Africa for every 1 minute of a degree of latitude and longitude in the region (424,646 sites and about 1.9 km x 1.6 km surface area per site) (Geosystems Global Corporation, 1998; Zucchini & Nenadic, 2006). The creators of the Atlas, Oleg Nenadic, Gunter Kratz, and Walter Zucchini, used data from the South African Weather Bureau, the Department of Forestry, the Department of Agriculture, the South African Sugar Association, and information from farmers and members of the public to create a model estimating rainfall patterns at each site for any time of year. To verify the accuracy of their model, the creators compared model rainfall estimates and actual rainfall data for 5070 locations (Kratz et al., n.d.; Zucchini & Nenadic, 2006).

Besides monthly rainfall projections, the South African Rain Atlas also provides the estimated number of rain days and storm days for each location, the amount of rain per day, and the probability of dry runs (consecutive days with no rain) for 5-day increments up to a month (Kratz et al., n.d.). The data is publicly available on the South Africa Rain Atlas website: http://wsopuppenkiste.wiso.uni-goettingen.de/rainfall/. This research uses the annual and monthly rainfall estimates to determine when poor leopard habitat becomes especially inhospitable because of low rainfall during the dry season.

Chapter Summary

This research identifies the situational factors that contribute to retaliatory leopard killings and where they occur in three study locations: the Amboseli and Tsavo West National Parks area in Kenya, the Heidelberg, Baviaanskloof, and Greater Addo Elephant National Park regions of South Africa, and India. Three research questions drive the analysis:

1) What is the scope and nature of illegal leopard killings within the study areas?
2) What forms do H-WC driven retaliatory leopard killings take?
3) What geospatial factors contribute to retaliatory leopard killings?

Content analyses of interview data from Kenya and South Africa and 68 media articles from India are used to determine the human situational factors of H-LC and retaliatory leopard killings in parts 1-3 of the analysis. Part 4 maps 13 locations of retaliatory leopard killings in the Heidelberg region of South Africa to better understand their environmental situational factors. The independent variables for this spatial analysis include river length, prey availability, prey abundance, road length, main road length, human settlement score, main biome type, park overlap, and season. Data on these variables come from 6 different academic and NPO sources. Table 5.1 on page 53 provides a summary of all the analyses.

Chapter 6: Results

1. Analysis part 1: Kenyan interviews

The results from the first 3 analyses (parts 1, 2, and 3) focus on the human context of H-WC and H-LC. The purpose of these analyses is to understand what human situational factors contribute to these conflicts and to tolerance for leopard killing. As stated in the previous chapter, the hypotheses for these analyses are:

H1: Individuals who have livestock are vulnerable to H-WC.

H2: Individuals who experience H-WC and its costs are less likely to support conservation.

H3: Support for conservation is low in areas where distrust among actors is high and government oversight is poor.

H4: If an individual has previous exposure to conservation initiatives, he is more likely to support conservation.

To understand why a place tolerates leopard killing, one first needs to understand the H-WC situation in that area. 87% of respondents in the Tsavo-Amboseli ecosystem reported that they suffered costs from wildlife, while only 28% received any benefits from wildlife (N = 234). When asked how they suffered costs from wildlife, respondents stated that wildlife was destructive.[65] Wild animals attacked their livestock, their crops, their property, and sometimes their neighbors or themselves (see table 6.1 below).

[65] All interviewees responded to whether or not they experienced costs or benefits from wildlife but fewer individuals gave examples of those costs and benefits (Ns ranged from 68 to 208 out of

Understanding the full impact of H-WC requires putting these numbers in the socio-economic context of the Tsavo-Amboseli ecosystem. The majority of respondents, and the majority of the population, are pastoralists (43%) or agro-pastoralists (30%), with only 27% depending on agriculture alone (2% cited other livelihood strategies) (N = 234). All local residents therefore live with the risk of losses from H-WC because of their livelihood strategy. Table 6.1 shows that pastoralists were actually the most at risk: 41% of those who suffered costs from wildlife were pastoralists and 30% were agro-pastoralists (H1) (see table 6.1).

Table 6.1. Socio-economic characteristics of respondents living in the Tsavo-Amboseli ecosystem

Variable	**Response (in %)**			**N**
	Category of respondent			
	Pastoralist	**Agro-pastoralist**	**Agriculturist**	
Livelihood strategy*	43%	30	27	234
Suffered costs from wildlife?	41%	30	29	234
	Self-perceived sufficiency of livelihood			
	Highly sufficient	**Sufficient**	**Not sufficient**	
Needs met by livelihood strategy?	3%	67	30	234
	Self-perceived economic status			
	High	**Medium**	**Low**	
Economic status	8%	69	23	234

*2% of respondents indicated other types of livelihood strategies.

Agriculture and pastoralism, though, are two ways of life that are at odds with each other in terms of resource consumption. The Kenyan government has been encouraging pastoralists to sedentarize and convert to agriculture (Poole, 2006). Unfortunately, the region’s semi-arid and arid climate does not lend itself to high-yield agriculture (Berger, 1993). It is possible to grow

234). Despite this lower sample size, the general themes that come out of these responses can be useful in understanding the challenges some local residents face from H-WC, especially as these themes are consistent with H-WC problems described in the literature.

crops, but they are highly dependent on rainfall and lack of rainfall can have devastating financial consequences for farmers. Most agriculturalists therefore supplement natural rainfall with artificial irrigation creating shortages of water and shortages of food when crops fail. Clearing the land for agriculture also reduces the amount of habitat for grazing livestock, competing with pastoralists' livelihood, and reduces the amount of habitat available to wildlife, increasing the amount of H-WC everyone in the region suffers. Meanwhile, human densities and settlements in the area are increasing because of population growth and migration of agriculturalists to the area, only exacerbating the resource competition among pastoralists, agriculturalists, and wildlife (Berger, 1993).

While most respondents felt that their livelihood strategy met their needs (67%, compared to 30 % not sufficient and 3% highly sufficient), they ranked their economic status as "medium" (69%) suggesting they are able to support themselves but are not wealthy (N = 234). Another 23% ranked their economic status as low, while only 8% thought their economic status high (N = 234) (see table 6.1). There was no statistically significant difference between the different livelihood strategies on both these points ($X^2 = 4.287$, df = 6, p = 0.638 for livelihood strategy meeting their needs and $X^2 = 3.595$, df = 6, p = 0.731 for economic status). These numbers suggest a socio-economic context where local farmers are able to support themselves but do not necessarily have an economic cushion to sustain constant financial losses from carnivore killings of livestock and elephants trampling crops.

The financial difficulties and resource competition described above are among the reasons why local farmers are not supportive of conservation efforts (H2). In fact, they are the most common obstacles respondents mention when asked to explain what the biggest challenge to conservation was. 66% of respondents believed H-WC was the biggest challenge to wildlife conservation in this region[66] (N = 224). 34% identified H-WC conflict directly while others talked about the reasons for H-WC, i.e. limited resources (24%) and limited space (8%). Those that suggested other challenges discussed issues like corruption, lack of knowledge about the importance of wildlife, and insufficient funding.

The political context and previous conservation attempts in the region are vital to understanding the current situation. Amboseli National Park was created as part of the fortress conservation model. Amboseli originated as a game reserve created in 1948 and managed by the National Park Service (Barrow & Murphee, 1998). “The purpose of game reserves was to protect wildlife in the areas that could not be established as national parks because they were already allocated for other purposes” (Viollaz, 2006, p. 5). Both local farmers and wildlife could use the resources in these multiple-use areas freely (Kameri-Mbote, 2002). In 1961, the reserve’s management and revenue were handed over to the Kajiado County Council so local group ranch members could receive direct benefits from wildlife and encourage them to support conservation (Barrow & Murphee, 1998).

Upon the success of the venture, though, the Kenyan government reclaimed the reserve and created Amboseli National Park in 1974, forbidding local farmers to use natural resources within the park (Lange, 2006). The decision strained relations between local farmers and the KWS, especially when KWS refused to compensate them for the lost resources as promised

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[66] Surprisingly, 79.1% of respondents said they had never been exposed to wildlife conservation issues (N = 233). This result is unusual given the prevalence of conservation initiatives in the area. Furthermore, most interviewees responded coherently to questions requiring an understanding of what conservation initiatives are, suggesting that they understood the concept even if they did not know the term for it.

(Poole, 2006). At the time of the interviews, 2006, Amboseli National Park generated $3.4 million U.S. dollars a year in tourism revenue, but only 2% of this money was returned to local communities. Talks were ongoing since 2005 to devolve control of the park back to the Kajiado County Council (Lange, 2006). The presence of such a lucrative conservation venture nearby and the large number of respondents who suffered costs from wildlife may explain why 74% of respondents indicated that they would not support wildlife conservation if it were not for economic benefits (24% would support wildlife conservation without economic benefits while 2% did not know, N = 227) (H3).

Given this context, it comes as no surprise that respondents resented the government for not sharing the revenue from Amboseli National Park with them and suggested that conservation-based income generating activities had brought corruption to the area (see table 6.2). Some respondents suggested that wildlife only benefited group ranch officials. 44% of respondents felt that KWS was mismanaging the park. 27% disagreed and 29% did not know (N = 233). KWS' renewed ownership of the park only added to local community members' anger when the government failed to protect them from the destruction and injuries "its" wildlife caused to them, their crops, livestock, and property. Given the large profits generated by the park, respondents felt they should at least be compensated for their losses, something that occurred only haphazardly, if at all (H3).

Table 6.2. The positive and negative aspects of living with wildlife

Negatives	**% of respondents who cited point**	**Positives**	**% of respondents who cited point**
See no benefit from wildlife	72%	Bursaries	54
Wildlife destructive to: • Crops • Livestock • Property • People	87%	Employment	24
No compensation for losses	88%	Occasional compensation for losses	12
Failure of government to control wildlife	NA*		
Corruption	NA*		

* Not applicable here because not quantified in the analysis; simply noted as a recurring concept during the content analysis.

Although generally frustrated, respondents did identify some benefits they derived from wildlife conservation. Of those who benefited from wildlife (N = 68), the most common benefit was bursaries for their children's education (54%). 24% of respondents also mentioned that wildlife created opportunities for employment (see table 6.1). 12% cited the compensation they received for livestock and crop losses. Overall, respondents identified the same benefits and costs from wildlife for other community members.

H-WC interventions suggested by local stakeholders

Despite 79% of respondents saying they had no experience with conservation (H4, N = 233, see footnote 66), many respondents suggested methods for mitigating H-WCs in keeping with conservation principles (N = 229). The majority of these responses involved fencing wildlife in parks or out of human settlements (65%). 38% of respondents felt it was best to erect fences around villages to keep wildlife out. 16% supported the idea of compensation for any damage suffered from wildlife and 3% of those suggested that fences in combination with compensation would limit damages. Only about 5% suggested killing problem animals; 8% responded “I don’t know”.

This last finding is perhaps the most important. The results from part 1 of this analysis suggest that, based on the 4 above-mentioned hypotheses, the residents of the Tsavo-Amboseli ecosystem are inhospitable to conservation initiatives. The costs from wildlife are high and affect a large percentage of the population, while local residents’ livelihood strategies increase the chances of H-WC. The constant and increasing H-WC conflict in the region stokes the public’s resentment of wildlife. Meanwhile, distrust among government officials, conservationists, and local residents is longstanding due to historical events, and local residents claim not to have much exposure to conservation initiatives. They feel let down by local authorities and are unlikely to call them for help when they suffer H-WCs. Local residents have little direct experience of the financial benefits of wildlife conservation, such as shared revenue from national parks, and the long-term environmental benefits of a healthy ecosystem, like better crop returns. Wildlife is an inconvenience for them, one that the government will do nothing to protect them from.

This deep resentment and lack of positive associations with wildlife create an inhospitable environment for wildlife conservation. Yet, despite this, only 5% of respondents suggested killing problem animals such as leopards (Makonjio Okello, 2005). Local residents primarily chose non-confrontational measures to handle H-WC, despite increasing conflicts with wildlife. They chose to co-exist with wildlife rather than eliminate problem species.

It is possible that more than 5% of respondents would kill problem animals if given the chance. In this case, though, respondents had few reasons to misrepresent their intentions and actions since they were not being asked about an illegal behavior, but rather about a possible solution to H-WC, one common elsewhere. Culling animals in protected areas is legally practiced in a number of African countries when animal populations become too large for a habitat and risk damaging it (Fuller & Johnson, 2005; Southern African Legal Information Institute, 2007). The practice of killing animals is therefore not, in itself, taboo. Although, social desirability may have led to the underreporting of killing problem animals as a solution to H-WC, there were no retaliatory killings reported in the study area during the time of the interviews, suggesting the practice is not widespread in the region.

To understand what situational factors influenced local farmers' opinion of wildlife conservation, a logistic regression was run with attitude towards wildlife conservation-based income generating activities (negative or positive) as the dependent variable. The interview question on which the dependent variable is based was worded as "what is your attitude towards wildlife conservation-based income generating activities?" This choice of words, instead of simply asking "attitude towards wildlife conservation activities," is due to the local culture. The conservation initiatives in the Tsavo-Amboseli ecosystem, Amboseli and Tsavo West National Parks and a few other small ecotourism ventures, all generate income through ecotourism and wildlife conservation (Viollaz, 2006). Local residents know of these initiatives and the income they generate. Since, in their experience, conservation initiatives are always income generating, they were asked to give their opinion of this particular conservation model. For the residents in this community, wildlife conservation-based income generating activities are a proxy for wildlife conservation.

The 6 independent variables in the regression were wildlife cost (Is wildlife imposing a cost to you?), wildlife benefit (Do you benefit from wildlife?), economic status, education level, mismanagement (Is KWS mismanaging Amboseli National Park?), and exposure to conservation (Have you been exposed to wildlife conservation issues?). Table 6.3 provides frequencies for each of these variables.

Table 6.3. Descriptive statistics for the dependent and independent variables in the regression

Variable	**Response (in %)**			
	Yes	**No**	**Don't know**	**N**
Wildlife cost	87%	13	NA	234
Wildlife benefit	28%	72	NA	234
Exposure to conservation	21%	79	NA	233
Mismanagement	44%	27	29	233
	Positive	**Negative**		
Attitude	51%	49	NA	225
	Low	**Medium**	**High**	
Economic status	23%	69	8	234
	No education	**Primary**	**Secondary**	
Education	61%	24	15	233

Logistic regression requires that three assumptions be met: 1) the absence of sparse data, 2) no collinearity between independent variables, and 3) no multi-collinearity between variables (Field, 2005). Sparse data is defined as 5 cases or less in any variable response category (Field, 2005). Crosstabs indicate if poor distribution of cases among coding categories could cause sparse data problems. Frequencies (see table 6.3) and crosstabs run between the dependent variable and independent variables (see table 6.4) revealed no sparse data. Only the variable economic status was borderline with 6 cases in the category of high economic status but negative attitude towards wildlife. Correlations between the independent variables (see table 6.5) revealed only three significant correlations between wildlife benefit and exposure to conservation, economic status and mismanagement, and exposure to conservation and mismanagement. Since all three were < 0.9, though, they would not adversely affect the results of the logistic regression model (Field, 2005). No multi-collinearity was found between the variables.

Table 6.4. Crosstabs between the dependent variable and the independent variables in the logistic regression model

Variable	**Attitude**	**N**
	Positive (in %)	
Wildlife cost		225
Yes	48%	196
No	69%	29
Wildlife benefit		225
Yes	85%	62
No	37%	163
Exposure to conservation		224
Yes	63%	46
No	47%	178
Mismanagement		224
Yes	45%	101
No	64%	58
Don’t know	48%	65
Economic status		225
Low	43%	51
Medium	52%	157
High	65%	17
Education		224
No education	44%	137
Primary	57%	53
Secondary	71%	34

Table 6.5. Kendall's Tau-b correlations between the independent variables of the logistic regression model

	Wild. Cost	**Wild. Benefit**	**Eco. Status**	**Education**	**Exposure cons.**	**Mismanagement**
Wildlife cost	1	-0.044	-.084	.013	.006	.015
Wildlife benefit	-.044	1	.015	.041	.198**	.048
Economic status	-.084	.015	1	.021	-.039	-.229**
Education	.013	.041	.021	1	-.022	.015
Exposure to conservation	.006	.198**	-.039	-.022	1	.139*
Mismanagement	.015	.048	-.229**	.015	.139*	1

* $p < 0.05$; ** $p < 0.01$ (sig. 2-tailed).

