Towards Understanding Tolerance to Damage Causing Mammalian Wildlife

By

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Declaration

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Abstract

Human Wildlife Conflict (HWC) is increasing globally and has been recognized as a major priority by most conservation organizations. This is due to the impacts that both wildlife and stakeholders can have on each other leading to a loss of support for conservation in general. Understanding the drivers of these impacts is therefore critical to mitigating the impacts. While the main focus of research in HWC has been finding technological solutions to mitigating the tangible impacts of wildlife for humans so as to increase tolerance of stakeholders towards wildlife, recent findings have pointed to the fact that this approach may be an oversimplification of the problem. A number of qualitative reviews and theoretical models have therefore emerged proposing a wide range of factors that may be important and emphasize the more complex nature of HWC. These models however are not based on quantitative synthesis of the research on this topic and there are no widely accepted models being used. Therefore a primary aim of this project was to develop a tolerance to wildlife damage model that was based on a quantitative synthesis of the body of research that has investigated attitudes to damage causing mammalian wildlife. A second aim was to test the emergent model using a case study of urban baboon–human conflict on the Cape Peninsula of South Africa. Key findings from the meta-analyses were that contrary to conventional wisdom, damage is not always the most important driver of tolerance as it interacted with taxonomic group and stakeholder type in complex ways. For example, tolerance of ungulates and primates was proportional to the probability of experiencing damage while elephants elicited tolerance levels higher than anticipated and carnivores elicited tolerance levels lower than anticipated. A second meta-analysis aimed to determine if common patterns of variables explaining tolerant attitudes were present across a wide range of species, stakeholders and contexts. Results showed that the majority of publications measured variables with a low likelihood of explaining drivers of attitudes or did not quantify variables of generally high utility. A synthesis of the most important factors emerging from these meta-analyses together with additional constructs and theories from other disciplines relevant for addressing the complexity inherent in HWC was undertaken and the Wildlife Tolerance Model (WTM) proposed. The WTM hypothesizes that the net

outcome of the extent to which a person is exposed to a species as well as the types of meaningful events (positive or negative) determine perceptions of the costs relative to benefits of living with a species. This in turn determines tolerance. A second component predicts 11 inner model variables that may further drive perceptions of costs and benefits. Results from the case study showed support for the WTM where both outer and inner model variables were found to be important drivers of tolerance. A key conclusion is that although synthesis of research and theory development is time consuming and costly, theory development and testing is critical to achieve long term efficiency in conservation management because failure to target interventions at the most important drivers will be costly, both financially and in biodiversity loss.

Opsomming

Mens en wild konflik (MWK) is wêreldwyd aan die toeneem en word deur meeste bewaringorganisasies as ‘n prioriteit gesien. Dit is te wyte aan die impakte wat beide wild en belanghebbendes op mekaar kan hê, wat op sy beurt kan lei tot ‘n algehele vermindering in die ondersteuning ten gunste van bewaring. Dit is dus kardinaal om die drywers van sulke impakte te verstaan om sodoende die vermindering van hierdie impakte te bewerkstellig. Studies wat MWK in die verlede bestudeer het, was veral gefokus daarop om tegnologiese oplossings te vind om die tasbare impak van wild op mense te verlig en sodoende, die verdraagsaamheid van mense teenoor hierdié wild te verhoog. Onlangse navorsing dui egter daarop dat hierdie benadering moontlik die probleem eenvoudiger laat lyk as wat dit werklik is. Dit het gelei tot die ontwikkeling van verskeie kwalitatiewe oorsigte asook teoretiese modelle wat ‘n verskeidenheid faktore uitlig en gevolglik die komplekse aard van MWK beklemtoon. Hierdie teoretiese modelle is egter nie gebasseer op die kwantitatiewe sintese van hierdie onderwerp nie en daar is ook geen algeheel aanvaarde modelle om te gebruik nie. ‘n Primêre doel van hierdie studie was dus die ontwikkeling van ‘n model wat die toleransie teen die skade wat wilde soogdiere aanrig, aandui. Hierdié model is gebasseer op ‘n kwantitatiewe sintese van die beskikbare literatuur wat die houdings van mense teenoor wild, wat skade veroorsaak, ondersoek het. ‘n Tweede doel van die studie was die toetsing van hierdie opkomende model. Dit is gedoen deur gebruik te maak van ‘n gevallestudie wat handel oor die konflik tussen mens en bobbejaan in die Kaapse Skiereiland van Suid-Afrika. Belangrike bevindinge van die meta-analise is dat, in teenstelling met konvensionele wysheid, is skade nie altyd die belangrikste drywer van verdraagsaamheid nie, aangesien dit met beide die taksonomiese groep asook die tipe belanghebbendes, in komplekse interaksie verkeer. Die verdraagsaamheid van mense teenoor hoefdiere en primate was, byvoorbeeld, eweredig gewees aan die waarskynlikheid dat hulle skade sou ervaar, terwyl olifante ‘n hoër vlak- en karnivore ‘n laer vlak van verdraagsaamheid ontlok het, as wat verwag sou word. ‘n Tweede meta-analise het ondersoek of daar gemeenskaplike patrone teenwoordig is wat mense se houdings van verdraagsaamheid oor ‘n wye verskeidenheid van spesies, belanghebbendes en konteks kon verduidelik. Resultate het getoon dat die meerderheid publikasies veranderlikes gemeet het met ‘n lae waarskynlikheid om die drywers van houdings te verduidelik – of veranderlikes is

gekwantifiseer wat nie algemeen nuttig was nie. ‘n Sintese van die belangrikste faktore wat deur middel van die meta-analise geïdentifiseer is, asook bykomende konstrukte en teorieë vanuit ander dissiplines (relevant tot die aanspreek van die inherente kompleksiteit van MWK) is onderneem en daardeur is die *Wilde diere Verdraagsaamheid Model* (WVM) voorgestel. Die WVM hipotiseer dat die netto uitkoms van die mate waarin ‘n persoon blootgestel is aan ‘n spesie, asook die tipes betekenisvolle gebeure (positief of negatief) bepaal die persepsies van ‘n persoon ten opsigte van die nadele relatief tot die voordele, wat geassosieer kan word deur met ‘n spesie in samesyn te lewe. Bogenoemde bepaal dan die algehele evaluering van saamleef met spesies en uiteindelik ook verdraagsaamheid. ‘n Tweede komponent van hierdie model voorspel 11 innerlike model veranderlikes wat persepsies van voor- en nadele verder kan dryf. Resultate van die gevallestudie het ter ondersteuning van die WVM model beide innerlike en uiterlike veranderlikes getoon, waar albei veranderlikes belangrike drywers van verdraagsaamheid was. ‘n Belangrike bevinding is dat, alhoewel navorsingsinteses en teorie-ontwikkeling tydrowend en duur is, is teorie-ontwikkeling en toetsing van kritieke belang om langtermyn doeltreffendheid in bewaringsbesuur te verseker, want as ingrypings wat fokus op die belangrikste drywers misluk, gaan dit nie net duur wees nie maar ook ‘n verlies aan biodiversiteit tot gevolg hê.

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Chapter 1

Introduction

1. Human Wildlife Conflict as a conservation problem

Mammals are declining worldwide (Schipper et al. 2008; IUCN 2008; Di Marco et al. 2014). Although habitat loss, habitat degradation and harvesting pose the greatest threat to mammals (Cowlishaw & Dunbar 2000; IUCN 2008; Schipper et al. 2008), these indirectly promote human-wildlife conflict (HWC) as the declining wildlife habitats become smaller and fragmented resulting in an increase of contact between people and wildlife. Habitat degradation and fragmentation can decrease the quality of available food for wildlife leading to reduced prey availability for carnivores that may promote livestock and human depredation (Agarwala et al. 2010; Craigie et al. 2010) as well as increased crop raiding (Lee & Priston 2005). Competition between domestic and wild herbivores may also increase, reducing tolerance for wild herbivores (Bagchi et al. 2004). Climate change may increase HWC where wildlife moves into new areas as habitats shift (Regehr et al. 2007) and where wildlife and humans are forced to share declining water resources (Dapash 2002). The recovery of some species can also contribute to an increase in HWC (Southwick & Siddiki 1988; Ericsson & Heberlein 2003; Enserink & Vogel 2006; LaRue et al. 2012) as well as the encroachment of human development into wild lands (Heuer 1993; Kalan 2012). Protected areas are particularly affected when their surrounding areas become part of a matrix of human altered habitats (Mora & Sale 2011).