The results of the logistic regression suggest that three variables significantly influenced local farmers' attitudes towards wildlife conservation-based income generating activities: wildlife cost ($p < 0.1$), wildlife benefit ($p < 0.001$), and education ($p < 0.05$) (see table 6.6). Based on the Wald Statistic, it appears that wildlife benefit (Wald = 31.674) most influenced respondents' attitude towards wildlife conservation-based income generating activities.[67] The model was significant at the $p < 0.001$ level. It is a fairly strong model: its goodness of fit when including predictors was 33.9% better than for the null model. The model was able to accurately predict the observed values for 71.6% of the respondents (N= 222 instead of 234 because of 12 cases omitted for missing data).

[67] Field (2005, p. 239) suggests using the Wald statistic cautiously because "when the regression coefficient (b) is large, the standard error tends to become inflated, resulting in the Wald statistic being underestimated." Nevertheless, given that this variable is highly significant and its Wald statistic is much higher than that of the other variables, there is little chance that the variable does not influence attitude towards wildlife conservation-based income generating activities. The degree to which it influences this attitude, though, should be interpreted with caution.

Local farmers who suffer costs from wildlife are less likely to have a positive attitude towards wildlife conservation (H2). Meanwhile, those benefiting from wildlife, economically or in other ways, are much more likely than people who do not benefit to support wildlife conservation. Finally, respondents with higher levels of education were more likely to have a positive attitude towards wildlife conservation.

Table 6.6. Results of the logistic regression measuring what variables influenced respondents' attitude towards wildlife conservation-based income generating activities

Variable	**B**	**S.E.**	**Wald**	**Df**	**Sig.**	**Exp(B)**
Constant	*-1.113*	*.674*	*2.731*	*1*	*.098*	*.328*
Wildlife cost	-.890	.481	3.433	1	.064*	.411
Wildlife benefit	2.382	.423	31.674	1	.000***	10.832
Economic status	.504	.307	2.697	1	.101	1.655
Education	.683	.229	8.919	1	.033**	1.979
Mismanagement			1.497	2	.473	
Exposure cons.	.428	.412	1.081	1	.299	1.535

* $p < 0.1$, ** $p < 0.05$, and *** $p < 0.001$.
Note: $R^2 = .254$ (Cox & Snell), .339 (Nagelkerke). Model $X^2(7) = 65.021$, N = 222, $p < .001$.

Based on these findings, support for wildlife conservation is primarily dependent on how much local farmers suffer costs or receive benefits from wildlife. The communities where H-WCs occur are often cash-poor, like the Tsavo-Amboseli ecosystem where income can vary drastically based on rainfall. Most local residents earn at least 79% of their income from selling crops and livestock (Kelly, 2010; Minister & Lands, 2010). They are thus unwilling/unable to suffer costs from wildlife, but respond quite positively to any added income they can obtain from it.

As for education, respondents with at least a primary education were more likely to support wildlife conservation initiatives. Approximately 39% of the respondents had at least a primary education so there is potential for developing a strong support network for wildlife conservation in the area. Education did not seem to play a role in whether or not a respondent had been exposed to conservation initiatives ($\tau = -.022$, $p = 0.723$). Knowledge of how important conservation is for biodiversity and ecosystem health may therefore not be why more educated farmers supported conservation initiatives. Perhaps educated respondents simply had a better grasp of the financial benefits they could receive from ecotourism and wildlife conservation-based income generating activities.

2. Analysis part 2: South African interviews

The Heidelberg area in South Africa is, like the Tsavo-Amboseli ecosystem in Kenya, rife with H-WC. The difference between the two is that farmers and NPO personnel in the Heidelberg area readily admit that retaliatory leopard killings take place locally, while in the Tsavo-Amboseli ecosystem only 5% of respondents suggested this as a solution to H-WC. Granted, there is a difference between an opinion that killing is a solution and a belief that killings are taking place. But for a killing to take place, the person committing the killing has to think of it as a potential solution (Kansky & Knight, 2014). If killing a problem animal is not a solution to H-WC, there is little reason to kill, especially given the effort required to track an animal, kill it, and dispose of its body.

Of the 16 people interviewed in the Heidelberg area, only 1 farmer out of 7 denied the existence of retaliatory leopard killings in the region. This particular farmer was part of the local conservancy and thus had a vested interest in denying such illegal behavior or may simply have been too disconnected from the experience of local, and perhaps poorer, farmers to hear about these killings. The majority of government officials, on the other hand, openly denied that leopards were being illegally killed in the area.

The purpose of this analysis is to understand why this location tolerates leopard killing, especially retaliatory leopard killings. This study passes no judgment on whether or not the respondents' claims are truthful. Rather, its purpose is to find the common threads in the actors' stories and determine how to use this common ground to reverse the tolerance for leopard killing and reduce H-LC and illegal leopard killings.

Respondents agreed that the main reason why local farmers illegally killed leopards was in retaliation for livestock predation (H1). NPO and government personnel specified that farmers sometimes killed leopards out of spite without any proof that they were responsible for attacks on their livestock. Conversations with farmers yielded a lot of anger at leopards, with several calling leopards "criminal" for attacking their private property when wild prey was plentiful. The general feeling was that livestock losses to tick fever and other natural causes were acceptable but that leopard predation on livestock would not be tolerated. This feeling was exacerbated by the belief that H-WC had not been a problem in the area until 20 years ago and so farmers felt that leopards had suddenly invaded what had been pristine livestock farming territory (H2).

Leopards in the area were primarily shot or caught via gin traps and left to die of dehydration and stress. A government official explained there was no local market for leopard skins because farmers preferred to bury any evidence of wrongdoing in the bush. A farmer explained that one community member had a pack of leopard-hunting dogs[68]. When a farmer lost livestock to a leopard, he called this person to hunt the leopard on his property. Reasons given for shooting “problem leopards” were that permits to legally kill them took too long to obtain, farmers did not want to risk more losses, and that they feared not being able to catch the leopard if they waited (H2).

The two main emotions expressed during the interviews were anger and distrust. Anger at the hardships imposed by leopards, ongoing land tenure and land-use issues, and the lack of government support. The overarching emotion, though, was distrust. Two levels of distrust were apparent: 1) general distrust and 2) H-WC solution-specific distrust.

The general distrust stemmed from historical events in the region. Farmers were angry that they received no support from the South African government. From 1867 to 1947, the mining industry subsidized farming. Expanding African markets and government protections turned South Africa into one of the few countries that exported food despite fickle rainfall (Wilson, 2009). South Africa, though, is no longer the farming superpower it once was, especially since its economic decline from the 1960s to the mid-1990s and its history of extractive policies and overgrazing that destroyed farmlands and their topsoil (Wilson, 2009). Those protectionist measures no longer exist, but farmers still felt that they should receive subsidies to keep their crops and beef competitive on the world market.

[68] These dogs chase the leopard either into the open or up a tree where a farmer can easily shoot it.

Farmers also resented the giving of land to black “inexperienced” farmers to diversify land ownership after apartheid, a practice they felt was doomed to fail because the government provided land but no training in farming practices. This general distrust is present in the Tsavo-Amboseli area as well when local residents talk about how the government mismanages Amboseli National Park and how the profits from it are poorly distributed. In the case of Kenya, though, it stems from the government’s forceful appropriation of land to create the national park and the reneging on promises to allow grazing within it and share revenue from it.

Adding to this general distrust is solution-specific distrust because of the failure of government responses to H-LC. This failure is partly due to the lack of organizational capacity in government institutions and a weak local government characteristic of post-apartheid South Africa (Wilson, 2009). The general belief among respondents was that the government’s response to leopard predation and retaliatory killings was inadequate. The specific complaints expressed by both farmers, government workers, and NPO personnel were very similar, although none of the parties recognized this. Everyone’s complaints focused on four main problems: the government’s response was slow and unwilling, it involved inefficient methods, there were inadequate resources to respond, and there lacked clear laws or a clear application of those laws (see table 6.7).

Table 6.7. Respondents’ complaints about the government’s response to leopard predation and retaliatory killings

Types of complaints	**Farmers**	**Government/NPO personnel**

Using inefficient methods	Feeding meat to leopards during translocation	Using ineffective methods
	Do not relocate far enough	Using “one size fits all” enforcement
	Trapping cages too small	Prevention measures 1 more burden for farmer
		Penalties not a deterrent
Laws inadequate	Unequal application of laws	No national legislation makes enforcement tough
Not enough resources	No compensation from Cape Nature	Not enough money to do things properly
		Short of enforcement personnel
		Not enough training
Slow & unwilling	Toothless	Wait too long to act
	Corruption	Corruption
	Uninterested in solving problem	No one will talk to help investigators and/or wildlife management personnel
	Inconsistent help, slow	

Inefficient methods were the main complaint. Farmers cited this as a reason why most of them would not call Cape Nature for help when they had a problem leopard on their property (H3). The main difference between the government/NPO personnel’s description of this problem and that of the farmers is that farmers tended to give more specific examples of how the government’s response was failing.

For example, farmers complained that government officials used cage traps that were too small, reducing the chances of capturing problem leopards on their property. With such small cages, the leopard felt the trap door come down on its tail and ran out of the cage before its door could fully close. In the event that a problem leopard was caught in a cage trap, farmers argued that Cape Nature officials did not relocate the animal far enough to prevent it from coming back to their farm. One farmer described how he had asked a veterinarian to tag a leopard trapped in a Cape Nature cage on his land. He then called Cape Nature and they assured him they would relocate the animal too far away for it to return. A few weeks later, this farmer once again had leopard predation problems. Cape Nature again set up a cage trap on his land and caught "another leopard." The veterinarian confirmed that this "other leopard" was actually the original animal, which had simply returned to the farm after relocation. Farmers also thought that Cape Nature was feeding leopards beef during translocations and that this habit was causing them to eat livestock upon their release.

Although government/NPO personnel disagreed with farmers on the fact that cage traps were too small[69], they did acknowledge broader failures in their response to H-LC. Some government personnel recognized that the "one size fits all" techniques that they often used (like trapping or bell collars) did not always prove effective, causing tensions in the community. They realized that each farm was a unique environment. Recommending one prevention technique across all locations was ineffective because it was sometimes not suited to the terrain or to the type of livestock farming there. They empathized, to a certain extent, with the fact that the predation prevention measures they offered farmers were just one more burden for them. They understood that livestock farming was a difficult activity and that predation prevention measures were time consuming to implement effectively. They also realized that the penalties they warned farmers about should they kill a leopard illegally were no deterrent given the lack of any easy alternative solutions to H-LC.

Government actors acknowledged struggling to respond fast enough to H-LC complaints. Their justification was that they were short of enforcement personnel and simply did not have

[69] In fact, personnel from the local NPO, The Landmark Foundation, regularly and successfully trapped leopards using cage traps to fit them with GPS collars.

enough resources (including vehicles) to send a Cape Nature employee out every time a farmer reported a leopard had eaten his livestock. Money was tight in the department and personnel often did not receive adequate training to deal with H-WC. Farmers saw the flip side of these problems. They rarely received monetary compensation from Cape Nature. The haphazard nature of Cape Nature's response left them feeling like the government was toothless and uninterested in solving their H-LC problems. If they did receive help, it was often inconsistent, breeding even more distrust between the parties.

This distrust was compounded by an inadequate legislative framework and ongoing corruption. Farmers and NPO personnel felt that wildlife crime/hunting laws were unequally enforced. Meanwhile, government personnel found it difficult to know which laws to apply and when because no unified national legislation exists in South Africa. Each province is free to enact its own wildlife protection laws. This caused confusion because a farmer caught with an illegal carcass could claim that the animal had been hunted in a province where it was legal to do so. Although this is not the case with leopards, this uncertainty in how to apply wildlife crime laws for other species meant that local farmers had little trust in the local justice system. The fact that corruption was common, and contributed to the unequal application of laws, also made it difficult for farmers and NPO personnel to trust government officials and vice versa. It created a setting were all the actors were pitted against each other. Government personnel described the deadlock well when they complained that local residents refused to talk with them when leopards were illegally killed, making any investigation quasi-impossible.

H-LC interventions suggested by local stakeholders

These failures with the government's response to H-LC created an atmosphere where farmers refused to call government/NPO personnel when they had a problem leopard on their land because they did not trust them to solve the problem. This led them to resort to their own, sometimes ill-informed methods, to stop leopard predation on livestock. Surprisingly, though, when asked directly what solutions were helpful in reducing H-LC, all the actors often agreed on which solutions were most effective, if for different reasons (see table 6.8)[70].

Table 6.8. Responses to H-LC cited by interviewees and their perceived effectiveness

Predation prevention method	Farmers	Government/NPO personnel
Translocation	Leopard comes back	Stress hurts survival
	Fed meat = eats livestock	Inter-leopard conflict

[70] There was also general agreement on why and when leopard predation and H-LC occurred (see table A4 in the Appendix). Farmers and government/NPO personnel only disagreed on who/what was to blame for these conditions: farmers tended to blame poor prevention methods and environmental conditions while government/NPO personnel tended to blame farmers.

Kill problem leopard	Kill right away	If trapping ineffective, issue kill permit
	Use poison collars	
	Not dominant male	
Trap & release	Hate this!	Trap & release with GPS, hope for fear of humans
Anatolian sheep dogs	Cause problems by hunting small prey	Good when hunting instinct bred out
Donkeys	Ok, not 100% effective	Work well
Wire collars	Ineffective	Ineffective
Bell collars	Ineffective	Good when used randomly
New ideas	Suggest alternative solutions: • Tourism not an option • Keep horns on meat cattle to protect them • Farming diversification • Compensation fund that farmers pay into • Move livestock to different pastures regularly • Leopard-friendly products	• Predator-proof enclosures • Research what other countries have done • Work on a case by case basis with farmer

Farmers and government/NPO personnel in general agreed that translocation is an ineffective response, but for different reasons. Farmers argue that translocation methods that involve feeding leopards beef during transport cause them to develop a taste for livestock and that translocation is only a temporary solution because leopards return to their original territories. Government/NPO personnel believe that translocation stresses leopards and sparks inter-leopard conflict when an animal is moved into another’s existing territory, both of which hurt a leopard’s chance of survival. Interestingly, inter-leopard conflict can drive leopards to return to their original territory. So farmers and government/NPO personnel partly agree on why translocation is ineffective; they just express it differently. Their views on the subject, though, are not entirely consistent. Some government/NPO personnel advocated that leopards be trapped and released in the same location hoping fear of humans would keep them away from livestock, while knowing this is not the case (as seen with translocations). Farmers, on the other hand, recognized the similarities and rejected this solution outright.

Farmers and government officials also agree that killing a damage-causing leopard is sometimes a viable solution, but differ on when this is appropriate (NPO personnel do not agree with this). Farmers prefer to shoot first to avoid further immediate conflict[71] while government/NPO personnel prefer to try non-lethal methods first before issuing a kill permit. All actors recognized that alternative predation prevention methods like Anatolian sheep dogs, donkeys, wire and bell collars, if they worked, were often hit or miss and required careful implementation and follow-up.

Farmers came up with innovative ideas on how to prevent leopard livestock predation, shown in the final row of table 6.8. Ideas included farmer-sponsored insurance schemes and leopard-friendly product designations for farms that used leopard-friendly predation prevention methods. Farmers also suggested diversifying farming practices to avoid being so vulnerable to livestock losses and moving livestock around to different pastures to stay one step ahead of leopards and avoid predation. Meanwhile, government/NPO personnel tended to be less creative when it came to alternative solutions. Their main solution at the time was to research what other countries had done to deal with H-WC. Given this, it seems appropriate to harness farmers' knowledge of the land and husbandry practices to come up with innovative solutions to H-LC.

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[71] Killing a problem leopard often leaves a territory vacuum that is quickly filled by another leopard. Killing therefore just delays the H-LC cycle from starting all over again. Some farmers seem to recognize this issue because they advocate not killing dominant males to prevent this territorial vacuum (females often share territory with males so they believe killing a female is less likely to create a vacuum).

Currently, though, the anger and distrust between farmers and government/NPO personnel is largely preventing any collaboration or sharing of knowledge between them.

Since both farmers and government/NPO personnel agreed that the government's response to H-LC was failing, it is not surprising that conservation initiatives were not well received in the region. Previous exposure to conservation initiatives likely only encourages individuals to support conservation if those conservation initiatives have proven benefits for the community (H4).

3. Analysis part 3: Indian media articles

H-LC conflict in India takes a slightly different form from H-LC in the Tsavo-Amboseli ecosystem and the Heidelberg area. Studies conducted by Vidya Athreya and her colleagues found leopards regularly strayed into human settlements in India. For example, they "found one of [their] radio-collared leopards visited a particular house every few days without ever disturbing its residents, who sleep in the open" (Gates, 2013). When leopards approach villages, they often attack livestock (cattle, goats, and sheep) and stray animals (H1). For instance, CCTV footage from an apartment building in Mulund (northeast of Mumbai) shows a leopard entering its lobby and capturing a live dog before dragging it off and killing it (Emirates 24/7, 2013).

A large percentage of the H-LC in India, though, is leopard attacks on humans. These attacks occur both inside and outside of villages, even inside houses (see figure 6.1). The media articles in this sample described leopard attacks on people as they were collecting firewood and Mahua fruits in the forest, walking on the road near or going about their daily activities in their village, while sleeping inside their houses at night, and while defecating outside. There were reports of children being dragged away by leopards while playing 500 meters or less from their houses. A leopard killed one woman less than 50 meters away from forest guards that were looking for it (Dahat, 2013). These attacks on humans are a departure from the H-LC seen in either the Tsavo-Amboseli ecosystem or the Heidelberg area. Although leopard attacks on humans do occasionally occur in these areas, they are uncommon.

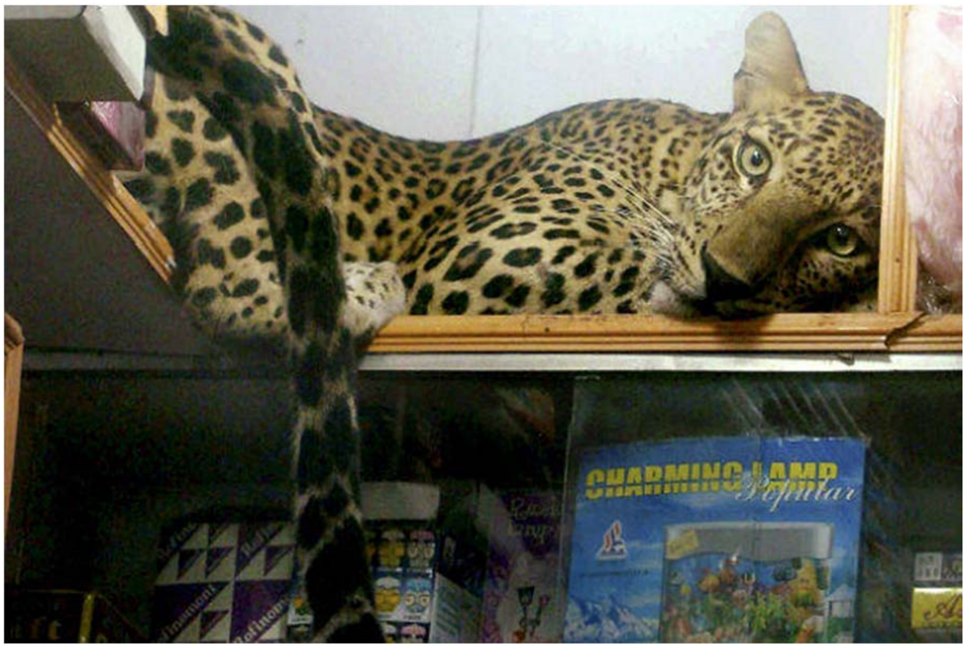

Figure 6.1. Leopard sitting on a store shelf in Sonepur District, Orissa, India in 2012 (picture by the Associated Press)

In India, the media reports that leopards are killed for a number of reasons. They are killed by local residents in retaliation for human deaths and livestock losses, shot by forest department officials to rid communities of man-eaters, they are poached for their hide and parts, and they are the victims of H-WC when hit by cars or caught in wire snares meant to protect crops or hunt bushmeat (Fernandes, 2013). Sometimes, these distinctions are not so clear as in the case of three tribal men who “poisoned a full-grown male leopard in the forests of Dhar district of Madhya Pradesh on June 1, 2013 to avenge the killing of a cow” (A. Singh, 2013) but who made off with the cats’ whiskers, presumably to sell.

Leopards in India are pelted with stones, shot, hunted with dogs, poisoned with carbofuran (an over-the-counter pesticide), electrocuted, axed, set on fire, and trapped with snares and speared through the mouth and bludgeoned. Local residents sometimes consume leopard meat (Goswami, 2013; S. Mishra, 2013). The most common scenarios in cases of H-LC conflict, though, are the shooting of leopards by community leopard hunters or forest department officials or the beating to death of leopards by angry mobs of local residents. For the most part, groups of angry villagers or poaching gangs kill leopards unless the killing is by a state sanctioned actor. In one case, “a full-grown female leopard was beaten to death by tea garden workers […] in Jorhat district after four workers, including a woman, sustained severe injuries in the big cat's attack” (The Times of India, 2013a). In another, “when [a leopard] was trapped in October, villagers from Lingarasanahalli reportedly pelted stones at the caged animal, killing it on the spot” (Mendonsa, 2013).

Although expressions of anger and distrust dominate in the Tsavo-Amboseli ecosystem and the Heidelberg area, the first emotion triggered by H-LC in India is fear. As one reporter said, “fear looms large on the minds of villagers” (Dahat, 2013). Leopard sightings trigger panic because villagers feel helpless to protect themselves (Sonawala, 2013). They are afraid to go about their daily activities, lest a leopard attack them. People move in groups outside villages, avoid going out at night, and carry sticks to protect themselves (Dahat, 2013). They also avoid entering the forest to collect firewood or other forest produce (Nayak, 2013). Yet, the most troubling change in behavior is that "villagers are reluctant to send their children to school fearing leopard attacks" according to a local teacher (Baitadi, 2013). The fear of attacks has literally changed the fabric of society.

The sense of fear and helplessness experienced by local residents also fuels anger at government officials, much like in South Africa. Local residents suffering from H-LC are angry at forest department officials' inaction in the face of leopard attacks on humans (H2, H3). As one villager put it: "[the] lackadaisical attitude of the wildlife officials has put our lives at stake" (Aarif, 2013). People feel that the forest department cares more about the wildlife than about the people. Since their actions are more reactive than preventive, if they act at all, local residents often say things like "you are waiting for something to happen, and only then you will act" (Overdorf, 2013).

The feeling that the government is failing them, the lack of official response, and the panic leopard sightings produce, gives local residents a rational to kill leopards themselves (H3). Community hunters who kill leopards at local residents' request, consider their work a public service (Gusain, 2013). The gratitude they receive from villagers validates their behavior, only adding to the problem of retaliatory killings.

Furthermore, the Wildlife Protection Act (WPA), which bans the hunting of all animals on Indian soil without a permit, gives local residents the impression that all wildlife is the responsibility of the government. As a result, they feel government officials should prevent attacks by "their leopards" (Rafiq, 2013) and are angry when they fail to do so. This anger is compounded by denials from government officials that H-LC is a problem and their attempts to blame villagers for causing attacks. In one such example, the Deputy Director of the Buffer Zone of the Tadoba Andhari Tiger Reserve, called leopard attacks on humans “accidents [and] a result of casualness on the part of villagers” (Dahat, 2013). In another, the forest department maintained that 8 human killings had only occurred in the forest when local villagers went to collect forest produce, when most of the attacks actually occurred within villages or on nearby roads. One reporter suggested “the culture of denial is so deeply embedded in forest bureaucracy that most officers refuse to accept that poachers continue to be a threat in their territory” (Mazoomdaar, 2013), even when newspaper articles regularly report on arrests of poachers and leopard carcasses found missing paws, claws, and teeth.

This culture of denial has led to general distrust between the forest department officials and local residents. Communication between actors, already poor to begin with, is now almost impossible, compromising conservation efforts (H3). Local residents complain that they report H-LC to forest department officials only to be told by them that they’ve received no reports (Nayak, 2013). Meanwhile, forest department officials complain that “people don’t cooperate with the department when it comes to catching these wild animals” (Aarif, 2013) and argue that they are attempting to solve the problem. Adding to their defensiveness is the fact that some families of forest department officials are involved in poaching (Shalya, 2013a).

Compared to the Tsavo-Amboseli ecosystem and the Heidelberg area, the level of animosity between the actors in India is much stronger. Villagers’ anger and distrust has resulted in local protests, beatings of forest department officials, and attacks on leopard rescue/translocation teams sometimes resulting in the death of the leopard before it can be removed (H3) (Dahat, 2013; Mendonsa, 2013; Overdorf, 2013; Rafiq, 2013). Even when forest department officials take steps to prevent H-LC, villagers take action into their own hands. In one such case, a forest official described the chaos engendered by villager-official animosity:

> "We got information about the leopard's appearance in the tea garden […]. Our staff [was] patrolling the entire tea garden to foil any attacks by the animal but due to the ruckus created by the locals, the situation turned out of control today. We finally opened fire in the air, but the garden workers brutally attacked the animal and killed it" (The Times of India, 2013a).

Meanwhile, official investigations of local residents who take matters into their own hands in such a way only add to the animosity between the parties.

This animosity also shapes the official response to H-LC in negative ways. Forest department officials often feel pressured by local residents and politicians to respond to leopard attacks quickly, without proper strategizing or requesting assistance from other departments that have implemented successful solutions. This pressure is both the social outcry when leopards kill humans but also the risk of violence from angry villagers. For instance,

> “A forest official requesting anonymity said the department was forced by agitated villagers to kill leopards. On one occasion, eight of his men were doused with kerosene and confined to a room by villagers who threatened to set them on fire if the man-eating leopard wasn’t killed. The official had to deal with the situation with no direction from his boss who had switched off his phone. With no space for negotiations, the man said he was forced to sacrifice a leopard. He agreed it was illegal and didn’t solve the problem, but at least, it appeased the villagers who set his staff free” (Lenin, 2013a).

Generally speaking, the media reported that the government response to H-LC had failed for a multitude of reasons. The first is a general tendency among forest department officials to delegate the problem to others without ever solving it. Such is the case in the above-mentioned quote where the official's boss was unavailable to handle villagers' anger at H-LC. Another examples is the "standard practice to play the jurisdiction card and disown animals that step out of park limits" (Mazoomdaar, 2013). Once an animal is no longer part of your jurisdiction, you are no longer required to find a solution to its problematic behavior or its death.

This "passing the buck" method comes in several other forms. One form is when "officers shy away from registering a poaching case. Instead a common reason is put forth [for a leopard death] like 'killed in territorial war' to avoid action from their higher-ups" (Naveen, 2013). Another is government officials who are told by their juniors of a H-LC and the need for a solution, say "yes we will do it," and never take action (Overdorf, 2013). It seems that at every point in the chain of command, individuals are afraid to acknowledge that the system is broken, that there are insufficient resources to address H-LC, and that nobody knows what to do and how to do it well.

Even when a poaching or retaliatory leopard killing case is recognized as such and forest department officials investigate, poor investigations by inexperienced and un-resourceful rangers make prosecutions difficult (Naveen, 2013). Conviction rates in Madhya Pradesh, for example, are less than 5%. The media regularly publicize arrests of poachers (mainly based on tips), but rarely report convictions. Meanwhile, there is little official incentive to do better. There is no initiative to build a motivated, trained and agile workforce and adequately incentivize it for consistent field results (Mazoomdaar, 2013).

Media articles often report mistakes on the part of forest department officials, mistakes that only add to local residents' and NPO personnel's distrust of government actors (H4). They are seen as less than competent. For example, attempts by forest department officials to tranquilize problem leopards have resulted in their death from medication overdoses (Mendonsa, 2013). In another case, forest department officials killed a leopard cub and injured another while trying to hunt a leopard that had attacked humans. Instead of admitting they had shot the wrong animal, they claimed they had accidentally hit the cubs while driving (The Times of India, 2013b). Attempts to cover up these mistakes, usually revealed by the media, only aggravate the distrust.

Government officials are struggling to protect wildlife and humans outside protected areas, but their approach sometimes goes against their own principles. Forest department officials often do not respect wildlife protection laws (WPA) or their own departmental guidelines on how to handle H-LC. Fayyaz (2013), for example, explained that one former wildlife department official told him that, "fearing action from the government and attacks from the public, wildlife officials rarely observe the law." Forest department officials will bypass getting a permit[72], and ask the police and security forces to shoot a problem leopard on sight (Fayyaz, 2013).

Adding to the problem is the general confusion among forest department officials about what the best practices are to deal with H-LC. There is a belief that one should spare leopards

[72] Only the Chief Wildlife Warden can declare a predator a man-eater and issue permission to kill it under the WPA.

that “accidentally” attack humans, but should shoot man-eaters, but there is neither a clear definition of what a man-eater is nor a foolproof way to identify one. As one reporter blatantly put it, “everyone -conservationists, villagers, and the Forest Department- agrees a man-eater has to be removed, but no one can say how to identify one” (Lenin, 2013a). This confusion only adds to the distrust, anger, and general animosity among actors as the “wrong” leopards are killed and human and livestock killings continue.

Throughout the articles in this analysis, man-eaters were described in conflicting terms. Man-eaters were leopards with abnormal eating patterns that ate when not hungry. At the same time, they were starving animals that could not catch wild prey because they were either too old, sick/hurt, or there was simply not enough wild prey around. Man-eaters attacked humans on purpose while also attacking them accidentally because they either mistook them for prey or were startled when trying to take cover in patchy forests during the day (First Post, 2013; Lenin, 2013b).

Regularly, media articles describe how the forest department killed a man-eater, only to have a human attacked near the previous kill sites the next day, presumably by the actual man-eater. Meanwhile, the forest department compounds its problems by using questionable local hunters to kill man-eaters and failing to fire them when they kill the wrong animal (V. J. Singh, 2013a). These hunters, often labeled “trigger-happy” or “reckless” in news articles (First Post, 2013; V. J. Singh, 2013a), described entirely ineffective ways of catching the “right” leopard. Their methods ranged from killing the leopard whose territory overlapped with the attack sites to killing any leopard seen next to a livestock carcass/human body to tracking the man-eater using the paw prints left at the site of an attack. NPO personnel and researchers discounted every method. Leopard territories can overlap so the presence of a leopard in a location does not guarantee it was responsible for the attacks in that area. Leopards are scavengers and will therefore eat a carcass they have not killed and pugmarks are not accurate to identify a particular leopard (V. J. Singh, 2013b).

H-LC interventions suggested by local stakeholders

When it comes to solutions to H-LC, translocations and killings of problem leopards seem to be the most common techniques used, but there is no consensus on their effectiveness or which local actors prefer. Some want translocations as a last resort when leopards attack people, others prefer killing problem leopards, and some want neither and prefer removal to captivity. Translocations seem to be causing more leopard attacks on humans according to Athreya et al. (2010). Identifying the right leopard to kill is problematic and has met with little success, while researchers argue that such killings create a territory vacuum that another leopard soon fills (Balme et al., 2009; Overdorf, 2013). Removal to captivity was successful in one case with no subsequent leopard attacks on humans when new leopards moved into the area, but this is more a stop-gap measure than a solution since space in zoos is limited (Lenin, 2013b).

The media and the actors they interviewed suggest a number of other possible solutions (see table 6.9). They fall into three categories: wildlife patrols, managing H-WC, and environmental education. Patrols focus on law enforcement efforts to prevent leopard killings through intelligence gathering and the creation of division-specific legal cells to help in proper evidence collection and prosecution of poachers. Some patrols would also monitor leopard movements to prevent leopard attacks on humans and livestock, but that is not their main focus.

Table 6.9. H-LC solutions suggested in media articles in 2013

Categories of H-LC prevention methods	Methods suggested in media
Kill problem leopards	Use camera traps to identify man-eaters
Translocation	Translocate to wild area
	Take into captivity
Patrols	Train forest department officials in anti-poaching measures
	Create legal cell for every forest division
	Smart patrol*
	Informants
	More inter-state cooperation for gathering & analyzing data
Manage H-WC	Better secure/protect livestock
	Floodlights near schools
	Round up stray dogs & keep in kennels outside villages
	Relocate villagers
Environmental education	Teach how to live with leopards
	Awareness programs after leopard sightings

* Patrol using special software combining satellite imagery and GPS to track animals and patrol where most needed.

Solutions to manage H-WC and environmental education focus on community empowerment and reducing attacks by teaching communities predation prevention measures. Lenin (2013b), for example, suggested that forest department official's efforts are ineffective because they focus too much on leopards. the focus of forest department officials' efforts is to blame for their lack of effectiveness (H4). He felt that the wildlife department should do more to help local residents and leopards co-exist without incident. "To live alongside leopards, farmers need help to secure their livestock and know how to avoid leopards. Instead, the well-intentioned [forest] department focused its attention on leopards" (Lenin, 2013b). Similarly, leopard researcher Vidya Athreya suggested that officials provide local residents with better tools to address H-LC: "Locals are familiar with the area and can keep a good vigil. They should be given facilities to alert the forest department immediately in case there's anything amiss" (Shalya, 2013b). Sonawala (2013) also reported that awareness programs, where local residents were taught about leopards and how to avoid H-LC, were particularly helpful at reducing the panic common after leopard sightings. These measures reduce local residents' helplessness in the face of H-LC and prevent retaliatory leopard killings. They also encourage local residents to become the eyes and ears of the forest department and report illegal killings.