HWC has therefore been recognized as a growing concern globally and is identified by most conservation international organizations as a major priority (World Parks Congress 2003). The reason for this is twofold. Firstly, HWC can incur major costs to rural people's livelihoods (Conover 2002) and lives; secondly, it reduces support for conservation projects in general (Craven et al. 1992; Bangs et al. 1998). For example in the USA wildlife-related economic losses to agricultural producers exceeds $4.5 billion annually and 80% of land managers and ranchers suffered wildlife damage in 1992 (Conover 2002). In Uganda the cost of crop raiding to land managers around

Budongo Forest Reserve was between US96 - 519 per household per year where the average local salaries in the area are US 25 - 30 per month (Hill 2004). The loss of both human and animal life can be extensive. Between 1980 and 2003, more than 1,150 humans and 370 elephants died as a result of conflicts in NE India (Choudhury, 2004) and 47% of cheetah (Marker et al. 2003a), 46% of Eurasian lynx (Andre´n et al. 2006), and up to 50% of tiger (Miquelle et al. 2005) mortality has been attributed to retaliatory killing in certain regions (Inskip & Zimmerman 2009). In Tanzania human mortality from lions between 1998 - 2009 ranged form 10 - 140 people annually (Packer et al. 2011).

2. Complexity of human-wildlife conflicts

The failure of conservation biology to effectively ensure the persistence of ecosystems (GEO 2006) and species (IUCN 2008) has forced conservation biologists to evaluate the disconnection between biological knowledge and conservation success (e.g., Knight et al. 2008). This has led to a growing sense among scientists and practitioners that social factors are often the primary determinants of success or failure (Mascia et al. 2003; Knight & Cowling 2007). They point out that conservation interventions are the product of human decision making processes and require changes in human behavior to succeed. Thus, conservation policies and practices are inherently social phenomena, as are the intended and unintended changes in human behavior they induce. Recognizing that conservation is about people as much as it is about species or ecosystems has seldom been made explicit in conservation circles (Mascia et al. 2003) but is increasingly been recognized as important. Some argue that wildlife management in the 21st century should aim to manage interactions between wildlife and people to achieve goals valued by stakeholders (Riley et al. 2002). This requires conservation managers and policy makers to consider the values of stakeholders because their cooperation and support is essential to achieve conservation goals (Decker et al. 2011).

Human –wildlife interactions can be framed as occurring within Social– Ecological System (SES) where interactions between ecosystems, biodiversity and people take place (Mosimane et al. 2013; Jochum et al. 2014). Framing HWC within SES acknowledges HWC as a complex conservation problem that requires

multidisciplinary and transdiciplinary approaches (Game et al. 2014). Within this approach HWC can be defined as a type of biodiversity conflict (Bennett et al. 2001) consisting of two components: (i) impacts that deal with direct interactions between humans and wildlife species (Young et al. 2010); and (ii) conflicts between humans over how to manage the impacts between humans and wildlife.

Attempts to address the impacts of damage causing wildlife have been undertaken through research that aims to find sustainable management practices to mitigate wildlife damage. A general pattern revealed in these studies is that losses due to wildlife damage are spatially heterogeneous and of variable financial impact, with the majority of land managers undergoing minimal damage whilst a small number of land managers suffer substantial damages (Hill 2000; MacGowan et al. 2006; Maclennan et al. 2009). Physical /biological variables that can contribute to increased risk of damage include animal densities across habitat mosaics, field characteristics (size and proportion of edges adjacent to natural vegetation) and landscape-level habitat features such as the degree of landscape fragmentation, degradation, configuration and composition. Farming practices and husbandry and the biology of the species concerned are also factors (Siemer & Decker 1991; McIvor & Conover 1994; Van Tassel et al. 2000; Karanth 2002; Woodroff et al. 2005). Such projects can be beneficial and important for finding technological solutions. However, mitigation strategies require a multitude of approaches that may change over time and therefore no magic “bullet” solutions are available. Solutions may also be costly and may require ongoing funding. They are therefore of limited use if stakeholders are unwilling to implement them. A critical question is therefore what factors determine the willingness and types of mitigation strategies that stakeholders living with damage causing wildlife will support and implement?

3. Tolerance

Humans in evolutionary history have never been asked to tolerate wildlife. Avoidance or elimination of wildlife has always been the most cost effective way of dealing with undesirable wildlife and until recent history has been relatively sustainable. In the 21st century and given the current rate of biodiversity loss, a question is do humans have the mental capacity to tolerate damage causing wildlife? A second question is what

levels of tolerance are needed to ensure survival of populations and species? The first step to answering these questions is to understand the factors that drive tolerance. An additional question is to what extent do these factors apply across species and landscapes, as this would ensure optimization of resources.

The concept of tolerance in the HWC literature has generally been used interchangeably with the attitude concept (Naughton-Treves et al. 2003; Karlsson & Sjöström 2011). The attitude concept has been extensively applied in research into the human dimensions of wildlife management (Manfredo et al. 2008; Decker et al. 2012). Attitudes can be defined as a disposition or tendency to respond with some degree of favorableness, or not, to a psychological object, the psychological object being any discernible aspect of an individual's world including an object, a person, an issue, or a behavior (Fishbein & Ajzen 2010). The attitude construct has occupied a central position in social psychology (Allport 1935; Fiske & Taylor 2013), and specifically environmental psychology (Clayton 2012) and has been at the center of attempts to predict and explain human behavior (Fishbein & Ajzen 2010).

There is sufficient evidence in the HWC literature to conclude that individuals differ widely in their attitudes and tolerance towards wildlife. For example, 84% of Namibian land managers' who have a cheetah problem removed cheetah from their farm while 16% did not remove cheetah (Marker et al. 2003). While we tend to focus on the 84% that remove cheetah, which is what we expect, we tend to ignore the 16% who do not remove cheetah despite having a problem. What makes these 16% tolerant towards cheetah and how can we encourage at least some of the 84% to become more tolerant?

In another study of tolerance towards predators in Kenya, respondents were asked for the number of cattle and shoats (goats) they were willing to loose before trying to kill the predator responsible. The tolerance range varied for different wildlife species (Romanach et al. 2007). Why would ranchers be willing to sacrifice different amounts of cattle and shoats for different species? It is hard to come up with a financial explanation for this. In the same study, interviewees from a communal ranch who had lost livestock to a predator in the previous year, showed higher tolerance for cattle and

shoat attacks for some predators compared to interviewees who had not lost livestock the previous year. Why would people who had experienced livestock depredation increase their tolerance?

A common assumption among HWC practitioners is that human tolerance to wildlife will be related to the extent of damage, such that land managers who experience high losses will have more intense negative attitudes towards wildlife. Many studies support this. For example individuals reporting a loss to a wolf or other predator were more likely to favor reducing or eliminating Wisconsin's wolf population (Naughton-Treves et al. 2003) and Namibian land managers who perceived cheetah as "problem" animals on their farms removed significantly more cheetahs annually than land managers who did not consider them problematic (Marker et al. 2003). For beavers, a positive correlation between negative attitudes and experience of beaver damage was found. In addition, acceptability of lethal beaver control was also greater among people who had experienced beaver-related problems, and across groups, people were more likely to support lethal control as the intensity of the human-beaver interaction increased (Siemer et al. 2003). Diminishing tolerance levels were also reported as a landowner's economic dependence on the land increased (Lacey et al. 1993). On the Cape Peninsula in South Africa, residents who experience higher frequencies of raiding by baboons are more likely to dislike baboons however once mitigation schemes were implemented there was an increase in the proportion of residents that liked baboons (Kansky & Gaynor 2000).

The relationship between damage and tolerance is, however, not always linear. For example, compensation payments to land managers who reported predation by wolves did not increase their tolerance towards wolves as measured by their vote to reduce the wolf population (Naughton-Treves et al. 2003). This suggests that the monetary value of the loss is not the only consideration in determining tolerance. Dickman (2010) points out that: *"On the face of it, conflict resolution should be a relatively simple endeavor, with the expectation that once the appropriate strategies have been put in place to deal with the reported issue, animosity towards the species concerned should abate. Unfortunately, evidence suggests that complete, long-term conflict resolution is rare, even where such strategies have been implemented (Marker 2002; Webber et al. 2007). This suggests that despite most people citing direct wildlife*

damage as the reason for their antagonism towards wildlife (Sillero-Zubiri & Laurenson 2001), the causes of conflict are often complex and deep-seated, and a broader approach must be utilized in order to ameliorate such conflict fully in the long term."

Socio-economic parameters and political and cultural/religious considerations can also affect human perception and tolerance to wildlife damage (for a review see Dickman 2010). For example an individual's cohort identity (bear hunter, livestock producer or general resident), education level, and the gender of the respondent were important factors in determining tolerance to corn and soy bean crop damage (MacGowan et al. 2006) and education level, feelings of moral obligation to conserve big game, and whether a rancher felt inconvenienced by the presence of big game, also affected tolerance levels to wildlife in Wyoming (Van Tassel et al. 2000). Political values and conflicts over land use and government policies may also shape people's attitudes and tolerance towards wildlife (Nie 2001; Hill 2004; Dickman 2010). The Masaai in Kenya killed endangered lion to protest government policies and as cultural rituals in addition to livestock depredation (Frank et al. 2006). Cultural values and norms can also affect rancher's willingness to use lethal control of jaguars in the Pantanal region of Brazil (Cavalcanti et al. 2010). In felid –human conflict socioeconomic factors as well as a combination of socio-cultural factors such as belief systems, educational and value systems and religion affected tolerance (Inskip & Zimmermann 2009).