Ultimately, though, media articles emphasized that the main problem with H-LC in India stemmed from the government's civic failures, not leopard behavior (First Post, 2013). Overdorf (2013) depicts the problem accurately in the following paragraph.

> "Local news stories of bloodthirsty man-eaters obscure an all too familiar reality: India's notorious civic failures, not Mumbai's leopards, are to blame for the killings. […] As many as a million tribal people and migrant laborers live in and around the urban wilderness and, because these communities have been ignored and neglected by the government, their settlements have actually spurred an increase in the leopard population and drawn the animals into the city, rather than driving them deeper into the forest. […] There is no garbage pickup and no plans to provide it, so the villages and slums attract legions of stray dogs. Fat and boisterous, these dogs have replaced the fleet deer and shy wild pigs to become the leopards' primary food source. There are no street lights, no sewers, and no toilets, so to relieve themselves children and women […] must squat in

> the dark near the rubbish heap — where leopards mistake them for their dogs, or settle for them, just the same."

India's urban planning, environmental conservation, and population management choices have created a landscape where human and leopard co-existence is necessary but fraught with problems, including leopard attacks on livestock and humans (H1). Its wildlife department's policies have either aggravated the problem or done nothing to address it. Public resentment against leopards (and other wildlife) has reached a tipping point and local residents are apathetic or unwilling to protect leopards or are complicit in illegal leopard killings (the definition of tolerance for leopard killing). A large overhaul of conservation and wildlife management practices is necessary to prevent such killings, be they from retaliatory killings or poaching.

4. Analysis part 4: GIS analysis of South African illegal leopard deaths

The last part of this analysis mapped environmental factors that contributed to H-LCs near Heidelberg (Western Cape Province) and in the areas surrounding Baviaanskloof conservation area and Greater Addo Elephant National Park (Eastern Cape Province). The purpose of this analysis was to examine what situational factors contribute to where humans and leopards conflict.

Two types of environmental situational variables are part of this analysis: 1) variables relating to where a H-LC incident took place and 2) variables describing when it took place. Eight variables center on location: main biome, parks overlap, river length, available prey, prey abundance, road length, main road length, and human settlement score. The latter category includes only the variable season. These variables were recorded for three grid cell categories: (1) grid cells were a H-LC occurred between November 1st, 2005 and April 1st, 2011 (experimental cells), (2) control grid cells adjacent to experimental cells (adjacent cells), and (3) control grid cells within a 4-grid cell distance of experimental cells (buffer cells).

As stated in the previous chapter, the hypotheses for this last analysis are:

H4.1: Retaliatory leopard killings are more likely to occur where human settlements overlap with leopard territory or habitat.

H4.2: Retaliatory leopard killings are more likely to occur where human settlements border leopard territory or habitat.

H4.3: Leopards are more likely to be illegally killed in areas of prime leopard habitat, when controlling for human settlement and road location.

H4.3b: Leopards are more likely to be killed in areas that provide poor leopard habitat, when controlling for human settlement and road location[73].

H4.4: Leopards are more likely to be killed in areas that provide poor leopard habitat during the dry season, when controlling for human settlement and road location.

Pre-analysis diagnostics were run to determine if the variables were normally distributed. Specifically, a Kolmogorov-Smirnov test revealed that all continuous variables were not normally distributed (see table 6.10). As a result, non-parametric tests were used for this

[73] H3 and H4 discuss the idea that leopard numbers determine the chance of an interaction that could turn into a H-LC. H5 and H6 have to do with the ease of catching prey and the chance that a leopard will resort to livestock predation if it cannot feed itself from natural sources.

analysis. Non-parametric tests were also employed because they require less perfect data than parametric tests and have fewer assumptions. They are thus better suited to dealing with small sample sizes (here N = 39), where error could be a major concern when interpreting the results (Field, 2005). Mann-Whitney and Kruskal-Wallis tests were run on the continuous variables: river length, available prey, prey abundance, road length, main road length, and human settlement score.[74] Chi-square and non-parametric correlations were used for the nominal and ordinal variables: season, main biome, and parks overlap. Exact significance was used to interpret the non-parametric test results because of the small sample size (N = 39).

Table 6.10. Kolmogorov-Smirnov test of normality for continuous variables

Variable	**Kolmogorov-Smirnov Test^**	
	Statistic	**Sig.**
River length	.211	.000*
Available prey	.247	.000*
Prey abundance	.340	.000*
Road length	.163	.010*
Main road length	.324	.000*
Human settlement score	.219	.000*

^ df = 39 for all variables.
* p = or < 0.01.

Continuous variables

[74] Another option would have been to use the Kolmogorov-Smirnov Z test. This test tends to have better power than the Mann-Whitney test in cases with sample sizes of less than 25 per group (Field, 2005). Kolmogorov-Smirnov Z tests were run and the same variable came out significant as in the Mann-Whitney tests. As the minimum sample size for Mann-Whitney is N = 7, it remained appropriate for this analysis with a sample size of N = 13 per group.

The differences in environmental factors between grid cell types were calculated in several stages. First, both types of control grid cells (adjacent and buffer) were grouped together and compared to the experimental grid cells. At this point, control cells did not seem to significantly differ from the experimental cells on any of the continuous environmental variables (see table 6.11). This suggested that locations were H-LC occurred did not have significantly different environmental characteristics (like river length, road length, prey availability and abundance, and human settlement score) than places where no H-LC took place (H4.1-H4.4).

Table 6.11. Mann-Whitney test comparing the environmental factors of experimental grid cells to those of all control grid cells

Variable	**Mann-Whitney U**	**Z**	**r**[75]	**Exact Sig. (1-tailed)**
River length	154.000	-.460	-.074	.331
Available prey	159.000	-.307	-.049	.381
Prey abundance	166.500	-.075	-.012	.474
Road length	166.000	-.089	-.014	.471
Main road length	136.000	-1.122	-.180	.136
Human settlement score	144.500	-.730	-.117	.237

[75] r is the effect size calculated using the following equation: r = Z / square root (N).

A Kruskal-Wallis test was then performed to compare the three grid cell types separately. The rational for testing the control groups separately was that adjacent control cells might have very similar environmental characteristics to experimental cells because of their proximity and might thus prevent us from seeing any significant results in the analysis. The Kruskal-Wallis test revealed that the location of H-LC was significantly affected by only one environmental determinant: main road length ($H(2) = 5.842$, $p = 0.05$) (H4.3 and H4.3b) (see table 6.12). To explore this relationship further, Mann-Whitney tests were done to compare experimental cells to adjacent control cells and experimental cells to buffer control cells separately.

Table 6.12. Kruskal-Wallis test comparing the environmental factors of all three cell types (experimental, adjacent control, and buffer control)

Variable	**Kruskal-Wallis H^**	**Exact Sig. (1-tailed)**
River length	.237	.444
Available prey	.099	.476
Prey abundance	.018	.496
Road length	2.150	.171
Main road length	5.842	.027*
Human settlement score	.546	.381

^ df = 2; * $p < 0.05$.

The Mann-Whitney test comparing the environmental factors of experimental grid cells to those of adjacent control grid cells found no significant difference between the two groups for any variables (see table 6.13). One possible reason for this, as mentioned previously, is that the adjacent control grid cells have too many similar environmental characteristics because they are located so close to each other.

The buffer control cells (median = 2.76), though, did significantly differ from the experimental cells (median = 0) for the length of main road that traversed them ($U = 51.000$, $p < 0.05$, $r = -.299$) (see table 6.14). $r = -.299$ represents a small to medium effect size; the threshold for a medium effect size is .3 (Field, 2005). These results suggest that buffer control cells, where no H-LC took place, had more mileage of main roads in them than experimental cells where a H-LC did take place. Although, this seems counter-intuitive because more main roads would mean more potential for humans and leopards to cross paths and a faster way for humans wishing to kill leopards to reach them, it is consistent with research by Dickson et al. (2005) and Schwab and Zandbergen (2011). These researchers found that large cats will rarely cross roads that are 2 lanes or larger (i.e. main roads), but will travel on dirt roads, which are most common in rural South Africa. More leopards are therefore likely to reside in areas with fewer main roads, so conflicts with humans would be more likely in such areas.

Table 6.13. Mann-Whitney test comparing the environmental factors of experimental grid cells to those of the adjacent control grid cells

Variable	**Mann-Whitney U**	**Z**	**r**	**Exact Sig. (1-tailed)**
River length	78.000	-.343	-.055	.372
Available prey	80.000	-.238	-.038	.417

Prey abundance	82.500	-.103	-.016	.465
Road length	69.000	-.796	-.127	.220
Main road length	84.000	-.035	-.006	.500
Human settlement score	73.500	-.564	-.090	.294

Table 6.14. Mann-Whitney test comparing the environmental factors of experimental grid cells to those of the buffer control grid cells

Variable	**Mann-Whitney U**	**Z**	**r**	**Exact Sig. (1-tailed)**
River length	76.000	-.453	-.073	.337
Available prey	79.000	-.289	-.046	.393
Prey abundance	84.000	-.026	-.004	.495
Road length	72.000	-.641	-.103	.272
Main road length	51.000	-1.869	-.299	.031*
Human settlement score	71.000	-.692	-.111	.251

* $p < 0.05$.

Nominal and ordinal variables

There was no statistically significant difference in main biome type, park overlap, or season for the three types of grid cells ($X^2 = 2.730$, df = 6, exact sig. (2-tailed) p = 1.000 for main biome type, $X^2 = 3.398$, df = 6, exact sig. (1-tailed) p = 0.396 for park overlap, and $X^2 = 2.476$, df = 2, exact sig. (1-tailed) p = 0.175 for season). Non-parametric correlations run between these variables and the three grid cell types were also not significant. As such, it appears that no season, specific biome type, or amount of protected area in a location plays a role in the location of H-LC conflicts.

Chapter summary

The results of this analysis paint three different, yet similar pictures of the human and environmental situational factors that create tolerance for leopard killings and facilitate H-LC and retaliatory killings in Kenya, South Africa, and India. In each of these locations, H-WCs and H-LCs are common, but retaliatory leopard killings only occur in South Africa and India. Table 6.15 below provides an overview of the situational factors in each of these places and organizes the results by research question.

Table 6.15. Results summary table organized by research question

Research questions	**Part 1: Kenyan interviews**	**Part 2: South African interviews**	**Part 3: Google Alert articles**	**Part 4: H-LC GPS locations**
• What is the scope and nature of illegal leopard killings within the study areas? • What form does H-WC driven retaliatory leopard killings take?	• No reported illegal leopard killings	• Retaliatory leopard killings for livestock losses common • Leopards shot or caught in gin traps, hunted with dogs	• Retaliatory leopard killings for human attacks common • Government shoots man-eaters • Leopards mainly shot or attacked by angry mobs	• Retaliatory leopard killing for livestock losses common • Leopards shot or caught in gin traps, hunted with dogs

What situational factors contribute to retaliatory leopard killings?	• Most suffered costs from H-WC
	• 1/3 received benefits from wildlife
	• All risked losses because pastoralists or crop farmers
	• Majority's economic status is medium
	• Biggest challenges to conservation: financial difficulties & resource competition
	• Resentment at government for corruption & not sharing revenue from national parks
	• Benefited from wildlife through bursaries, employment, & some compensation for losses
	• Fencing most popular solution to H-WC
	• More education & benefits
		• Belief that leopard predation should not occur
		• Killing rational: permits took too long, afraid of more losses/not catching leopard
		• Anger at costs from leopard & lack of government support
		• General distrust of authority
		• H-WC solution-specific distrust
		• Failure of government response to H-LC
		  o Slow & unwilling
		  o Inefficient methods
		  o Inadequate resources
		  o Inconsistent application of laws
		• Stakeholders generally agreed on best response: predation prevention methods
		• Farmers had innovative H-LC solutions
		• Most did not support conservation
			• Leopard sightings trigger panic
			• People feel helpless
			• Fear fuels anger at government
			• Failure of government response to H-LC
			  o Passing the buck
			  o Lack of training
			  o Confusion over best practices
			  o Mistakes & cover-ups
			• Most common response: translocation, culling
			• Killing rational: public service, lack of official response, protection
			• Belief government owns wildlife & should prevent H-LC
			• Government denial of problem
				Leopard killings more likely in locations with fewer main roads

	from wildlife = support conservation more • Costs from wildlife = support conservation less		• Blame public for H-LC • Strong distrust of & attacks on government • Government's civic failures exacerbate H-LC	

Chapter 7: Discussion and conclusion

Results summary

Similarities between study locations

The results from chapter 6 provide three different, yet similar pictures of what tolerance for leopard killing looks like. These locations in Kenya, South Africa, and India share several human and environmental situational factors that define locations where H-LC turns into retaliatory leopard killings.

In all three locations, the majority of the population is suffering from H-WC. In Kenya and South Africa, the conflict is leopard livestock predation, while in India it is a combination of human and livestock attacks. Local residents live with the daily threat of H-WC and constantly fear losses, financial or human, from wildlife. They also fear increasing economic and land-use pressures that jeopardize their livelihoods. Most local residents in Kenya and South Africa earn a livable income but lack the economic cushion necessary to sustain losses from H-WC. As result, tolerance for wildlife and its costs is limited.

The analysis of environmental factors that influence retaliatory leopard killings found that most killings in South Africa took place far from main roads. This is consistent with research on leopard behavior that found that large cats will rarely cross roads 2 lanes or larger, but will often travel on dirt roads, which are common in rural South Africa (Dickson et al., 2005;

Schwab & Zandbergen, 2011). In Kenya and India, where rural infrastructure is limited, the same pattern would be expected. Government neglect and a lack of access to basic services exacerbates an already tenuous relationship between humans and wildlife in these areas.

At the same time, local residents fail to consider the natural consequences of co-habitation with wildlife, like H-WC. Increased competition between humans and wildlife for natural resources is exacerbating these conflicts, yet residents in all three locations refuse to accept losses from H-WC. These unrealistic expectations leave them frustrated and angry when the inevitable conflicts occur, brought on by resource shortages and population pressure.

Meanwhile, antagonism between government, conservation, and public actors in the region continue to foster anti-conservation feelings in Kenya, South Africa, and India. The government's general denial that retaliatory killings and H-LC exist in South Africa and India frustrates local residents who bear the brunt of these problems. In all three locations, a history of problematic government policies for wildlife conservation has also frayed residents' relationship with authority. Through these policies, the government took ownership of wildlife either by passing laws to protect it or by appropriating public land to create conservation areas. This created an expectation among local residents that the government is responsible for protecting them from "its" wildlife. Unfortunately, government actors have invested little in H-WC prevention, leaving local residents to fend for themselves.

While taking away wildlife ownership and land rights, government actors have also refused or failed to provide needed financial support to these regions. South African livestock farmers receive no subsidies for their beef. There is little revenue sharing from successful conservation initiatives in all three locations. In India, the government is simply failing to provide for basic infrastructure, let alone compensation for losses due to H-WC, which can take 16-18 months to process (World Wildlife Fund, 2010, December). Fortress conservation's failure has left local residents feeling resentful for this government intrusion that does nothing to solve their conflicts with wildlife.

When conservation and government actors have tried to address H-WC in Kenya, South Africa, and India, their responses have generally failed. Local residents therefore associate conservation efforts with negative rather than positive outcomes (with the exception of bursaries in Kenya). These failures are two-fold. Some solutions have failed in practice for a variety of reasons: ineffective methods, general confusion on best practices, lack of resources, communication breakdowns, poor information/intelligence sharing between agencies and locations, inadequate application of laws, and low personnel morale or commitment to the job.

Other H-WC solutions, although moderately successful, have failed in the eyes of local residents because they do not meet their needs or expectations. One such example is bell collars in South Africa. Although some livestock farmers use bell collars, they report many problems with their use, while conservation organizations consider them an excellent predation prevention method. Farmers suggest they are ineffective for leopards but effective for caracal. They note the difficulty of using them correctly, by taking them on and off livestock regularly, because they put livestock out to graze several days at a time with limited human contact. Farmers are also unimpressed that they are not 100% effective against livestock predation, although they do reduce attack frequency. Regardless of why a solution failed, every failure adds to the negative view local residents have of conservation.

In Kenya, South Africa, and India there is deep anger and distrust of wildlife conservation authorities, both government and NPO. These emotions are the byproduct of conservation actors' failure to acknowledge the high costs of H-WC for local residents, the exclusionary and misleading nature of previous conservation policies, and the failure of proposed solutions to H-WC. That anger and distrust, though, is mutual. This is especially evident in India and South Africa when government and NPO personnel blame the victims of H-WC for being careless and shame local residents that retaliate against wildlife.

In all three locations, there is culture of distrust among the parties that gets in the way of conservation goals and renders everyone unable to see and acknowledge their common ground, which is often substantial. Each actor is entrenched in his/her mindset and unwilling to consider alternate viewpoints. They also have a hard time acknowledging the weaknesses of their solutions, making it difficult to improve on the status quo. Despite this unfavorable environment, these locations were also the best places to find solutions because local residents had ideas about how to deal with H-LC and retaliatory leopard killings. In fact, their solutions had a higher chance of acceptance and success because they took into account local lifestyles, mindsets, the physical environment, and were informed by past failures.

Differences between study locations

The reasons why retaliatory leopard killings are more common in India and South Africa, rather than Kenya, lie in the differences between these three locations. In Kenya, local residents have had some positive experiences with conservation initiatives, mainly through bursaries, but also through employment opportunities and revenue sharing. Most of the conservation initiatives in this area generate income and are therefore linked with economic opportunities in local residents' minds, especially for those with higher levels of education. At the same time, the government is taking steps to communicate with communities about their conservation strategies and asking for local input, creating a forum to discuss grievances and problems that arise from H-WC and conservation initiatives. This area also has small grassroots NPO programs that involve local residents in protecting the wildlife and natural habitat in which they live (the Lion Guardians program is one example of this). These programs foster goodwill among local residents by meeting an ongoing social and/or infrastructure need, like tracking lost livestock or helping reinforce corrals, while also educating residents about the need to protect carnivores for the good of the ecosystem.

This combination of open communication, sustainable economic incentives[76], and local-run grassroots programming, help residents accept the costs of living with wildlife. It gives them a stake in protecting the wildlife and natural habitat around them and empowers them to find non-lethal solutions to H-WC. Although problems of distrust among actors and talk of corruption among KWS exist, they do not dominate the conservation landscape in the area.

In South Africa, on the other hand, there are few income-generating conservation initiatives and ecotourism in the area is limited. Livestock/crop farming and game farms are the main sources of income, all of which suffer from leopard predation. Just like the juxtaposition of game and livestock farms causes problems when carnivores breed on game farms and feed on livestock farms, farmers also oppose conservation initiatives because they increase the leopard

[76] Even if they remain small incentives compared to the profits KWS makes from National Parks.

population and thus the frequency of H-LCs. Local residents view carnivore conservation as detrimental to their livelihoods because it increases the risk of livestock predation and decreases their ability to get rid of problem leopards.

H-LC is a recent problem in South Africa because rural population density was still low as of 20 years ago. As a result, local residents believe that H-LC “should not be happening” because it was not a problem before. This belief exacerbates local resistance to conservation initiatives, a resistance largely fueled by anger and distrust between government/ NPO actors and local residents and their shaming and blaming of each other for H-LCs. In contrast to Kenya, there are no positive incentives for wildlife conservation to counter-balance the antagonism and no efforts to put aside grievances and communicate openly. In this context, South Africa’s fragmented and often poorly enforced wildlife protection laws and the corruption that hampers effective law enforcement only add to the problem.

Although South African government, NPO, and public actors combined have the knowledge and experience to prevent H-LC and retaliatory leopard killings, they do not trust each other enough to agree on and implement effective solutions. The lack of economic incentives only increases livestock farmers’ unwillingness to embrace conservation since they feel they are being asked to risk financial losses from leopard livestock predation with no way to recoup those losses.

The gravity of leopard attacks on humans in India, in comparison to livestock predation, creates a deeper level of fear, anger, and resentment than in either Kenya or South Africa. The Indian government’s failed response to H-LC and their lack of accountability, with obvious victim blaming and disinterest in improving, drives retaliatory leopard killings. Local residents feel fearful and helpless in the face of a problem that they believe the government is responsible for solving, yet the government is shirking its obligations and failing to respect its own wildlife protection laws. Local residents' desperation and anger at being left to their own devices is driving assaults on government and NPO personnel as well as retaliatory leopard killings.

When Indian forest department officials do act, their confusion over best practices and the official H-LC response strategy erodes any trust local residents' may have in them. This confusion over best practices is reflected in the quotes officials give journalists and the fact that many news articles are filled with ecological inaccuracies. Contradictory beliefs about what leopards are "man-eaters" and how to identify them is just one example of this. Another is the forest departments' focus on relocating/culling leopards instead of teaching local residents predation prevention methods. Forest department officials' confusion often leads them to act before they think, resulting in mistakes when handling H-LCs. The subsequent cover-ups and defensive behavior to avoid public shaming for these mistakes only strain their relationships with local residents and other conservation actors further.

Each of these locations is at a different step in the process of preventing H-LC and retaliatory leopard killings. In Kenya, continuing to develop communication channels and small-scale community-driven conservation programs that meet local social and infrastructure needs is essential for protecting carnivores. In South Africa, the focus should be on beginning that process of open communication and building bridges between knowledgeable parties before discussing possible H-LC solutions. In India, education to empower local residents is the first step, while deciding on best practices for preventing and responding to H-LC comes next. Once both those goals are accomplished, working to reverse the anger and distrust between NPO/government personnel and local populations will be possible.

Recommendations

Solutions to the problem of H-LC and retaliatory leopard killings will require a coordinated effort between species experts, local populations, national wildlife management authorities, and NPOs. These solutions should abide by the following principles:

- They should be interdisciplinary, multi-pronged, and self-sustaining (Klenke et al., 2013). No solution is 100% effective, therefore it is best to approach the problem with multiple strategies. These solutions will also require long-term implementation so they should not rely on possibly unreliable outside funding to continue to operate.
- Local residents with a vested interest in protecting their communities and ecosystem[77] should drive and evaluate their implementation, with international actors' support (Klenke et al., 2013). Combining the expertise of international conservation actors and local residents who suffer from H-LC and commit retaliatory killings will result in more targeted and better designed conservation interventions that local residents are more likely to support and which are therefore more likely to succeed (Kansky & Knight, 2014).

[77] Generally speaking, this research found that local residents are invested in the future of their environment, even if their behavior does not always reflect this because they have difficulty seeing the long-term consequences of their actions.

- Choosing the right type of solution for the right location is key to the success of conservation interventions.

Governments' responses to illegal wildlife killings tend to focus on their corrosive effect on national security and link to other transnational organized crimes like narcotics and human trafficking. In doing so, they ignore the fact that most killings are linked to social issues rather than crime (Lin, 2005). Leopards are illegally killed in communities where local residents have no reason to protect leopards that impose costs on them and add to their struggles to earn a living. H-LC adds to the existing social strains these individuals face, especially as H-LC is on the rise because of global population growth and the industrialization of developing countries (Schaller, 2011). Applying targeted strategies to reduce H-LC is one thing, but, ideally, local residents also need to receive other forms of social support, like improved access to basic services or farming subsidies, to reverse tolerance for leopard killings. Solving the social issues behind illegal leopard killings is beyond the scope of this research, but SCP can provide the tools to reduce H-LC and its costs to a minimum, as well as some interventions to reduce social strain (see the "Reduce the provocations" column of table 7.2 below), thereby preventing most retaliatory leopard killings.

Past solutions have also tended to neglect landscape factors and failed to recognize that H-WC is not evenly distributed across the landscape (Klenke et al., 2013, p. 2). This research, identifying what situational factors make H-LC and retaliatory leopard killings more likely in an area, is meant to help conservation actors focus their limited resources on the most at-risk locations. Knowing where efforts should be targeted then allows them to come up with location-specific solutions using frameworks like SCP where the focus is on changing the environment to deter the offender. Changing the environment is the fastest solution to prevent H-LC and retaliatory leopard killings; interventions aimed at changing mindsets and criminal dispositions take far longer. SCP also provides more specific and practical measures to reduce H-LC and retaliatory killings than most other theoretical frameworks in criminology. Given the little time left to prevent leopard extinction, the more targeted, practical, and rapid the solution, the better.

Informal guardians and participatory crime analysis

The first step in designing an SCP-driven intervention to H-LC and retaliatory leopard killings is to create informal guardians to protect leopards (Pires & Moreto, 2011). One of the main findings of this research is that formal infrastructure to combat wildlife crimes is failing, be it legislation or law enforcement efforts. Wildlife authorities everywhere lack the money, resources, and training to adequately prevent illegal leopard killings. Although efforts to overhaul law enforcement and legislation are necessary, they could take decades, and other options, like informal guardians, are readily available now.

Every study area in this research had its own informal infrastructure to deal with H-LC. In South Africa, livestock farmers had a local farmer with leopard hunting dogs they used to track and shoot problem leopards. In Kenya, Maasai hunters knew how to track carnivores in the area and some local residents knew how to build fortified corrals to protect livestock from predators. In India, specific villagers act as designated hunters for problem leopards; even the government uses their services. This existing informal infrastructure is not always leopard conservation friendly or sophisticated, but it exists and communities respect it. It works for them where government and law enforcement initiatives have failed. Working within this existing infrastructure is the first step. The second step is to work with community members to make this infrastructure more effective and leopard conservation friendly.

Working within this informal infrastructure means empowering local residents to use their knowledge of the area to find H-LC and retaliatory leopard killing solutions that work for them, yet also abide by conservation principles. Participatory crime analysis offers a an ideal framework for this because it is based on the premise that local people know their communities best and that a collaborative process bringing together analytical skills and local knowledge produces better solutions (Liebermann & Coulson, 2004). During a participatory crime analysis workshop, local residents learn about crime prevention principles, draw where they live, and identify hot spots of crime. A moderator groups these locations onto one detailed map and residents visit the sites to photograph hot spots and discuss why crimes occur there. They then analyze the information and work together to find responses, creating a toolkit for preventing local crimes (Liebermann & Coulson, 2004).

The same approach could be used to brainstorm ways to prevent H-LC and retaliatory leopard killings. The SCP framework provides a starting point from which local residents, NPO personnel, and government actors can build a toolkit of predation prevention methods and retaliatory leopard killing solutions to use in their communities (Table 7.1 shows the SCP framework with examples of each technique). Combining local knowledge with SCP allies theoretically tested tools and practical knowledge for a better solution to H-LC and retaliatory killings, as intended in participatory crime analysis. A combination of techniques is more likely to achieve the maximum reduction in H-LC and retaliatory leopard killings. Table 7.2 offers a range of possible SCP-driven solutions to both problems based on the results of this research.

Table 7.1. Twenty-five techniques of situational crime prevention (Center for Problem-Oriented Policing, n.d.)

Increase the Effort	Increase the Risks	Reduce the Rewards	Reduce Provocations	Remove Excuses
1 Harden targets • Steering column locks and immobilisers • Anti-robbery screens • Tamper-proof packaging	**6 Extend guardianship** • Take routine precautions: go out in group at night, leave signs of occupancy, carry phone • "Cocoon" neighborhood watch	**11 Conceal targets** • Off-street parking • Gender-neutral phone directories • Unmarked bullion trucks	**16 Reduce frustrations and stress** • Efficient queues and polite service • Expanded seating • Soothing music/muted lights	**21 Set rules** • Rental agreements • Harassment codes • Hotel registration
2 Control access to facilities • Entry phones • Electronic card access Baggage screening	**7 Assist natural surveillance** • Improved street lighting • Defensible space design • Support whistleblowers	**12 Remove targets** • Removable car radio • Women's refuges • Pre-paid cards for pay phones	**17 Avoid disputes** • Separate enclosures for rival soccer fans • Reduce crowding in pubs • Fixed cab fares	**22 Post instructions** • "No Parking" • "Private Property" • "Extinguish camp fires"
3 Screen exits • Ticket needed for exit • Export documents • Electronic merchandise tags	**8 Reduce anonymity** • Taxi driver IDs • "How's my driving?" decals • School uniforms	**13 Identify property** • Property marking • Vehicle licensing and parts marking • Cattle branding	**18 Reduce emotional arousal** • Controls on violent pornography • Enforce good behavior on soccer field • Prohibit racial slurs	**23 Alert conscience** • Roadside speed display boards • Signatures for customs declarations • "Shoplifting is stealing"
4 Deflect offenders • Street closures • Separate bathrooms for women • Disperse pubs	**9 Utilize place managers** • CCTV for double-deck buses • Two clerks for convenience stores • Reward vigilance	**14 Disrupt markets** • Monitor pawn shops • Controls on classified ads. • License street vendors	**19 Neutralize peer pressure** • "Idiots drink and drive" • "It's OK to say No" • Disperse troublemakers at school	**24 Assist compliance** • Easy library checkout • Public lavatories • Litter bins
5 Control tools/ weapons • "Smart" guns • Disabling stolen cell phones • Restrict spray paint sales to juveniles	**10 Strengthen formal surveillance** • Red light cameras • Burglar alarms • Security guards	**15 Deny benefits** • Ink merchandise tags • Graffiti cleaning • Speed humps	**20 Discourage imitation** • Rapid repair of vandalism • V-chips in TVs • Censor details of modus operandi	**25 Control drugs and alcohol** • Breathalyzers in pubs • Server intervention • Alcohol-free events

Table 7.2. Possible SCP solutions to leopard livestock predation and retaliatory leopard killings

Increase the effort	**Increase the risks**	**Reduce the rewards**	**Reduce the provocations**	**Remove the excuses**
Harden targets: Bell collars Donkeys Smart collars	Extend guardianship: Keep livestock about to give birth in protected enclosures until they can rejoin the herd Encourage neighborhood "adoption" of local leopards to foster willingness to protect	Conceal targets*	Reduce frustrations: Subsidize farmers who set aside part of their land for conservation Offer lower beef prices to communities that ban bushmeat hunting	Set rules: Empower local residents to create their own rules Support local leadership for conservation projects Micro-loans for community conservation initiatives or local predation prevention efforts
Control access to facilities: Predator-proof corrals Fence in villages	Assist natural surveillance: Create phone app that predicts likely predation locations based on environmental conditions	Remove targets	Avoid disputes: Roundtables to discuss grievances and restore trust Build trust through information-sharing forums	Post instructions: Host workshops on how to live with/near leopards
Screen exits: Immediately investigate cases of "missing collared leopards" and canvas location of disappearance to prevent disposal of body	Reduce anonymity: Shame individuals who kill leopards using social media and elders (only in areas where distrust is NOT a problem)	Identify property	Reduce emotional arousal: Tick fever prevention efforts to reduce livestock mortality Insurance schemes to lessen economic blow	Alert conscience: *Provide alternative benefits* Bursaries Revenue sharing from eco-tourism Land restoration projects
Deflect offenders: Use "lion lights" (motion-sensitive strobe lights) that turn on when predators roam near corrals	Utilize place managers: Game-scouts & shepherds to track leopard movements and guard livestock when leopards nearby	Disrupt markets	Neutralize peer pressure: Harness peer pressure Develop label for livestock products recognizing leopard-friendly farms (like "organic"	Assist compliance: Anonymous cell phone app to report illegal killings Community enforcement liaison

Trap and neuter stray dogs, relocate them to a facility outside of village	Predation response team to respond to complaints of H-LC and create a prevention plan		label)	Regular visits by wildlife officials to establish a relationship
Control tools/weapons: Stop over-the-counter sales of pesticide, specifically carbofuran	Strengthen formal surveillance: Equip livestock with cell phones that track movement and call farmers when animals run from predators	Deny benefits: Develop livestock feed that makes animals taste bad to predators Immediately dispose of livestock carcasses to prevent leopard return to kill	Discourage imitation: Randomly move livestock around to different grazing areas to prevent recurrence of predation	Control drugs and alcohol

*Techniques in grey are not applicable to the problem of H-LC and retaliatory leopard killings.

Designing SCP-driven interventions

Only select parts of the 25 techniques are relevant for H-LC and retaliatory leopard killings, but all 5 main principles apply. Techniques for reducing the rewards of H-LC and retaliatory killings are limited because you cannot require livestock owners and local residents to stop raising livestock or move elsewhere (i.e. remove targets, human and livestock). Concealing targets is also difficult because leopards are expert trackers and can smell prey even if concealed. Identifying property is impossible since leopards have no sense of ownership and do not abide by human moral principles. Disrupting markets does not apply since perpetrators of retaliatory leopard killings rarely resell a leopard's carcass for fear of being caught. Finally, controlling drugs and alcohol (under "removing the excuses") is also irrelevant since these substances do not play a role in leopard behavior. They also rarely play a role in local residents' choice to kill a leopard in retaliation for livestock losses; deep-seated anger is the primary motivator here. Although alcohol can certainly exacerbate this anger, it is not the cause of it, as explained in chapter 6.

The remaining techniques offer some innovative and wide-ranging solutions to both H-LC and retaliatory leopard killings. There is no need to separate solutions to H-LC and to retaliatory leopard killings because both stem from the same root causes. It is just a question of where in the chain of human-leopard interactions you choose to intervene to prevent illegal leopard killings. In fact, working jointly on these different places in the chain can have a stronger positive effect on leopard survival then working solely in one place.