The importance of understanding individual attitudes of land managers toward wildlife is considered important because negative misconceptions can affect their willingness to manage their lands for wildlife (Conover 1998; Cavalcanti et al. 2010; Dickman 2010). MacGowan et al. (2006) found that regardless of the amount of damage, whether real or perceived, landowners varied on the level of damage that was tolerable to them. For some, no damage was tolerable therefore "*it is important for wildlife biologists and educators to acknowledge individual differences in tolerance levels when working with agricultural producers. What is tolerable damage to one individual may not be tolerable to another, and thus, should not be dismissed as insignificant."*

An attempt to incorporate variation in tolerance towards wildlife in a government compensation schemes was addressed by Heigh et al. (2001) who suggest that a welfare value may be a more appropriate measure for calculating wildlife damage instead of the market value of the loss. This value incorporated the variability of land managers' tolerance to wildlife damage because some land managers may receive benefits from wildlife and a damage estimate should attempt to net these benefits from the value of yield losses. They derived a welfare measure for net losses from wildlife benefits and then developed and applied an econometric model to estimate the welfare loss from wildlife damage. Their model showed that other damage models based on yield loss might overstate damage by 50% because benefits from wildlife are not netted out. This difference between the value of yield loss and the welfare measure of damage indicated that for that particular study most land managers were willing to tolerate the wildlife damage they experienced (Heigh et al. 2001).

Research on stakeholder attitudes and perceptions to living with wildlife has expanded rapidly in recent years with the goal of understanding the drivers of tolerant behavior. This research is largely undertaken as individual case studies and to date no quantitative synthesis of the outcomes of these studies are available. This hinders progress in the field as synthesis is critical to knowledge and wisdom production that in turn enable improved links with decision making (Costanza 2009). Further, although a number of theoretical framework and reviews that identify drivers of tolerance have been proposed (Carpenter et al. 2000; White et al. 2009; Dickman 2010, 2012; Carter et al. 2012; Zajac et al. 2012; Bruskotter & Wilson 2014; Jochum et al. 2014) these are not based on a quantitative synthesis of the field resulting in a lack of widely accepted or used frameworks. This prevents identification of possible important drivers of tolerance and the extent to which they can be applied at broader spatial scales. Landscape approaches are increasingly being recognized as most cost effective in conservation policy (Millennium Ecosystem Assessment 2005; Sayer et al. 2013). This project aims to address this problem by quantitatively synthesizing this large body of research in order to identify factors, if any that can explain tolerant attitudes across a broad range of species and context. It then proposes a conceptual model based on this synthesis as well as reviewing concepts and theories from additional disciplines. Lastly, the conceptual model is tested using a case study of urban primates on the Cape Peninsula of South Africa.

4. Project goal, objectives and thesis structure

The project goal was:

To propose and test the utility and efficacy of a tolerance to damage causing wildlife theoretical model, in order to guide future research and management of the human dimensions of wildlife conflict.

Three project objectives were identified in order to achieve the above goal:

1. To conduct a quantitative review of the attitude and tolerance literature in order to identify key factors driving attitudes of stakeholders towards damage causing mammalian wildlife.
2. To synthesize results of the quantitative reviews as well as review additional relevant disciplines in order to construct a conceptual model that can be applied across species and cultures, incorporates the complexity of HWC as a SES and is useful as a practical research and conservation tool.
3. To test the utility and efficacy of the conceptual model using a case study of baboon-human conflict on the Cape Peninsula, South Africa.

To achieve the first objective, two meta-analyses were conducted that are reported in Chapters two and three. Chapter two identifies the broad factors that were commonly reported in studies of attitudes towards four groups of medium and large damage causing mammalian wildlife: carnivores, ungulates, elephants and primates. The variables that could be extracted were stakeholder types, species group, species, country, the type of question used to illicit an attitude, the proportion of respondents with a positive attitude and the proportion of respondents that experienced damage. These were then analyzed to determine which of these factors were important in explaining positive attitudes. A tolerance to damage index was developed that measured the proportion of respondents with positive attitudes relative to the proportion that experienced damage and this was used to compare tolerance for different species groups for different stakeholder types. Chapter three extracts the variables that were examined by authors in each of the studies comprising the meta-analysis and the extent to which they explained attitudes towards all species. Each variable was then reported as either significantly contributing to explaining the

attitude or not. The variables were then coded into categories and sub-categories and the number of times each category significantly explained attitudes was calculated in order to discover if there were key categories explaining attitudes for all species.

A synthesis from the meta-analytical results as well as a review of a wide range of disciplines and sub disciplines such environmental psychology, social psychology, economic psychology, human-animal relations (geography, anthropology, sociology), Commons Research and Human Dimensions of Wildlife was undertaken in order to identify additional potentially important variables that could be important for the practical management of HWC. The Wildlife Tolerance Model (WTM) was then proposed in Chapter four (Objective two). The model consists of two sub-models; an outer and inner model. An overview of the model is provided together with justification of its components and a schematic diagram. Some hypotheses are provided to guide future research and to test the model.

Chapters five and six address objective four and report on results of a survey conducted on the Cape Peninsula, South Africa in order to test the two sub-models of the WTM. Chapter four tests for evidence supporting the outer model of the WTM while Chapter five examines the role of the inner model variables in driving tolerance towards baboons by residents in five residential areas.

The chapters are written as papers with each consisting of an introduction, methods, results and discussion section. Therefore some repetition between the chapters was inevitable. Chapters two and three have been published and therefore some differences in formatting are evident. Chap two is published in the journal Conservation Biology as: Kansky, R., M. Kidd, and A.T. Knight. 2014. A meta-analysis of attitudes towards damage – causing mammalian wildlife. Conservation Biology 28: 924-938. Chapter three is published in the journal Biological Conservation online preview as: Kansky, R., and A.T. Knight. 2014. Key Factors Driving Attitudes Towards Large Mammals in Conflict with Humans. Biological Conservation, 179: 93-105.

The appendices for each chapter and the references for all chapters are provided at the end of the thesis.

Chapter 2

Meta-Analysis of Attitudes toward Damage-Causing Mammalian Wildlife

Published as: Kansky, R., M. Kidd, and A.T. Knight. 2014. A meta-analysis of attitudes towards damage – causing mammalian wildlife. Conservation Biology 28: 924-938.

Abstract

Many populations of threatened mammals persist outside formally protected areas, and their survival depends on the willingness of communities to coexist with them. An understanding of the attitudes, and specifically the tolerance, of individuals and communities and the factors that determine these is therefore fundamental to designing strategies to alleviate human-wildlife conflict. We conducted a meta-analysis to identify factors that affected attitudes toward 4 groups of terrestrial mammals. Elephants (65%) elicited the most positive attitudes, followed by primates (55%), ungulates (53%), and carnivores (44%). Urban residents presented the most positive attitudes (80%), followed by commercial farmers (51%) and communal farmers (26%). A tolerance to damage index showed that human tolerance of ungulates and primates was proportional to the probability of experiencing damage while elephants elicited tolerance levels higher than anticipated and carnivores elicited tolerance levels lower than anticipated. Contrary to conventional wisdom, experiencing damage was not always the dominant factor determining attitudes. Communal farmers had a lower probability of being positive toward carnivores irrespective of probability of experiencing damage, while commercial farmers and urban residents were more likely to be positive toward carnivores irrespective of damage. Urban residents were more likely to be positive toward ungulates, elephants, and primates when probability of damage was low, but not when it was high. Commercial and communal farmers had a higher probability of being positive toward ungulates, primates, and elephants irrespective of probability of experiencing damage. Taxonomic bias may therefore be important. Identifying the distinct factors explaining these attitudes and the specific contexts in which they operate, inclusive of

the species causing damage, will be essential for prioritizing conservation investments.

1. Introduction

1.1 Human Dimensions of Conservation and Human-Wildlife Conflict

Understanding and empowering people through conservation initiatives is widely regarded as essential for implementing effective conservation initiatives (Smith et al. 2009; Minteer & Miller 2011). However, integration of the natural and social sciences has been slow (Mascia et al. 2003; Saunders et al. 2006; Decker et al. 2009) and remains a major challenge (Jentsch et al. 2003; Gilbert & Hulst 2006). Effective wildlife management in the 21st century should therefore aim to manage interactions between wildlife and people to achieve goals valued by stakeholders (Riley et al. 2002). This requires conservation managers and policy makers to consider the values of stakeholders whose cooperation and support is required to achieve conservation goals (Decker et al. 2011). Human-wildlife conflict (HWC) is more than simply competition for space, food, and life—it pits different values for nature against one another, demanding attention from economic, legal, social, and environmental policy makers (Knight 2000; Nie 2002).

1.2 Human Attitudes in HWC

Attitudes can be defined as a disposition or tendency to respond with some degree of favorableness, or not, to a psychological object, the psychological object being any discernible aspect of an individual's world including an object, a person, an issue, or a behavior (Fishbein & Ajzen 2010). The attitude construct has occupied a central position in social psychology (Allport 1935; Fiske & Taylor 2013), and specifically environmental psychology (Clayton 2012), for decades because of how pervasive evaluation is in everyday life. Without the ability to evaluate our environment in terms of good and bad, desirable and undesirable, or approach and avoid an individual's existence would be truly chaotic and probably quite short (Fazio & Olson 2012). For this reason, the attitude concept has been at the center of attempts to predict and explain human behavior (Fishbein & Ajzen 2010). The attitude concept has been extensively applied in research into the human dimensions of wildlife

management (Manfredo et al. 2009a, 2009b; Decker et al. 2012).

The concept of tolerance in the HWC literature has generally been used interchangeably with the attitude concept (Naughton-Treves et al. 2003; Karlsson & Sjöström 2011). *Tolerance* can be defined as "the action of bearing hardship, or the ability to bear pain and hardship" (*Oxford English Dictionary*, x ed. [online], s.v. "tolerance") and more specifically in the context of HWC as an ability to accept damage from wildlife (Marker et al. 2003; Zimmermann et al. 2005).
We conducted a meta-analysis (Glass 1976) of studies investigating the attitudes of people experiencing direct conflict with large and medium-sized mammals, specifically carnivores, elephants, primates, and ungulates. Larger mammalian species are generally more at risk of extinction (Purvis et al. 2000; Schipper et al. 2008; Inskip & Zimmermann 2009), often fulfill critical roles in ecosystem functioning (Estes et al. 2011), and occur mostly outside protected areas (Grunblatt et al. 1996; Crooks et al. 2011; Cantu´-Salazar et al. 2013). This is particularly the case for carnivores. For example, more than 80% of remaining habitat occupied by tigers (*Panthera tigris*) is outside reserves (Miquelle et al. 1999), and more than 90% of jaguar (*Panthera onca*) and snow leopard (*Panthera uncia)* habitat is outside reserves (Nowell & Jackson 1996).

Accordingly, the attitudes, perceptions, and tolerance of people living with wildlife are relevant to conservation managers and policy makers (Decker et al. 2011). Despite the large number of global studies examining attitudes toward HWC, including qualitative reviews (Naughton & Treves 1999; Sillero-Zubiri & Laurenson 2001; Treves 2009; Dickman 2010), we are aware of only one quantitative review, which was limited specifically to wolves (Williams et al. 2002). Our aims were to quantify potential differences in attitudes toward species groups across countries and stakeholder groups; determine if experiencing damage contributes to attitudes toward species groups; and, develop a measure of human tolerance toward HWC that allows comparisons between different stakeholder groups in different locations for different species and species groups.

2. Methods

We conducted a meta-analysis of peer-reviewed journal articles published from 1 January 1990 through March 2011 in English that quantified the attitudes of stakeholders who had experienced direct conflict with carnivores, elephants, primates, or ungulates. We defined an attitude as "a disposition or tendency to respond with some degree of favor, or not, to a psychological object" (Fishbein & Ajzen 2010). To qualify, attitude measures had to be evaluative and quantified on a scale. Studies detailing attitudes of individuals not having direct experience with HWC were excluded because the general public can have more positive attitudes toward wildlife when not directly affected (Williams et al. 2002; Martín-López et al. 2008), although, in some cases, negative attitudes are displayed by people not having contact with a species (Treves et al. 2013). We restricted our references to those published in scientific journals (Calver & King 1999). Although inclusion of gray literature in meta-analyses is sometimes recommended to prevent publication bias for significant results (Rosenthal 1979), this was not an issue in our review because attitudes were recorded as percentage of respondents having positive, neutral, or negative attitudes. We searched Web of science for terms listed in Appendix I. We then located additional publications by examining the reference list of each publication. Finally, we refined the publications to include only those published after 1990 because studies conducted before 1990 were few and commonly applied outdated methods. We then examined the selected publications in detail and extracted and compiled 8 variables in an Excel spreadsheet. The variables extracted were defined by their availability across all publications and their relevance to our research questions. The variables are defined in Table 2.1.

2.1 Data Analyses

The attitudes reported in percentages in each publication were extracted and converted to a binary variable as either positive or nonpositive. A binary variable was necessary because some publications reported 2 category responses (e.g., yes or no) to attitude questions. Where a middle value of an attitude scale was used, we categorized it as either a positive or nonpositive value depending on the context of the question. For example, for questions, such as would you like the population of species x to

increase, stay the same, or decrease? We combined “stay the same” and “increase” because we considered “stay the same” to be more aligned with a positive rather than non positive attitude. For cases where the middle value was not obviously aligned with a positive attitude, responses were categorized as nonpositive. We think it is more robust to have a false negative than a false positive because assuming people are more positive than they are would be more detrimental to a species.

We assigned responses for each individual participating in a survey to a positive or nonpositive attitude category using the following computation: if 20% of a survey sample of 300 individuals reported positive attitudes, 60 individuals were coded as positive and 240 nonpositive. To derive a similar individual record for the damage variable, we converted the percentage of respondents experiencing damage into a probability of experiencing damage per individual. For example, if 40% of a sample experienced damage, then the probability of each individual experiencing damage was 0.4. We assigned a probability to each individual rather than a definitive yes or no because information on individual respondents was typically unavailable.
Not all publications reported what proportion of the sample experienced damage from individual species. We therefore compiled 2 types of data sets, a smaller one which did not report a damage proportion and a larger one that did. For most analyses, we used the 2 data sets combined to create one large data set without a damage variable (whole data set [WD]). However, since we were also interested in the effect of experiencing damage on attitudes, we used the smaller data set (damage data set [DD]) to examine this.

We conducted 2 types of multivariate analyses. First, we used classification and regression trees (CART) (Breiman et al. 1993) to produce importance plots and cost sequence plots (Appendix II). Second, we used logistic regressions to calculate Wald statistic and odds ratios. For both analyses, we used Statistica 11 (StatSoft 2012). Due to the exploratory approach of the CART procedure and subsequent risk of overfitting the data, we randomly split the data set into a test sample of 30% of all records and a train sample of the remaining 70% of the data. We compared the results of these 2 subsets to check the validity of our tests. Analysis of the damage extent variable was conducted using one-way ANOVA with Fisher least signficant difference (LSD) post hoc tests. As described above and in Table 2.1, we used 2 data sets WD and DD and

thus conducted 2 analyses (CART and logistic regression) on each. We also conducted 2 scales of analysis, the first on primary variables (column 1 in Table 2.1) and the second on secondary variables (column 3 in Table 2.1). Secondary variables formed subcategories of primary variables. For example, the primary variable stakeholder comprised 4 secondary variables: commercial farmers, communal farmers, urban residents, and others. For most analyses we report on the WD only, while analyses of the DD are reported when examining the effect of experiencing damage on an individual's attitudes.

Table 2.1 The primary and secondary variables extracted from publications and examined for their affect on attitudes toward 4 groups of mammalian wildlife

Primary variable	Definition	Secondary variables
Question type	items (i.e., questions) used in individual studies to measure respondents attitudes, perceptions, and tolerance	Questions were coded into 7 themes that emerged from the data and were not based on any prior theoretical concepts. These were questions seeking responses: support for an increase, decrease, or stable future population of a species; whether a person had or would kill or remove a species from her or his property; desirability of a species on a persons' property or desirability of living near a species; support for removal or lethal control of a species as a management option, in the context of under-abundant species; support for reduction of over-abundant species with nonlethal control; describes an affect or cognition of a species, such as the extent to which a species is liked or should be conserved (questions consisted of single or multiple questions summarized into a single index); degree to which an individual will tolerate damage from a species.
Attitude	proportion of all individuals surveyed in the publications included in this meta-analysis who presented positive or nonpositive attitudes	A binary variable was computed by collapsing scales with multiple categories into 2 categories of responses. When the scale consisted of an even number of items, the binary variable was created by splitting the number of items equally and summing each half. When the scale consisted of an uneven number of items, the middle category was added to either the positive or nonpositive categories, depending on the context.