Increasing the effort for H-LC and retaliatory leopard killings

The majority of solutions in the “increase the effort” category of table 7.2 focus on limiting opportunities for leopard predation. Bell collars and donkeys protect the herd. Donkeys are already semi-accepted in South Africa and are cheap to buy. Bell collars are ill suited to the husbandry practices there, where farmers leave their livestock to graze in remote pastures for multiple days at a time. Nevertheless, they can be useful in Kenya where herders stay with the flock while grazing and so have the opportunity to take collars on and off regularly. Predator-proof corrals, ideally with wire mesh roofs and fencing at least a foot deep in the ground to prevent leopards from jumping or digging into enclosures, can be used at both locations. They will be easier to incorporate into the local lifestyle in Kenya, though, because agro-pastoralists there already bring their livestock in at night.

Fencing of villages is a possibility in India. Although fences can be difficult to maintain and pose some problems for migrating animals, they could be a first line of defense in communities where leopards wander into villages, especially if villages are small and far between. In India, trap and neuter programs to reduce stray dog populations near villages would go a long way to reducing leopard attacks on humans. Leopards roam near villages to feed on stray domestic animals. Limiting the number of stray animals would deplete this leopard food source and reduce leopard presence near villages. “Lion lights” with motion sensitive sensors could also deflect predators away from livestock corrals and from houses in both Kenya and India. Ideally, these methods are all applied in tandem for maximum protection.

Increasing the effort to commit retaliatory leopards killings can be done in two ways. One is to make killing tools less accessible. Banning over-the-counter sales of pesticides used to poison livestock carcasses and the use of wire/snare traps for hunting small game would help prevent some leopard deaths. They would not prevent shooting deaths in South Africa, but they would eliminate the more indirect and easy ways of killing leopards. The second method is to immediately investigate any cases of missing collared leopards to increase the risk that an offender is caught in the act before he can dispose of the body. If a collar suddenly goes silent and is far from the end of its battery life, chances are a leopard has been killed and its collar destroyed. Canvassing this leopard's last known location might increase the chances of arrest. This would require partnering with researchers and NPOs that track local leopard populations and could help wildlife officials build valuable relationships with conservation partners.

Increasing the risks for H-LC and retaliatory leopard killings

Solutions for "increasing the risks" of H-LC and retaliatory leopard killings focus on teaching livestock farmers and agro-pastoralists how to identify and manage leopard predation risk factors in their environment. The purpose of these interventions is to make leopard attacks on livestock and people more difficult so people are less likely to commit retaliatory leopard killings, thereby reducing both behaviors. South African livestock farmers noticed that leopards often attacked cows that wandered from the herd to give birth. A simple solution to preventing these deaths is to keep birthing cows indoors until they can rejoin the herd (Farmer 1, personal communication, August 17, 2011).

Technology can play a role in managing these predation risks. A simple cellphone application that predicts likely predation locations, based on some of the environmental factors discussed in this research, could allow livestock owners to make better decisions about where to graze their livestock and when to corral them for safety. This application can be combined with game-scouts that track leopard movements and warn farmers or selectively guard livestock when leopards are nearby (similar to the Lion Guardians' model (Lion Guardians, 2012)). Researchers that collar leopards might even consider sharing general leopard movement patterns[78] with livestock farmers if they see a risk of leopard predation on a particular farm. In India, where leopards and humans often live alongside each other without knowing it (Gates, 2013), education efforts in schools might focus on "adopting" local leopards and tracking their movements as part of the science curriculum to give families a sense of ownership and a positive connection to the wildlife around them. This might help create a willingness to protect leopards.

Another technological solution for thwarting leopard predation is equipping livestock with cellphones that track herd movement (Agence France Presse, 2012b). The cell phones are attached to sheep's neck and are set to turn on and call the farmer if the animal runs, often because a predator startled it. The farmer can then go scare off the leopard and/or bring his livestock to a protected enclosure until the danger passes. This invention is an example of local ingenuity: a South African farmer named Erard Louw created it after losing 27 sheep and 13 lambs to livestock thieves (Agence France Presse, 2012b).

[78] Sharing too much information with livestock farmers can be detrimental, though, if they decide to use the information to track a leopard and kill it (which has happened in the Heidelberg area of South Africa).

To deter farmers from taking matters into their own hands and killing leopards in retaliation for livestock losses, communities should consider implementing predation response teams to immediately address complaints of H-LC and work with livestock farmers to create a predation prevention plan that works for their farm. These teams do not have to be government-run. They can be an informal group of trusted community leaders, senior farmers, NPO personnel, and even government wildlife officials that choose to support farmers struggling with H-LC. The team should deploy as quickly as possible after a complaint to offer alternative solutions to retaliatory killings. The Corbett Foundation created a similar model for tiger predation near India's Corbett Tiger Reserve with positive results (World Wildlife Fund, 2010, December). In their case, they provided immediate financial compensation for losses while livestock owners waited for government compensation. A similar model might be possible in Kenya and other parts of India, where government compensation is an option. A better model, though, would be one where response teams focus on preventing future losses since compensation for past losses is not always possible and is generally unsustainable. Such a model could incorporate a farmer-run insurance scheme where each farmer in the community contributes to the fund and receives compensation based on the extent of his livestock losses. This could be an alternative to government compensation provided H-WC is not rampant in the area and all farmers agree to apply basic predation prevention methods on their farms to minimize livestock losses.

Reducing provocations for H-LC and retaliatory leopard killings

A possible predation prevention plan for a farm suffering from H-LC could include several solutions suggested under the “reduce the provocations” column of table 7.2. For example, the response team could suggest ways to reduce the farm’s livestock losses like randomly moving livestock around to different grazing areas to avoid repeat predation. Team members could also work with a farmer to reduce tick fever losses, which account for far more livestock deaths than leopards (Farmer 4, personal communication, August 18, 2011). If a farmer suffers less livestock losses overall, he may be more willing to tolerate the occasional leopard attack. Other predation prevention methods could fall under “reducing the rewards” of predation for leopards. It might be possible to develop livestock feed that makes their meat taste bad for predators and so discourages predation. Certain plants already deter herbivore predation by producing bitter-tasting toxins like caffeine and quinine, so developing this genetic technology is not impossible (Meadows, 2009). Response team members might also suggest that farmers monitor their flock regularly and immediately dispose of any carcasses to dissuade leopards from returning to a kill site and potentially eating more livestock.

Another option to reduce the provocations for both H-LC and retaliatory leopard killings is to give farmers incentives to conserve leopards. South African farmers complained of the lack of government subsidies during their interviews. Government wildlife officials could consider subsidizing famers who set aside part of their land for conservation and agree to implement certain predation prevention techniques. This would give farmers a financial incentive to tolerate some leopard livestock predation. Farmers who agreed to these terms could have the option to label their meat as “leopard-friendly” and sell it for higher prices to buyers, much like “organic” foods in the United States. South Africa is a developing economy (United Nations Secretariat, 2011) and the market for “luxury” and “organic” items is on the rise there ("Luxury brands turn to Africa as the next growth frontier," 2014; Nsehe, 2014). Creating a “leopard-friendly” label for meat products may provide a lucrative outlet for livestock farmers, one that could counter the losses they see from H-LC. In places like India, where bushmeat hunting of ungulates and other leopard prey is exacerbating H-LC, the government could offer lower beef prices to communities that ban bushmeat hunting, encouraging local residents to buy domesticated instead of wild meat.

Removing the excuses for H-LC and retaliatory leopard killings

Lastly, part of any SCP-based solution to H-LC and retaliatory leopard killings should include removing the excuses for these behaviors. The five relevant SCP techniques in this category are “set rules”, “post instructions”, “alert conscience”, and “assist compliance.” Setting rules and alerting one’s conscience should be modified because of the study area’s human context. Setting rules is problematic because most local residents resent that NPOs and government personnel in these areas come in and tell they what they can and cannot do on their land while failing to offer useful help for H-WC. A better option is to empower local residents to set their own rules for preventing H-LC and conserving wildlife. Two possible ways to empower them could be: 1) government wildlife officials and NPO personnel could support local leadership for conservation projects and 2) they could offer local residents micro-loans to develop and implement their own predation prevention methods.

Alerting one's conscience is also ill suited to these locations because residents are too focused on their immediate survival and that of their flock and livelihood to consider the long-term consequences of their actions (see footnote 17) (Leader-Williams & Milner-Gulland, 1993). They also do not consider killing leopards that attack humans or livestock to be wrong. Pangs of conscience are therefore unlikely to move them, but if local residents received some benefits from wildlife, they might be less willing to kill the reasons why they receive those immediate benefits. Possible benefits could include bursaries for school fees in Kenya and India or land restoration projects for farmers in South Africa. Several farmers, government officials, and NPO personnel mentioned sites where illegal vegetation clearing, soil degradation, and soil erosion into streams were a problem for crop farming and livestock raising (Farmer 1, personal communication, August 17, 2011; Government wildlife official 2, personal communication, August 19, 2011; NPO worker 4, personal communication, August 21, 2011). These sites were usually the result of unsustainable farming techniques by previous generations of landowners. Offering to clean up these sites would increase the value of farmer's land. It would also encourage farmers to consider the long-term consequences of their farming practices and might be the start of a discussion on protecting leopards and considering alternative predation prevention methods to retaliatory killings. In India, such discussions could take place during workshops on how to live with or near leopards. Several media articles noted that such awareness workshops, held right after leopard attacks on humans, helped calm local populations and were welcomed by communities (Singh, 2014; Sonawala, 2013). They provide an avenue for local people to vent their frustrations and fears, while also learning how to protect themselves and their livestock from leopard attacks.

Perhaps one of the most important ways to remove excuses to retaliatory leopard killings is to assist in the reporting of these events. Communities where these killings occur are often tight-knit, and local residents, even if they are against retaliatory killings, will probably have a hard time reporting neighbors without reprisal (Government wildlife official 2, personal communication, August 19, 2011). In such harsh environments, one must be able to depend on one's neighbors for help, which makes reporting them all the more difficult. Government wildlife officials can help by creating websites and cell phone applications where local residents can report illegal killings anonymously.

Government wildlife officials also need to establish a neutral and amicable presence in the community, in the vein of community policing officers. They should make a point to stop by every farm to introduce themselves and learn about farmers' struggles with H-WC and other issues. Alternatively, they could designate a community member to be a law enforcement liaison and act as a go-between between law enforcement and local residents. This latter option might work best in communities where elders play a leadership role and could act as impartial and respected go-betweens. This type of initiative has been helpful in Indonesia where wildlife officials regularly visit rural communities to monitor their problems with wildlife (Government wildlife official 4, personal communication, November 26, 2013).

Addressing distrust through conflict resolution techniques

Before any of these solutions and programs can be implemented, though, stakeholders must address the distrust that exists between local residents, government officials, and conservation NPO personnel. Part of creating informal guardians to prevent H-LC and retaliatory leopard killings requires fostering the willingness to intervene to protect leopards. According to Reynald (2010), the ultimate test of an informal guardian's capability, once a guardian is familiar enough with his or her environment and identifies an offender or crime in commission[79], is whether or not he or she chooses to intervene to disrupt the crime event. Willingness to intervene, though, is partly based on trust between informal and formal guardians. An informal guardian intervening to prevent a retaliatory leopard killing must trust that intervening will help protect the leopard, that local authorities will provide additional help if necessary (including prosecuting the perpetrator or providing alternative and effective H-LC solutions to retaliatory killings), and that he or she will not face retaliation from peers. Willingness to intervene also depends an informal guardians' sense of ownership of the animal and responsibility to protect it (Reynald, 2010). These requirements are not met in most of the study areas because of ongoing distrust between local residents, government wildlife officials, and NPO personnel.

In every study location, some level of distrust between actors hampered conservation and H-WC prevention efforts. The level of distrust in South Africa and India was crippling to the point where local residents would rather resort to their own stopgap measures than call in wildlife officials. Unless these tensions are aired in the open and fences are mended, recruiting informal guardians and implementing any of the above-mentioned solutions effectively will be nearly impossible. Lewicki and Tomlinson (2014, p. 104) state that "if individuals or groups trust each other, they can work through conflict relatively easily. If they do not trust each other,

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[79] These concepts are the two other requirements for informal guardians: availability and knowledge of context (see chapter 4).

conflict often becomes destructive, and resolution is more difficult." Stakeholders in the study areas are failing to prevent H-LC because of this lack of trust and because they refuse to acknowledge its existence. By failing to acknowledge the distrust, the conflict continues to generate animosity and pain, neither of which is easily forgotten and which prevents parties from listening to each other and believing what each other says. It is a circular problem because serious conflict often destroys trust and increases distrust, thereby making any conflict resolution more difficult to achieve (Lewicki & Tomlinson, 2014).

Part of the solution for retaliatory leopard killing in the study areas should include conflict resolution techniques[80] to reduce distrust and foster cooperation between local residents, government wildlife officials, and NPO personnel. In Kenya, the KWS has started holding community outreach workshops with the help of researchers, where they discuss what they are doing to prevent H-WC with local residents (Viollaz, 2006). This information-sharing forum helps local residents understand what solutions government officials are implementing. It also makes the KWS's actions seem less arbitrary and allows local residents to give feedback on whether or not these solutions are making a difference. Similarly, participatory crime analysis workshops improve relations between people and local law enforcement by empowering local residents to take an active role in protecting their communities from crime (Liebermann & Coulson, 2004). These sorts of events can be a place to openly discuss conflicts, but also to

[80] Conservation conflict transformation offers a similar framework with which to improve the effectiveness of conservation efforts. According to Madden and McQuinn (2014, p. 97), "principles and processes from the peace-building field inform conservation conflict transformation and offer useful guidance for revealing and addressing social conflicts to improve the effectiveness of conservation efforts." Its focus is on capacity building and conflict interventions.

showcase common ground between parties. Trust can then develop as stakeholders gain knowledge of each other and the reasons for each other's behavior (Lewicki & Tomlinson, 2014). These sorts of efforts are part of the SCP principle of reducing provocations by avoiding disputes.

During these information-sharing forums, there is always a risk that some actors will resort to shaming others for their beliefs and behavior. This is something that NPOs, like The Landmark Foundation, have attempted to reduce the anonymity behind and increase the risks of retaliatory leopard killings. They do so by either by outing illegal leopard hunters on social media or by reporting offenders to elders in indigenous communities. The Landmark Foundation, for example, posts pictures and names of local residents who have killed leopards on their Facebook page. Although this does reduce anonymity and could lead to criminal sanctions, it also adds to the anger and distrust that exists between stakeholders and reduces the chances of cooperation between local residents and NPO personnel. Limited shaming of entities, like governments or corporations, that exacerbate H-LC or fail to protect leopards is sometimes helpful to encourage a change in behavior, but such shaming should be used strategically and only in areas where distrust is not a crippling problem to leopard conservation.

Limitations of this research

While this research provides valuable information on the situational factors that influence where and why H-LC and retaliatory leopard killings take place, it is limited in several ways.

Data on wildlife crimes, especially illegal killings, are traditionally difficult to obtain and, if data exist, their quality is often poor (Clyne, 2014). The retaliatory leopard killing data used in part 4 of this research, although better than average, still suffers from some limitations. The first is the inevitable problem of observed versus unobserved cases of leopard killings. Like for crime in general (Maxfield & Babbie, 2008), observed leopard killings are likely only a small percentage of the actual number of killings that occur. This is especially true 1) for retaliatory killings because the perpetrator hides the carcass to avoid discovery and 2) for leopards because few accurate leopard population estimates exist. In an effort to reduce the number of unobserved killings, this research uses GPS collar and carcass recovery data from a small-scale NPO that is actively embedded in the life of the community. This NPO tracks the leopard population in the Heidelberg area and, like community policing officers, engages local residents to solve H-LC problems. Between their knowledge of local leopards and their ties to the community, NPO personnel collect some of the most accurate data available on H-LC and retaliatory leopard killings in the area, but unobserved cases are of course still possible.

The data for the independent variables in part 4 of this analysis come from different years. This is part of the difficulty with primarily using open-source data. The retaliatory leopard killing cases date from 2005 to 2011. All of the independent variable data come from a mixture of those same years, with the majority from 2009 (see table 5.7 for more details). Every effort was made to get data from the same year whenever possible, since data from 2009 are a fair middle ground for this range of leopard killing dates. The two most problematic variables were human settlement (dating from 2005) and prey abundance (dating from 2006). Both these variables are likely to have changed significantly from 2005-2006 to 2011. Fortunately, they change in predictable ways: increases in human settlement and a decrease in prey abundance due to habitat destruction (Graham et al., 2005; Schaller, 2011) (Woodroffe, 2000 in (Henschel, Hunter, Breitenmoser, Purchase, et al., 2008)). The influence of these variables on H-LC and retaliatory killings is thus probably under-represented in this study.