Species	animals widely recognized as a biologically distinct group for which attitudes were reported	Each species was afforded a separate entry. Some publications reported on several species while others focused on a single species. The full species list is reported in Supporting Information.
Species group	order or grand order to which a species belonged	Species were categorized into 4 groups as carnivores, ungulates, primates, or elephants by order or grand order according to Kingdon (2003).
Country development status	status of a country as categorized by criteria of wealth and human well-being	Countries were categorized as either developed or developing according to the United Nations criteria of developed or developing regions. Developing countries were those from Africa, the Caribbean, Central America, South America, Asia, excluding Japan, and the Americas, excluding North America. Developed regions were North America, Europe, and Japan (TODO: clickthrough URLhttp://unstats.un.org/unsd/methods/m49/m49regin.htm#least)
Experience direct conflict	respondents who lived within the range of the species under consideration	Publications were initially excluded if respondents' attitudes were not recorded separately for respondents who lived within the range of the species under consideration and those who did not live within the range of the species under consideration. However, the small number of publications identified with this criterion necessitated that we include those publications that consisted of both types of respondents. Ultimately, 2 categories of publications were identified: live in conflict zone (LCZ) and live in mixed conflict and nonconflict zone (MZ).
Stakeholder group	categories of respondents surveyed in the publications included in this meta-analysis	Five categories emerged from the publications surveyed: commercial farmers (broad-scale producers of crop and animal products primarily for commercial sale), communal farmers (small-scale crop and animal producers who primarily produce for subsistence or possibly for sale), urban residents, other (applied when a publication did not explicitly identify a stakeholder type or to any other type of stakeholder that experienced direct conflict but was not categorized as commercial or communal farmer, urban resident, or "no damage" by the researcher, for example rural residents, hunters, berry pickers). The second type of "other" in the other category was necessary because there was an insufficient number of publications

		with these stakeholder categories to analyze statistically. No damage stakeholders were those who, although living in an area where a species occurred, did not have costs imposed by wildlife, for example tourists visiting a nature reserve.
Damage	proportion of respondents who experienced a cost from a species	Not all publications reported what proportion of the sample experienced damage from a particular species. Two types of data sets were therefore compiled, a smaller one which did not report a damage proportion and a larger one that did. Most analyses used the 2 data sets combined to create one large data set without a damage variable (whole data set [WD]). Because the effect of experiencing damage on attitudes was also of interest, we used the smaller data set (damage data set [DD]) to examine this.

We defined tolerance as “the proportion of individuals who have a positive attitude toward a species group despite suffering damage by that species group” and computed a tolerance to damage index (TDI) as follows: TDI = proportion of individuals suffering damage – (1 – proportion of individuals with positive attitudes), where the proportion of individuals suffering damage is the proportion of the respondents in a study who experienced some damage from a species and 1 – proportion positive is the proportion of individuals in a study whose responses were non-positive.

A tolerance value of 0 indicates neutrality (i.e., proportion of respondents with a positive attitude is proportional to the proportion of respondents experiencing damage). A negative value indicates low tolerance, and a positive value indicates high tolerance. Because we could not match damage data to individual attitudes, we calculated this index with publication level data and thus could not incorporate sample sizes of each study into this index.

We identified 508 publications related to the topic of HWC, which was refined down to 54 publications that met the criteria for inclusion in the meta-analysis (Supporting Information). When coded, this produced a data set of 83,820 individual responses for the WD and 28,436 individual responses for the DD. The 54 publications covered 22 countries and 43 different species (Appendix III). Twenty-two (41%) of the studies were conducted in developed nations and 32 (59%) in developing nations. One publication was conducted in both developed and developing countries (Appendix III). The number of publications which surveyed people's attitudes toward different carnivore species (64) was more than twice the number of publications which surveyed people's attitudes toward different ungulate species (30), 9 times more than the number of publications which surveyed people's attitudes toward elephants (7), and 16 times more than the number of publications which surveyed people's attitudes toward primates (4) (Appendix III). Considering the total number of respondents surveyed, 81% were surveyed on their attitudes toward carnivores, 14% were surveyed on their attitudes toward ungulates, 3% were surveyed on their attitudes toward elephants, and 2% were surveyed on their attitudes toward primates. Attitudes of respondents were solicited for 22% of carnivore species (International Union for Conservation of Nature [IUCN] total = 285 spp.), 9% of ungulate species (IUCN total = 329 spp.), and 1% of primate species (IUCN total = 414 spp.) listed on the IUCN

Red List (2008). The percentage for elephants was 3500% because there are only 2 species.

3. Results

3.1 Describing Attitudes

Forty-six percent of respondents presented positive attitudes, and 54% had nonpositive attitudes. Eighty percent of urban residents had positive attitudes, whereas 51% of commercial farmers and 26% of communal farmers had positive attitudes. Forty-three percent of others and 61% of those who experienced no damage had positive attitudes (Table 2.2).

Table 2.2 Attitudes of respondents toward damage-causing mammalian wildlife by stakeholder and species group

Group	Positive attitude (%)	Nonpositive attitudes (%)
Stakeholder type		
all stakeholders	46	54
urban residents	80	20
commercial farmers	51	49
communal farmers	26	74
other	43	57
no damage	61	39
Species		
elephants	65	35
primates	55	45
ungulates	53	47
carnivores	44	56

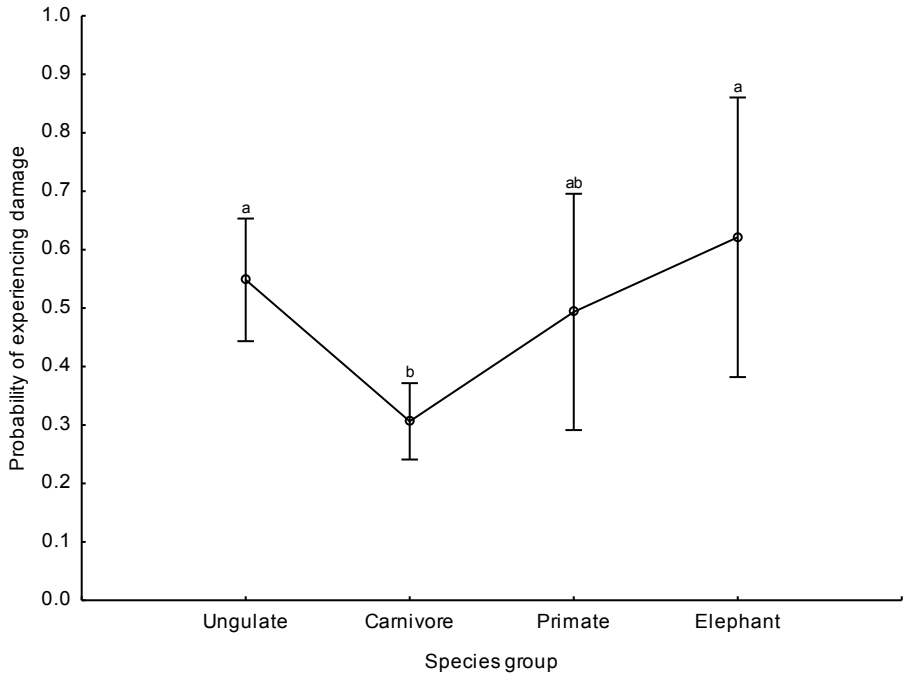
Elephants elicited the greatest proportion of positive responses from stakeholders (65%), while carnivores elicited the smallest proportion of positive attitudes (44%). Primates (55%) and ungulates (53%) elicited similar proportions of positive attitudes and respondents had equal probability of presenting positive and non positive attitudes towards primates and ungulates (Table 2.2).

3.2 Experience of Damage

On average, 40% of individuals surveyed from developed countries and 39% from developing countries experienced damage from wildlife. These differences were not significantly different ($F_{(1, 103)} = 0.13523$, $p = 0.71$). Sixty-two percent of all stakeholders experienced damage from elephants, 55% from ungulates, 49% from primates, and 31% from carnivores. Significant differences were found between species groups ($F = 6.7$, $p < 0.01$), and post hoc tests showed a significant difference between carnivores and elephants ($p = 0.01$) and carnivores and ungulates ($p = 0.01$), but not between carnivores and primates or elephants and primates (Fig. 2.1a).

Communal farmers (43%), urban residents (43%), and commercial farmers (39%) had similar probabilities of experiencing damage from wildlife (one-way ANOVA $F = 1.42$, $p = 0.24$). Other stakeholders experienced the lowest probability of damage (21%) (Fig. 2.1b).

a.



b.

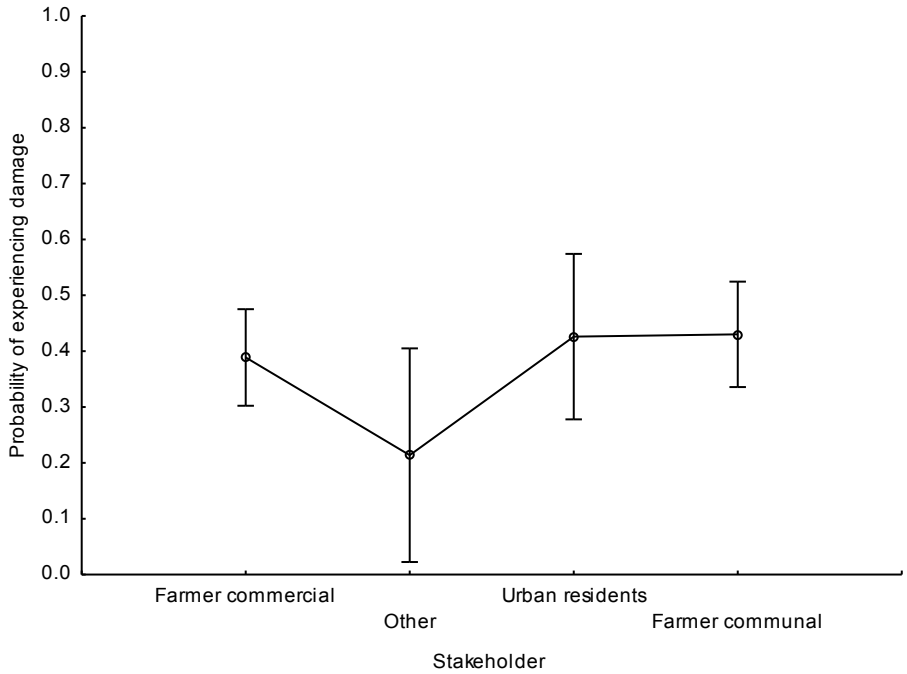


Figure 2.1 The probability of a survey respondent experiencing damage due to the presence of wildlife by (a) species group and (b) stakeholder group. Letters above bars indicate significant post hoc differences between groups. Comparing 2 groups, if at least one letter occurs in each group, the groups do not differ significantly ($p > 0.05$). No overlapping letters indicate significant differences ($p < 0.05$).

3.3 Tolerance to Damage Index

The TDI (Table 2.1) was 0.15 for both developed and developing countries ($F(1,103) = 0.00396$, $p = 0.95$). Respondents were most tolerant of elephants (0.16) and least tolerant of carnivores (−0.26). Tolerance of ungulates (0.03) and primates (0.04) was close to zero, indicating that attitudes were proportional to damage experienced. The TDI between species groups differed significantly ($F(3,101) = 5.889$, $p < 0.01$). In post hoc tests, respondent tolerance of carnivores was significantly lower than their tolerance of ungulates ($p < 0.01$), primates ($p < 0.05$), and elephants ($p = 0.014$), but there were no significant differences between respondent tolerance of ungulates, primates, or elephants (Fig. 2.2a).

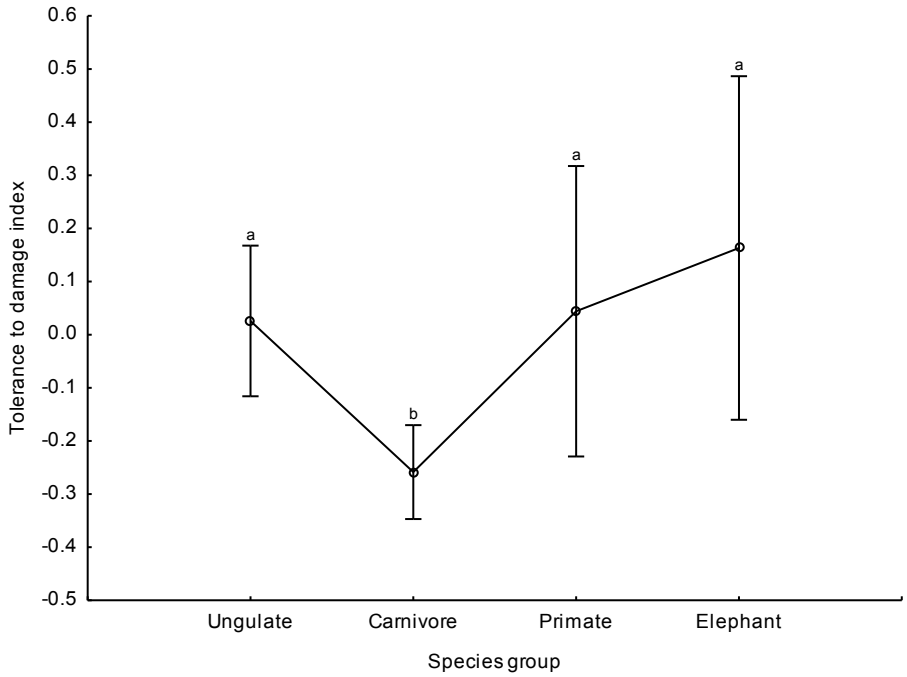
The TDI was negative for all stakeholders: lowest for other stakeholders (−0.32) and highest for commercial farmers (−0.05). Urban residents (−0.19) and communal farmers (−0.20) presented similar TDIs. There were no significant differences in TDI among stakeholders ($F(1,101) = 1.906$, $p = 0.13$), although differences between communal and commercial farmers ($p = 0.075$) and between other and commercial farmers ($p = 0.055$) were nearly significant (Fig. 2.2b).

3.4 Explaining Attitudes

Analysis of primary variables was conducted on the WD with attitude as the response variable and 5 predictor variables: stakeholder group, question type, species group, experience of direct conflict and development status (Table 2.1). Logistic regressions identified all 5 variables as contributing significantly to explaining positive attitudes toward species ($p < 0.001$). The stakeholder group had the highest Wald statistic (1674), followed by question type (1287), species group (753), and development status of the country (295) (Fig. 2.3a). Results of the CART analysis showed similar rankings for question type code (2nd) and development status of country (4th) but ranked species group as the most important (1st), while stakeholder group ranked third (Fig. 2.3b).

Using the DD with attitude as the dependent variable and the 5 independent variables above, in addition to the damage variable as the 6th variable, damage contributed significantly to explaining positive attitudes ($p < 0.0001$). In addition, damage ranked

a.



b.

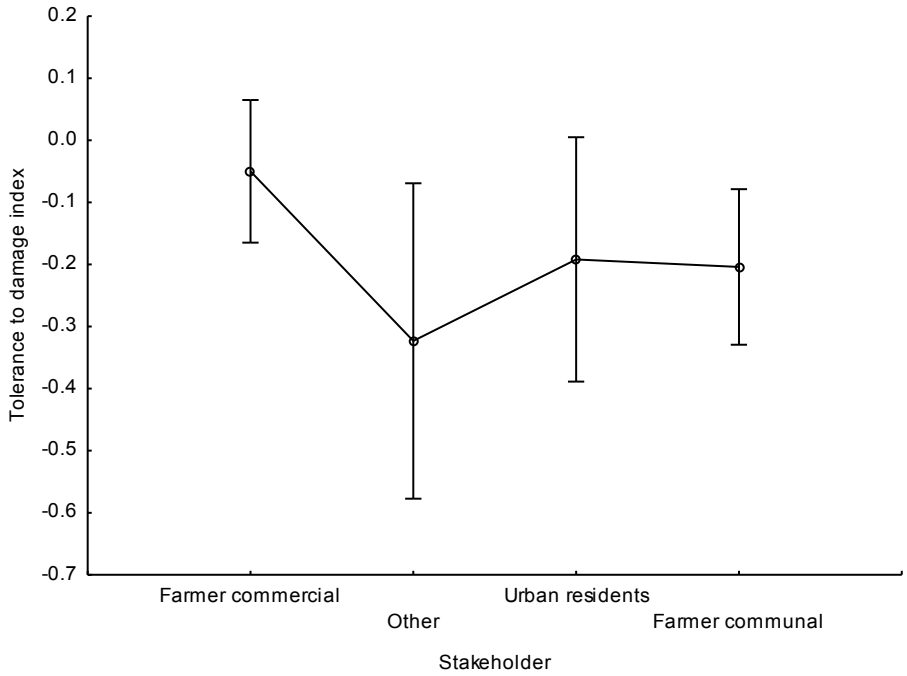


Figure 2.2 Mean values of the tolerance to wildlife damage index (TDI) by (a) species group and (b) stakeholder group. A tolerance value of zero indicates neutrality (i.e., proportion of respondents with a positive attitude is proportional to the proportion of respondents experiencing damage). A negative value indicates low tolerance, and a positive value indicates high tolerance. Letters above bars indicate significant post hoc differences between groups. Comparing 2 groups, if at least one letter occurs in each group, the groups do not differ significantly ($p > 0.05$). No overlapping letters indicate significant differences ($p < 0.05$).