Part 4 was able to examine only a limited number of cases, 15 killings in 13 locations. The case-control design added 24 units from two control groups. Non-parametric tests were used because they are better suited to small sample sizes. The Mann-Whitney test, for example, has a minimum sample size of N = 7 (Field, 2005). Furthermore, the results from part 4 show that the only variable that was significant, main road length, had a strong exact significance value compared to other independent variables' significance values. If anything, this small sample size could have resulted in false negatives for other variables, but the fact that main road length was so strongly significant suggests that it plays an important role in the location of retaliatory leopard killings.

The snowball sampling method for the South African interviews and the small number of interviews (16 in total) is another potential limit, but snowball sampling was necessary to get such a tight-knit rural community to talk to a foreign researcher (Goodman, 1961). Being vouched for by a community member meant that farmers were willing to open up about their problems with leopards and their conflicts with NPO and government personnel. The amount of distrust between stakeholders described in chapter 6 might have affected some respondents' answers. This is more likely in email communications with government personnel where there was no established rapport. The amount of sensitive and detailed information given during in-person interviews and the range of opinions expressed, including controversial ones, suggest that most interviewees were honest in their responses.

That this researcher was female and young also helped obtain accurate information during interviews because, in such a male-dominated profession, a young woman was not considered much of a threat (Government wildlife official 3, personal communication, August 23, 2011). Farmers could therefore share sensitive information with this researcher because, even if repeated, her credibility among their peers would be limited. The choice not to take notes during these interviews likewise made interviewees more comfortable and allowed for more open communication about their problems with leopards. The downside of this method was possible content error when writing up interviews from memory, but the general points made by the interviewees would have been hard to forget. Any hesitation on content was noted in the interview transcripts and that information was excluded from the analysis.

Although the number of South African interviews is small, the diversity of the respondents and the depth of interviews (sometimes lasting 2-3 hours) helped produce more detailed information. The livestock and dairy farmers, conservation NPO workers, and government officials interviewed were chosen because of their varied positions on illegal leopard killings. Some were friendly towards local conservation efforts, but several others were strongly opposed to them. A couple of farmers were also actively involved in illegal leopard killings. The amount of detail discussed in these interviews provided good reference points from which to crosscheck facts based on data from other locations and scholarly and grey literature. Generally, the information given by respondents was consistent with known patterns of H-LC and retaliatory leopard killings.

The sample of Indian media articles used in part 3 of this research could have been biased in two ways. Media bias could have resulted in only the more sensational cases of H-LC and retaliatory leopard killings being included in the sample (Entman & Gross, 2008; Gordon, 2000). Any cases of H-LC not reported in the press would have gone unnoticed. Using Google Alerts to collect these articles could also lead to the inclusion of more western world sources because of Internet access and usage patterns (Strickland, 2014). The latter turned out not to be true, most articles came from developing countries' newspapers, especially Indian media, and the cases cited came from all over the continent, from small villages to large cities. Media bias was present because leopard attacks on humans rather than livestock received more column inches, but the range of H-LC scenarios reported, including livestock attacks, was consistent with what the scholarly and grey literature described (Athreya & Belsare, 2007; Athreya et al., 2010; Chauhan, 2011; Marker & Sivamani, 2009). As such, the articles presented a fairly accurate picture of the H-LC and retaliatory leopard killing situation in India, as good as possible without doing fieldwork in country.

Some measurement problems exist with the Kenyan interview data. The use of translators when conducting interviews adds a potential source of error if the translator mistranslated or misrepresented the interviewees' response. Translators were necessary because of the many dialects spoken in the Kenyan study area. Despite their downside, they were instrumental in putting local residents at ease and understanding the nuances of local opinions.

A more important measurement problem, though, was the use of the question "what is your attitude towards wildlife conservation-based income generating activities?" to assess general attitudes toward conservation. This question is problematic because of its complex structure and reference to a specific type of conservation initiative. A better question would have been "How do you feel about wildlife conservation?" with possible answer categories of negatively, positively or neutral. Responses to other questions about conservation in general, though, showed that there was some confusion about what "conservation" was (see footnote 65). Since most respondents were aware of local conservation-based income generating activities, asking their opinions on such initiatives was the next best alternative.

There are a number of limitations to the spatial analysis performed in part 4 of this research. The first is that the GPS points given by The Landmark Foundation for leopard killing locations were not always exact. Sometimes, they simply referred to the location of the farm where the leopard was killed. This was part of the reason for choosing a grid cell size of 5.4 km x 4.7 km. Since the average subsistence farm size in the Heidelberg area was 8.32 km^2 (Vink & Tregurtha, 2003)[81], the impact of an inexact leopard killing location is limited. The advantage of using a 5.4 km x 4.7 km grid cell as the unit of analysis was that it provided more environmental context. Unfortunately, this also meant aggregating some spatial data to that level of measurement. For example, biome type had to be aggregated to this level of measurement even though an area of 5.4 km x 4.7 km can include multiple biome types. The most common biome type was chosen when a grid cell had multiple biome types within it, thus introducing some error into the analysis. Fortunately, this problem only affected the variables biome type and human settlement (where the cell's mean value was used). The rational for allowing this type of error is

[81] No more recent estimate is available, but given the decline of South African agriculture in the last 20 years, it is unlikely that subsistence farm sizes have gotten larger (Wilson, 2009).

that the general environmental context is more important to this analysis than minor variations in biome or human settlement.

Second, measuring the variables prey availability and prey abundance also posed some challenges. Due to a lack of prey population counts in the study area, this research made two assumptions: 1) that if a prey's habitat overlaps a grid cell, that prey is available there and 2) that an average prey abundance score from a meta-analysis of all leopard prey studies was representative of prey abundance in the study area. These measurements are not ideal, but represent the best available data for the area. Future research might focus on getting proper prey population estimates in the study location.

Third, one risk of spatial analysis is the propagation of error from one processing stage to another. According to Burrough and McDonnell (1998), "the quality of outputs from a spatial analysis is a function of (1) the quality of the data, (2) the quality of the model, and (3) interactions between the data and the model. When data from different sources are combined, the effects of many different kinds of uncertainties (i.e. measurement errors, scale differences, temporal differences, and other factors) may also combine" (Lloyd, 2010, p. 19). Since this analysis involves data from 6 different sources, it is subject to such propagation of errors. Every effort was made to reduce the amount of error at each stage, as detailed through chapters 5 and 6.

A notable strength of this research is its use of multiple analytical approaches, study areas, and data sources. The scarcity of illegal leopard killing data and the poor quality and small sample sizes of existing data were the reasons for choosing this strategy. Replicating the results across multiple locations and with different data sources increased the reliability of this research's findings. Using data from 3 different countries also had the added benefit of cross-country comparisons. Nevertheless, it is important to note that the results of this analysis are meant to draw broad conclusions about H-LC and retaliatory leopard killings, not specific ones. The field of H-WC and retaliatory killing research, especially from a criminological perspective, is still young and more specific conclusions can be drawn as better data is collected. This is a starting point on which to build future research and conservation initiatives.

Concluding remarks

Despite growing awareness of the problem of H-WC and retaliatory killings, specifically H-LC and retaliatory leopard killings, NPOs and governments focus on poaching/wildlife trafficking and law enforcement responses. This focus is detrimental because it fails to recognize the important role H-WC plays in illegal wildlife killings and the potential local populations have to prevent them. Oftentimes, researchers discount the value of local contextual knowledge and practical experience.

This research offers a broad overview of the human and environmental factors that influence where and why H-LC and retaliatory leopard killings take place. Its major strengths are its focus on local residents' opinions on these issues and its application of SCP techniques to find solutions to both problems.

It emphasizes the importance of participatory crime analysis as a framework for identifying and implementing solutions to retaliatory leopard killings. It also suggests targeted SCP-driven interventions to reduce H-LC and retaliatory leopard killings using a combination of predation prevention methods and incentives to conserve wildlife. The goal of these responses is to increase acceptance of predators and the costs they inflict, while also reducing those costs to a minimum.

Future research should focus on finding effective ways to build trust among stakeholders. It should also focus on refining predictive models of where H-LC and illegal leopard killings are likely to take place so prevention efforts can be targeted to the most at-risk areas. Finally, collecting more quality data on illegal wildlife killings, retaliatory and poaching-related, is key to continuing research in this area. Isolated datasets exist, but a more concerted effort is necessary to collect data on a global scale and share it openly between researchers so conservationists have the tools they need to design effective interventions.

Appendix

- Table A1. Cases of wildlife & wildlife product seizures compiled in the TRAFFIC Bulletin “Seizures & prosecutions March 1997-October 2011”

Date	**Date accuracy**	**Country of seizure**	**Location of seizure**	**# arrested**	**Items seized**	**# of items seized**	**Notes**
7/15/96	estimated	India	Arunachal Pradesh		leopard skin	4	
8/19/96		India	Ambedkar Nagar, Bihar	3	leopard skin	1	
9/9/96		India	Rishikesh, Uttar Pradesh	2	leopard skin	1	
9/17/96		India	Delhi	1	leopard skin	2	
10/26/96		India	Dangs District, Gujarat		leopard	3	1 leopard and two cubs poisoned
11/1/96		India	Delhi	1	leopard skin	1	
11/3/96		India	Indore, Madhya Pradesh	1	leopard skin	1	
12/9/96		India	Chandigarh		leopard skin	2	taxidermist
7/11/96		India	Bomdila, Arunachal Pradesh		leopard skin	4	
10/31/96		India	New Delhi	2	leopard head	1	
3/13/97		UK	Portsmouth	1	leopard medicinal ingredients		
12/30/96	estimated	India	Pithorgarh and Uttar Pradesh (UP)		leopard	5	
1/20/97		India	Kohlapur, Maharashtra	1	leopard skin		
1/31/97		India	Satna, Madhya Pradesh (MP)	2	leopard skin	3	
2/1/97		India	Satna, Madhya Pradesh (MP)	1	leopard skin	11	
2/2/97		India	Satna, Madhya Pradesh (MP)		leopard skin	2	
2/10/97		India	Satna, Madhya Pradesh (MP)		leopard skin	5	
2/11/97		India	Andhra Pradesh (AP)	1	leopard skin	1	

2/18/97		India	New Delhi	2	leopard skin	1	
2/19/97		India	Khatauli (UP)	1	leopard skin	1	
2/19/97		India	Satna, Madhya Pradesh (MP)	2	leopard skin	2	
2/20/97		India	Sundernagar, Himachal Pradesh (HP)	2	leopard skin	1	
3/17/97		India	Darjeeling, West Bengal	1	leopard skin	2	
3/18/97		India	Corbett National Park (UP)	2	leopard bones	2.5 kg	
4/5/97		India	Calcutta	3	leopard skin	1	
4/13/97		India	Kondli, East Delhi		leopard skin	4	
4/17/97		India	Deeddag village, Sirmour District (HP)		leopard skin	3	
5/14/97		India	Bhuvaneshwar, Orissa		leopard skin	1	
5/15/97		India	Bhuvaneshwar, Orissa	2	leopard skin	3	
5/16/97		India	Vikas Nagar, Dehradun (UP)	5	leopard skin	8	
5/20/97		India	Vikas Nagar, Dehradun (UP)	1	leopard skin	2	
5/22/97		India	Dehradun (UP)	1	leopard skin	3	
5/23/97		India	Dehradun (UP)	1	leopard skin	4	
5/28/97		India	Cuttack, Orissa	1	leopard skin	1	
5/29/97		India	Nagpur, Maharashtra	1	leopard skin	3	
6/11/97		India	Bijnore District (UP)	1	leopard skin	1	
7/4/97		India	Shimla (HP)	2	leopard skin	4	
11/1/96	estimated	South Korea	Seoul		leopard skin	2	
11/6/97		India	Meghalaya, Assam		leopard skin	4	
12/18/97		Malaysia	Taman Datuk, Kandan Baru	1	leopard meat	1 kg	
4/15/98	estimated	Belgium	Zaventem airport		leopard skin	1	
4/15/1998*	**estimated**	**India**	**India**	**68**	**leopard skin**	**42**	
4/15/98	**estimated**	**India**	**India**	**68**	**leopard**	**7**	
2/6/99	estimated	China	Yunnan Province		leopard skin		
7/7/99		China	Fuzhou, Fujian Province		leopard skin		
2/15/99		India	Hoshangabad District, Madhya Pradesh (MP)	15	leopard skin	3	
2/24/99		India	Bilaspur (MP)	5	leopard skin	2	

4/19/99		India	Near Kanha Tiger Reserve, Balaghat District (MP)	15	leopard skin	6	
5/25/99	estimated	India	Near Melghat Tiger Reserve, Maharashtra	8	leopard skin	2	
11/8/99		France	Roissy airport, Paris		leopard skin	2	
12/20/99		India	Ghaziabad	3	leopard skin	50	
1/12/00		**India**	**Khaga, Uttar Pradesh**	**7**	**leopard skin**	**70**	**taxidermist**
1/12/00		**India**	**Khaga, Uttar Pradesh**	**7**	**leopard claws**	**18000**	**taxidermist**
7/15/1999*	**estimated**	**Thailand**	**Betong, Yala Province**		**Clouded leopard skin pieces**	**100+**	
7/15/99	**estimated**	**Thailand**	**Betong, Yala Province**		**leopard skull**	**1**	
7/15/99	**estimated**	**Thailand**	**Betong, Yala Province**		**leopard jaw**	**1**	
9/15/99	estimated	Vietnam	Vietnam		leopard	1	
1998		UK	London	1	leopard skull	1	
6/15/00	**estimated**	**India**	**India**		**leopard skin**	**86**	
6/15/00	**estimated**	**India**	**India**		**snow leopard skin**	**1**	
10/1/00	estimated	Belgium	Brussels		leopard skin	3	antiquers
6/8/01		Djibouti	Djiboutiville		leopard skin	9	
4/27/01		India	Kanpur, Uttar Pradesh	4	leopard skin	19	
4/27/01		**India**	**Lucknow, Uttar Pradesh**		**leopard skin**	**5**	
4/27/01		**India**	**Lucknow, Uttar Pradesh**		**leopard claws**	**10**	
8/8/01		China	Baoshan, Yunnan	2	leopard skin (pieces)	33	
4/9/02		Taiwan	Chiang Kai-shek airport		leopard skin	1	
2/15/02	estimated	India	Katni, Madhya Pradesh	2	leopard skin	4	
2/12/03		India	Matigara, North Bengal		leopard skin	20	
4/1/03		India	Dharchula		leopard skin	15	
4/4/03		Nepal	Halchowk, Swayambhu, Kathmandu	1	leopard skin	109	
10/8/03		China	Sansan, Angren County	3	leopard skin	581	
9/15/04		**France**	**Roissy airport, Paris**		**leopard skull**	**1**	

9/15/04		**France**	**Roissy airport, Paris**		**leopard skin**	**1**	
2002-7/2004		Italy	Rome, Prato, Bologna, Reggio Emilia, Milan		leopard medicinal ingredients		
6/1/04		Russia	Altai	2	snow leopard skin	15	
7/15/04	estimated	India	Chennai	1	leopard skin	2	
10/16/04		India	Rajasthan	1	leopard claws		
6/15/04	estimated	India	Shahdol	2	leopard skin	7	
2/1/05		**India**	**Patel Nagar, Delhi**	**4**	**leopard skin**	**38**	
2/1/05		**India**	**Patel Nagar, Delhi**	**4**	**snow leopard skin**	**1**	
2/1/05		**India**	**Patel Nagar, Delhi**	**4**	**leopard paws**		
2/1/05		**India**	**Patel Nagar, Delhi**	**4**	**leopard bones**		
1/15/05	estimated	Ethiopia	Addis Ababa	66+	leopard skin		
9/2/05		**Nepal**	**Rasuwa District**	**3**	**leopard skin**	**36**	
9/2/05		**Nepal**	**Rasuwa District**	**3**	**leopard bones**		
8/15/05	**estimated**	**Nepal**	**Kathmandu**		**leopard skin**	**1**	
8/15/05	**estimated**	**Nepal**	**Kathmandu**		**leopard bones**		
3/8/05		India	Mukherjee Nagar, Delhi	2	leopard skin	3	
4/6/05		India	Delhi	3	leopard skin	45	
7/29/05		India	Chhatarpur, Madhya Pradesh	1	leopard skin	30	
7/28/05		India	Bhopal	1	leopard skin	1	
1/10/06		India	Fatehpur, Uttar Pradesh		leopard skin	14	
1/10/06		India	Jabalpur, Madhya Pradesh	3	leopard skin	2	
4/15/07	estimated	Taiwan	Taiwan	1	leopard skin	1	
2/12/07		Nepal	Dhangadi, Nepal	3	leopard skin	5	
7/27/07		**China**	**Xining, Qinghai**	**1**	**snow leopard skin**	**27**	
7/27/07		**China**	**Xining, Qinghai**	**1**	**snow leopard head**	**3**	