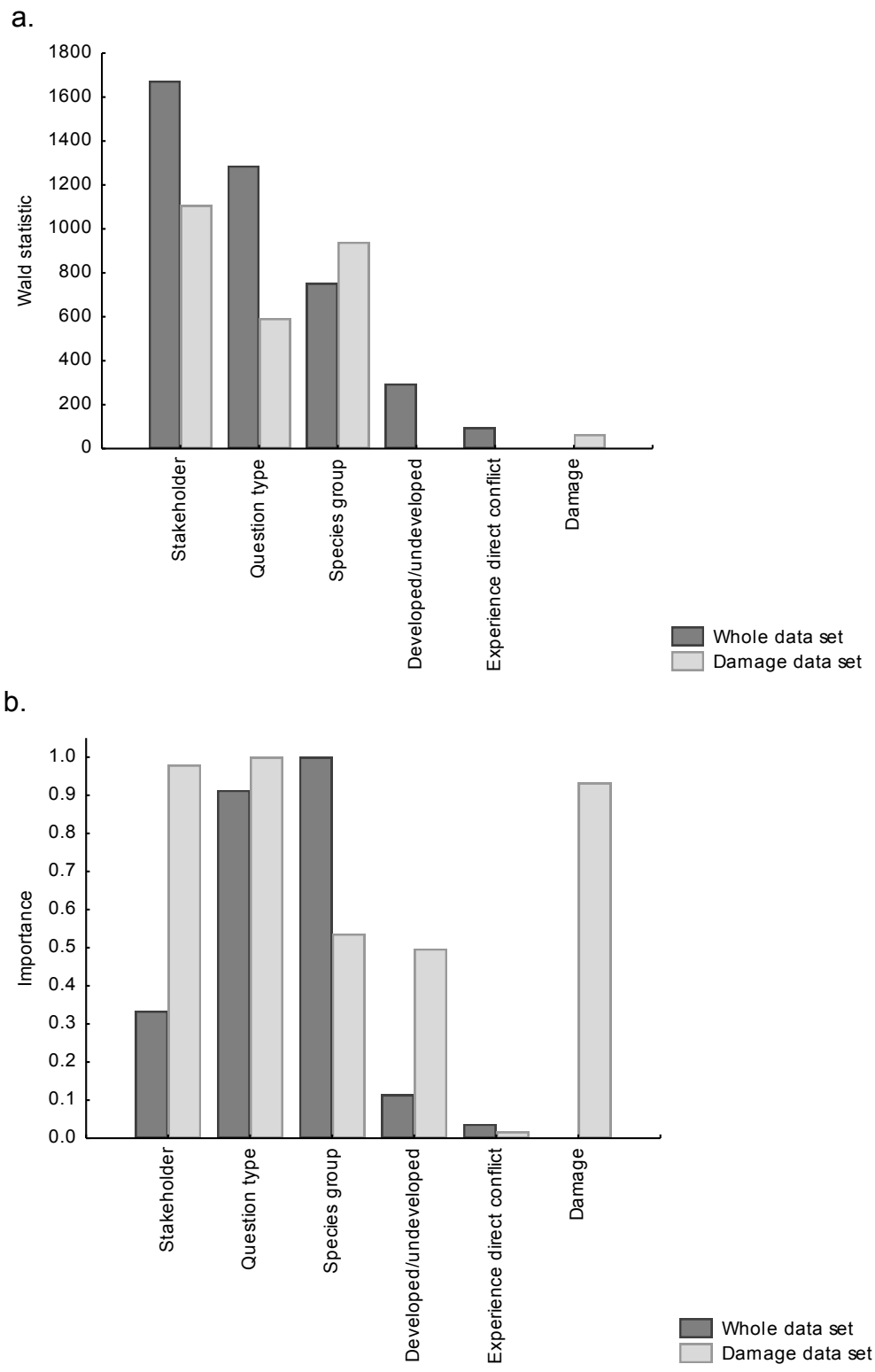


Figure 2.3 (a) Results of (a) logistic regression (Wald statistic) and (b) CART analysis for both the whole data set and the damage data set, showing contribution and relative importance, respectively, of 6 variables to explaining positive attitudes toward different wildlife species. Variable definitions are defined in Table 1. For logistic regression (a) whole data set, all five variables significantly contributed to explaining positive attitudes ($p < 0.0001$). For logistic regression, damage data set, all variables contributed to explaining positive attitudes ($p < 0.0001$) except developed/undeveloped and experience direct conflict.

4th (Wald = 64) in the logistic regression (Fig. 2.3a) and third in the CART analysis (Fig. 2.3b).

Logistic regressions of the secondary variables Table 2.1 with the WD data set presented significant *p* values for all 5 stakeholder groups ($p < 0.001$). Commercial farmers (odds ratio = 1.35) and urban residents (odds ratio = 1.9) were more likely to exhibit positive attitudes, while communal farmers (odds ratio = 0.48) and other stakeholders (odds ratio = 0.74) were between 2 and 1.4 times more likely to have nonpositive attitudes, respectively.

Significant *p* values were obtained for all 4 species groups ($p < 0.001$). Elephants (odds ratio = 2.3) were more likely to elicit positive attitudes, while primates (odds ratio = 0.9), ungulates (odds ratio = 0.8), and carnivores (odds ratio = 0.6) were more likely to elicit nonpositive attitudes. The CART analysis suggested that communal farmers were particularly likely to present nonpositive attitudes toward carnivores, irrespective of the question type (72% compared to 54% of all stakeholders). Logistic regression on the DD indicated that the probability of experiencing damage was a significant variable in explaining attitudes toward different species groups ($p < 0.001$). The effect of damage was corroborated by the CART analysis, where 5 trends emerged (Fig. 2.4). Similar to the WD, communal farmers were also more likely to elicit a nonpositive response toward carnivores irrespective of question type and the probability of experiencing damage (77% vs. 56%). For commercial farmers, urban residents and other stakeholders, the probability of a positive or nonpositive response was similar, but it tended toward positive (47% vs. 44%). Communal farmers, commercial farmers, and no damage stakeholders were more likely to present positive attitudes toward ungulates, primates, and elephants (66% vs. 44%) irrespective of question type and probability of damage. Urban residents and other stakeholders were more likely to be nonpositive when probabilities of damage from ungulates, elephants, and primates were high (62% vs. 44%) and more likely to be positive with low probabilities of damage from these groups (74% vs. 56%) (Fig. 2.4).

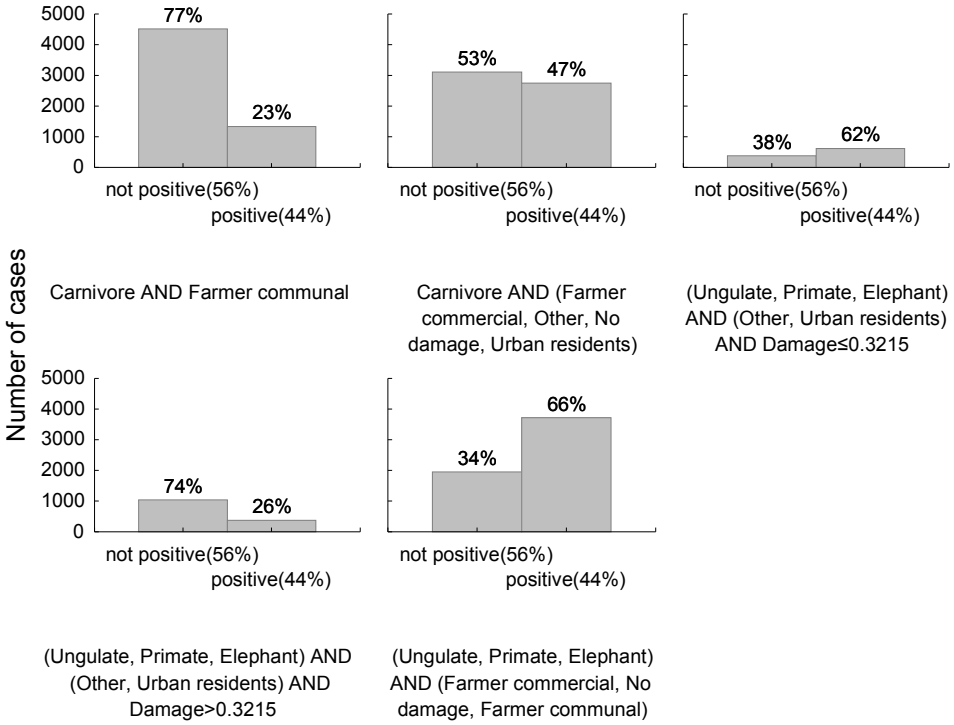


Figure 2.4 Attitudes (positive and not positive) of respondents toward different wildlife species determined by CART cost sequence analysis of the damage data set and secondary variables. Primary and secondary variables are described in Table 1. CART partitions the data into subgroups (each characterized by a rule which identifies the subgroup) that are as distinct as possible. Here 5 subgroups were generated. The percentages in parentheses on the x-axis indicate the percentage of that class in the whole data set. The percentage above the bar gives the percentage of the class in the subgroup. For example, for the first subgroup (carnivores and farmer communal), 77% of the cases were "not positive," whereas for the whole data set 56% of cases were not positive. The damage probability value is the cut-off point generated by CART rules.