7/27/07		**China**	**Xining, Qinghai**	**1**	**snow leopard skeleton**	**2**	
7/27/07		**China**	**Xining, Qinghai**	**1**	**clouded leopard skin**	**1**	
10/25/07		India	Karaundhi, Sonbhadra District, Varanasi, Uttar Pradesh	2	leopard skin	10	
8/10/07		Nepal	Nepal		leopard skin	2	
9/15/05	estimated	Nepal	Syphru Bensi, Langtang National Park	2	leopard skin	37	
1/29/08		**Thailand**	**Khub Pung village of Tambon Nam Kham**		**leopard**	**3**	
1/29/08		**Thailand**	**Khub Pung village of Tambon Nam Kham**		**clouded leopard**	**2**	
3/12/08		**France**	**Paris**	**1**	**leopard skin**		**taxidermist**
3/12/08		**France**	**Paris**	**1**	**leopard**	**1**	**taxidermist**
4/15/08	estimated	Cameroon	Douala, Littoral Province	2	leopard skin		
3/15/08	estimated	China	Xinjiang	6	snow leopard	4	
1/15/08	estimated	China	Shanghai	1	clouded leopard skin	1	
7/22/08		India	Almora	2	leopard skin	1	
7/27/08		India	Saharanpur	3	leopard skin	8	
7/28/08		India	Vikasnagar	1	leopard skin	1	
7/30/08	estimated	India	Chhattisgarh	2	leopard skin	1	
8/1/08		India	Delhi	1	leopard skin	1	
8/6/08		India	Vikasnagar, near Dehradun	1	leopard skin	1	
8/13/08		India	Dehradun, Uttarakhand	2	leopard skin	3	
8/6/08		**United States**	**Denver, Colorado**	**3**	**leopard skin**	**2**	
8/6/08		**United States**	**Denver, Colorado**	**3**	**leopard skull**	**1**	
4/3/09		Russia	Ussuriisk, Primorsky Province		Amur leopard skin	1	

11/15/08		Kenya, Congo, Ghana, Uganda, Zambia		57	leopard skin		
12/13/07		India	Gujarat	1	leopard skin	23	
3/20/09		**India**	**Manas National Park, Barpeta District**	**16**	**leopard skin**		
3/20/09		**India**	**Manas National Park, Barpeta District**	**16**	**leopard bones**		
10/15/05	**estimated**	**United States**	**Minnesota**	**1**	**clouded leopard**		
10/15/05	**estimated**	**United States**	**Minnesota**	**1**	**clouded leopard**		
2/24/09		United States	Smyrna, Georgia	1	snow leopard	1	
8/20/09		UK	London		leopard medicinal ingredients		
11/23/09		UK	Manchester	1	leopard medicinal ingredients		
7/21/09		Cameroon	Bafoussam	2	leopard skin	2	
10/19/09		China	Linchang, Yunnan Province		leopard skin	1	
7/15/00	estimated	India	Pinjore, Haryana	1	leopard skin	2	
7/26/09		India	Birhi, Chamoli	1	leopard skin	3	
9/16/09		India	Chhattisgarh, Kanker District	2	leopard skin	1	
10/10/09		India	Vikasnagar, near Dehradun	2	leopard skin	2	
9/20/10		UK	Aberystwyth	2	leopard	1	zoo owners, illegal display of live leopard
2/1/10	estimated	South Africa	North West Province	6	leopard parts		
10/11/10		Tanzania	Tanzania	3	leopard skin	8	
3/7/10		China	Manas County, Xinjiang Province	2	snow leopard	1	herders protecting livestock with traps

1/15/10	estimated	China	Luntai	5	snow leopard	2	
11/15/08	estimated	China	Yining	3	snow leopard	4	
4/14/10		**China**	**Dehong State, Yunnan Province**	**2**	**leopard skin**		
4/14/10		**China**	**Dehong State, Yunnan Province**	**2**	**leopard skeleton**		
2/26/10		India	Solan, Himachal Pradesh	4	leopard skin	4	
3/18/10		India	Basti (UP)	3	leopard skin	3	
6/28/10		**India**	**Devgadh Baria Taluka, Dahod District**	**2**	**leopard skin**	**4**	
6/28/10		**India**	**Devgadh Baria Taluka, Dahod District**	**2**	**leopard nails**	**4**	
1995	estimated	India	Delhi	1	leopard skin	1	
9/15/10		India	Chakrata Dehradun district		leopard skin	2	
9/15/10		**Vietnam**	**Hanoi, Hoang Mai District**	**2**	**clouded leopard skeleton**	**1**	
9/15/10		**Vietnam**	**Hanoi, Hoang Mai District**	**2**	**clouded leopard skull**	**3**	
1/19/11		Gabon	Gabon		leopard skin	12	
8/20/11		Thailand	Mekong River, Ban Tarn Choom, Ratana Wapi District		leopard	1	
5/16/11		Malaysia	Kampung Ayer Molek, Bukit Ibam, Muadzam Shah, Pahang	1	leopard parts	5	
5/13/11		Thailand	Suvarnabhumi International Airport	1	leopard	2	live baby leopards drugged and in suitcase
Key:							
*Incidents in **bold** with the same date correspond to the same incident involving multiple types of seized objects.		Leopard:	Snow leopard:	Clouded leopard:	Amur leopard:		
		Panthera pardus	*Panthera uncial*	*Neofelis nebulosa*	*Panthera pardus orientalis*		

- Table A2. Existing published studies with reliable illegal leopard killing counts

Study (Examples & excerpts in Appendix)	**Measures**	**How Data Was Gathered**	**Who Gathered Data**	**Area Covered**	**Time Period**	**Reliability (Poor, Fair, Strong)**	**Reasons for Reliability Score**
Grey Publications							
Environmental Investigation Agency & Wildlife Protection Society India (2006)	# of leopards and leopard products seized, # of individuals charged with poaching, # of people prosecuted for poaching	Seizure data compilation	Police, CITES Management Authority, WWF, TRAFFIC, News outlets	India, Nepal, China	1999-2006	Fair	Data gathered from biased sources like the media but range of sources may provide a good selection of cases, just not exhaustive.
TRAFFIC Seizures Bulletin	# of leopards and leopard products seized	Seizure data compilation	Departments of National Parks & Wildlife, Customs, law enforcement, CITES Management Authority, WWF, TRAFFIC, News outlets	Worldwide	1996-2011	Fair	Data gathered from biased sources like the media but range of sources may provide a good selection of cases, just not exhaustive.
Google Alerts	# of leopards poached, # of leopards and leopard products seized, # of humans killed by leopards	News articles, internet content	News outlets	Worldwide	4/28/12-2/9/13	Fair	Data gathered from biased sources like the media, news outlets limited to those with an internet interface.

TRAFFIC News Bulletin	# of leopards and leopard products seized	News articles	Non-profit personnel	Worldwide	2007-2013	Poor	Bulletins represent only a partial list of incidents based on preferences of its editor. Provides a good highlight of mediatized cases of poaching.
Peer-Reviewed Publications							
Balme et al (2010)	# of leopards poached, leopard mortality rates, prey availability & abundance rates	GPS collaring, carcass recovery	Non-profit researchers, University researchers	Phinda Private Game Reserve & Mkhuze, KwaZulu-Natal Province, South Africa	2002-2007	Strong	Data primarily taken from Panthera Munyawana Leopard Project (see below).
On-Going Research Projects							
The Landmark Foundation Leopard & Predator Project	# of leopards poached, leopard movements	GPS collaring, carcass recovery	Non-profit researchers	Western & Eastern Cape Provinces, South Africa	2004-2012	Strong	Researchers are embedded in communities where they are gathering data allowing them to access far more cases than those reported to law enforcement.

The Cape Leopard Trust Leopard Projects	# of leopards poached, leopard movements	GPS collaring, carcass recovery	Non-profit researchers	Cederberg, Boland, & Gouritz regions of the Western Cape Province, South Africa	2003-2012	Strong	Researchers are embedded in communities where they are gathering data allowing them to access far more cases than those reported to law enforcement.
Panthera Munyawana Leopard Project	# of leopards poached, leopard movements	GPS collaring, carcass recovery	Non-profit researchers	Phinda Private Game Reserve (and surroundings), KwaZulu-Natal Province, South Africa	2002-2012	Strong	Researchers are embedded in communities where they are gathering data allowing them to access far more cases than those reported to law enforcement.
Official databases							
KwaZulu-Natal Wildlife Crime Incidents Database	# of leopards poached	Law enforcement reports	Biodiversity research unit of KwaZulu-Natal Province	KwaZulu-Natal Province, South Africa	Unknown	Unknown	Data is unavailable to the public.
Interpol Environmental Crime Committee Ecomessages Database	# of leopards and leopard products seized	Law enforcement reports	Law enforcement agencies from INTERPOL member countries	Europe	Unknown	Unknown	Data is unavailable to the public.

Healthmap Wildlife Trade Database	# of leopards poached, # of leopards and leopard products seized	News articles, internet content, seizure data compilation, law enforcement reports, non-profit reports, user-submitted data	Non-profit researchers	Worldwide	2010-2013	Fair	Data gathered from wide range of sources but comparison with Google Alerts and The Landmark Foundation data suggests many cases are not incorporated in database.

- Figure A1. Kenyan interview questions[82]

1) Date & interview no.

2) Group ranch:
   a) Mbirikani, b) Kuku, c) Kimana, d) Rombo

3) Location

4) Sex:
   a) Female, b) Male

5) Ethnicity:
   a) Maasai, b) Kikuyu, c) Kamba, d) Tanzanian, e) Other

6) Level of education:
   a) No education, b) Primary, c) Secondary, d) University

7) Age:
   a) < 20, b) 21-30, c) 31-40, d) 41-50, e) 51+

8) Style of proprietorship:
   a) Owner, b) Tenant, c) GR member

9) What is your primary livelihood strategy?
   a) Agriculture, b) Pastoralism, c) Agro-pastoralism, d) Wildlife conservation, e) Other

10) List other important strategies:
    a) Agriculture, b) Pastoralism, c) Agro-pastoralism, d) Wildlife conservation, e) Other

11) How do you rate your economic status?
    a) High, b) Medium, c) Low, d) N/A

12) How do you rate the appropriateness of your primary livelihood strategy.
    To your needs:
    a) Not sufficient, b) Sufficient, c) Highly sufficient
    To environmental integrity:

[82] Please note that the word choice used in this questionnaire is based on the idioms and expressions commonly used in Kenyan English and may therefore be unfamiliar to an American or English speaker.

a) Not appropriate, b) Appropriate, c) Highly appropriate

13) Do you benefit in any way from the presence of wildlife in the area?
a) Yes, b) No
If yes, explain.
If no, what are the hindrances?

14) Is wildlife beneficial to other people?
a) Yes, b) No
If yes, who and how?

15) In what ways would you like to see wildlife utilized? (only give options if participant cannot give clear answer)
a) Ecotourism lodges, b) Hunting, c) Community sanctuary, d) Revenue sharing from government-controlled parks, e) Traditional uses, f) Other

16) Are you aware of any initiative involving wildlife utilization?
a) Yes, b) No
If yes, identify the initiatives

17) Is wildlife imposing a cost to you?
a) Yes, b) No
If yes, how?

18) Is there a public/communal cost to wildlife?
a) Yes, b) No
If yes, how?

19) Are there any measures put in place to improve human-wildlife interactions?
a) Yes, b) No
What are the initiatives and who has been responsible?
Have they succeeded?

20) Do you have any suggestions as to how the negative impacts can be reduced?

21) What have been the wildlife population trends?
a) Increased, b) Decreased, c) Stayed the same

22) Have you noticed any differences in ways in which Kenya Wildlife Service (KWS) or other stakeholders react to human-wildlife interactions?

23) Generally, have you been exposed to issues touching on wildlife conservation?
a) Yes, b) No

24) What is your attitude towards wildlife conservation-based on income generating activities?
a) Positive, b) Negative
Elaborate on your choice

25) If not for economic benefits/incentives, would you still support wildlife conservation?
a) Yes, b) No

26) Have you heard of the proposal by the government to hand over Amboseli National Park (ANP) to the Kajiado County Council?
a) Yes, b) No
If yes, from what source?

27) Irrespective, do you support or not support this proposal?
a) Support, b) Not support, c) Ambivalent
Why?

28) Is KWS mismanaging ANP?
a) Yes, b = No
How?

29) If the proposal fails, what would you want KWS to do in regard to ANP to gain your support?

30) Will the county council improve its management?
a) Yes, b) No
How?

31) If the proposal succeeds, how do you want the Park managed?

32) At a personal level, are you going to benefit from the envisioned change of management?
a) Yes, b = No
If yes, how?
If not, who will benefit?

33) In your opinion, what has been the biggest challenge to wildlife conservation in this region?

34) How should it be resolved?

35) What is your overall opinion of wildlife conservation within the area?

- Figure A2. South African interview questions

Questions for farmers with knowledge (first or secondhand) of poaching:

1) Why do you think poaching occurs?
    1. What factors make it easier/possible for poachers to operate?

2) What do local residents think about poaching?
    1. Are they for it or against it?
    2. Do they see the ills or just don't care much because the consequences of poaching do not directly affect them?
    3. Do they view the land and its resources as theirs to use as they please?

3) Do you know of anyone who poaches? If so, who are they (no names just background information on the person)?
    1. How many are there?
    2. Do they work in groups (organizational structure loose or strictly defined)?
    3. What are their financial circumstances?
    4. Do they have any specific knowledge or experience with wildlife?

4) Why do these people poach? What incentives do these individuals respond to (with an eye to using that to find an alternative to poaching)?

5) What negative effects have you personally felt in your community from poaching?
    1. Are there any indirect effects from poaching that you've noticed and that wouldn't be evident to the casual observer?
    2. Do most people in your community experience any negative effects from poaching?
    3. Is this a topic that comes up among community members?

6) Do you know where poachers unload their products (identify markets)?
    1. Who has access to these markets?
    2. Ask if possible to see such a market.

7) What do you believe would be the best methods to combat poaching in your area?
    1. What would it take to implement these methods?
    2. Who should be responsible for these efforts?

8) What obstacles currently exist to effectively combating poaching in your area?
    1. Are there any issues of corruption, cultural practices, lack of resources, or lack of interest from authorities?
    2. Are people in your area interested in helping stop poaching?

3. What perception do community members have of current anti-poaching efforts or of wildlife management personnel in general?

9) Have there been any previous efforts made to stop poaching in your community?
    1. Were they successful?
    2. What made them successful/unsuccessful?
    3. What would you have done differently than they did?
    4. Are they still being implemented? If not, why not?

Questions for law enforcement personnel who deal with poaching:

1) How does law enforcement determine whether or not a product is illegally poached?

2) How do you determine the point-of-origin of illegal wildlife products (apart from species/habitat location) so that you can combat poaching more effectively in that area?

3) Do you feel you have enough resources to work with?

4) What current policies and strategies do you have in place to stop poaching of local wildlife?

5) Do you have an idea of the extent of poaching in your area? How do you determine this?

- Table A3. Example of the leopard data collected by The Landmark Foundation

The Landmark Foundation Leopard Captures								
Date	**Number**	**Sex**	**Age**	**Location**	**Status**	**GPS Location**		**Notes**
9-Jun-10	1	Male	Adult	Heidelberg	Collared			Caught in a water reservoir and released on site.
8-Jun-10	1	Male	Sub Adult	Winterhoek Mountains	Died	33° 24.547'S	23° 41.808'E	Gin trap, between 24 - 36 hours, exposure and stress.
5-Jun-10	1	Male	Sub Adult	Rheenendal	Uncollared			23kg, good condition. Saw mother as it recovered and walked away.

- Table A4. South African respondents' beliefs about when and why leopards kill livestock

Why leopards kill livestock	Farmers	Government/NGO personnel
Lack of prey	Anatolian sheep dogs eat small prey	Farmers killing all small prey
Natural animal behavior	Grouping behavior of sheep, easy prey	Leopards acclimatizing to humans
	Cows leave troop for 2-3 days to give birth	
Husbandry	Dairy farmers see cattle more, cattle bigger	Insufficient checks on grazing livestock
	Small farms cannot rotate grazing locations	No clear headcount
Landscape & neighbor issues	Buffer farms	Buffer farms
	Game farm animals escaping, fed meat	
	Predators breed on reserves, eat on farms	

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