3.5 Carnivores

Carnivores were the only group within the WD for which there was a sufficiently large number of individual species studied to allow exploration of attitudes toward different carnivore species. Logistic regression indicated that mountain lion (*Puma concolor*) (odds ratio = 1.12) and lynx (*Lynx* spp.) (odds ratios = 1) were equally likely to elicit positive or nonpositive attitudes (Fig. 2.5). The remaining species all had significant *p* values ($p < 0.001$). Species with high probabilities of eliciting positive attitudes were tiger (odds ratio = 2.4), wild dog (*Lycaon pictus*) (odds ratio = 1.86), lion (*Panthera leo leo)* (odds ratio = 1.64), leopard (*Panthera pardus*) (odds

ratio = 1.63), cheetah (*Acinonyx jubatus*) (odds ratio = 1.2), and jackal (*Canis mesomelas*) (odds ratio = 1.2). The species that were significantly more likely to elicit a nonpositive attitude were wolverine (*Gulo gulo*) (odds ratio = 0.8), wolf (*Canis lupus*) (odds ratio = 0.66), bear (*Ursus* spp.) (odds ratio = 0.65), hyena (*Crocuta crocuta*, *Hyaena* sp.) (odds ratio = 0.57), and coyote (*Canis latrans*) (odds ratio = 0.3) (Fig. 2.5).

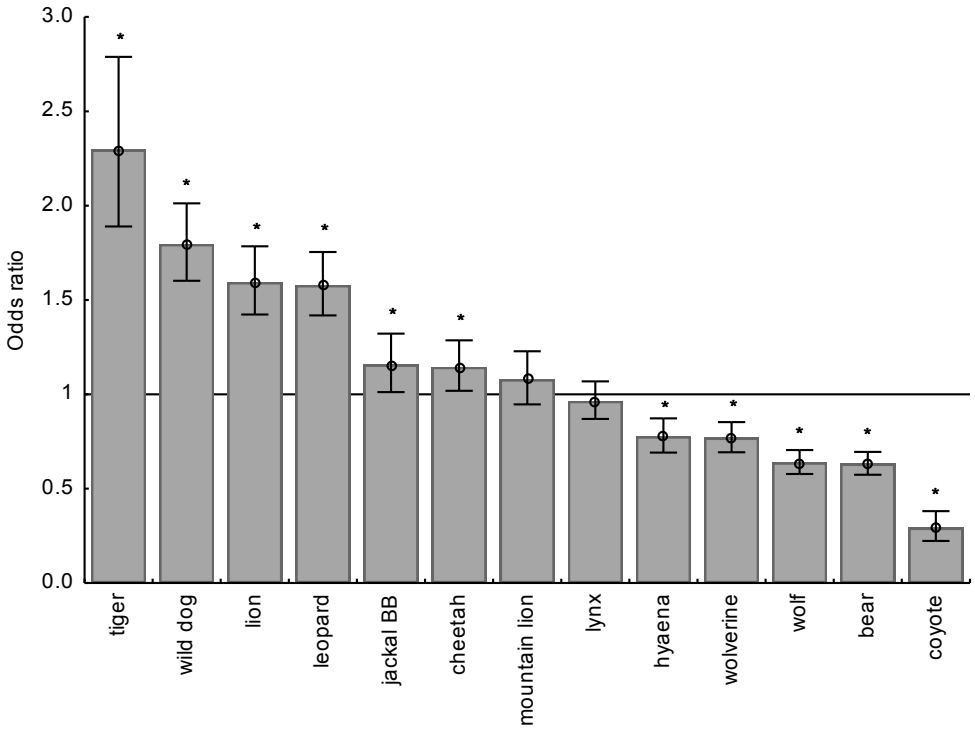


Figure 2.5 Attitudes (positive and not positive) toward carnivore species as determined by logistical regression analysis (described in methods) with the whole data set (described in methods) (BB, black backed jackal; bars, 95% confidence limits; * $p<0.001$).

Finally, we explored the effect of damage by individual carnivore species on different stakeholder groups using the DD. Four trends emerged from the CART analysis (Fig. 2.6). Commercial farmers, urban, and other stakeholders were more likely to exhibit nonpositive attitudes toward coyotes (77% vs. 65%) and positive attitudes toward wolf, bear, mountain lion, cheetah, hyena, leopard, jackal, wild dog, and tiger, irrespective of probability of damage or question type. For the majority of cases, communal farmers were more likely to exhibit nonpositive attitudes toward all

carnivore species when the probability of damage was low (81% vs. 65%), but for a small subset of cases (300), counter-intuitively, they were more likely to be positive when the probability of experiencing damage was high (65% vs. 35%), irrespective of question type (Fig. 2.6).

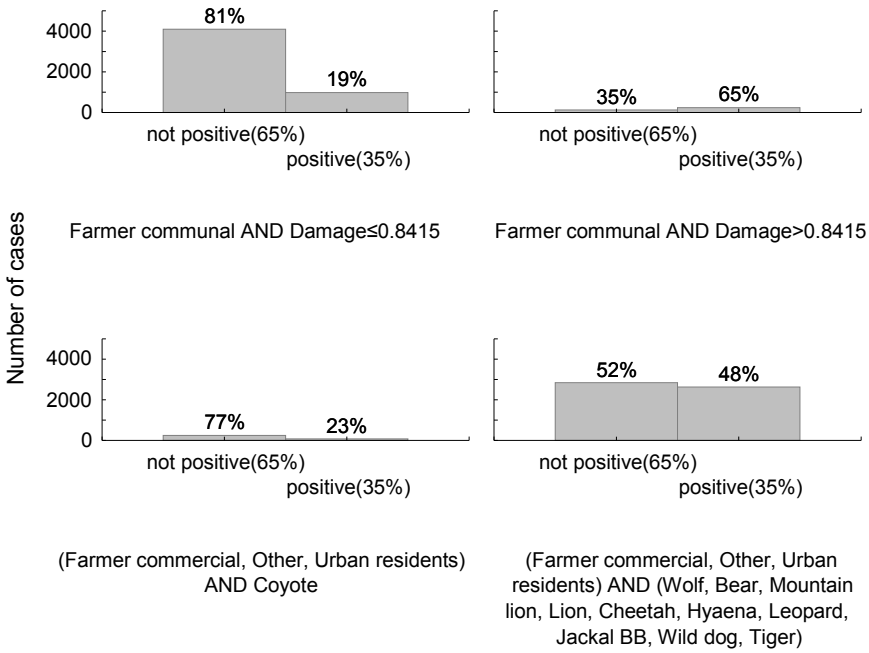


Figure 2.6 Attitudes (positive and not positive) of respondents toward carnivore species determined by CART cost sequence analysis of the damage data set for carnivores. All primary and secondary variables are described in Table 1. CART partitions the data into subgroups (each characterized by a rule which identifies the subgroup) which are as distinct as possible. Here, 4 subgroups were generated. The percentages in brackets on the x-axis indicate the percentage of that class in the whole data set. The percentage above the bar gives the percentage of the class in the subgroup. For example, for the first subgroup (farmer communal and damage ≤ 0.8415), 81% of the cases were "not positive," whereas in the whole data set 65% of the cases were not positive. The damage probability value is the cut-off point generated by CART rules. (BB, black backed jackal; damage probability value, cut-off point generated by CART rules).

4. Discussion

4.1 Development Status of Country

The development status of a country was statistically significant, but of relatively low importance in determining positive attitudes toward damage causing wildlife (Fig. 2.3). This suggests that while stakeholder group, question type, and species group mostly explained positive attitudes, the development status of a country did explain some positive attitudes. Since differences between developed and developing countries are often related to wealth, health services, education, and institutional infrastructure, research explaining the factors determining these differences will assist in designing more effective species management policies and strategies.

4.2 Tolerance of Damage

Respondents' tolerance to damage from ungulates and primates was proportional to the probability of experiencing damage (Fig. 2.2), but they presented lower tolerance toward carnivores and higher tolerance toward elephants. Our damage variable measured whether a respondent experienced damage or not and did not account for the severity or financial costs accruing to stakeholders, meaning stakeholders may have experienced more severe damage from carnivores than from elephants, ungulates, or primates. Alternatively, livestock may have intangible values that were not documented, meaning any loss due to carnivores would be substantial. It is possible that the small number of elephant studies may not be representative of the full range of attitudes and that alternatively, similar trends to those of the carnivores. If, however, these differences are accurate, the reason may be due to a more positive cultural symbolism of elephants (Kuriyan 2002) relative to carnivores (West 2001; Dickman 2008; Lewis-Williams & Challis 2011), perhaps given the long history of carnivores preying on humans (Kruuk 2002).

Our TDI presented no significant differences between stakeholder types or between developed and developing countries. However, because our TDI did not take into account the severity of damage or its frequency or rate over time, differences may be masked by these factors. A damage measure that accounts for these additional dimensions would be valuable for constructing tolerance indexes in the future.

Until comparative data is available that uses comparable measures of attitudes as well as tangible and intangible costs and benefits, explaining differences between species groups and the lack of differences between stakeholder groups and between developed and developing countries is problematic. Differences between species groups is likely given the human propensity to value animal species unequally (Bonnet et al. 2002; Serpell 2004; Stokes 2007) and the wide range of reasons potentially explaining this heterogeneity (organismal complexity: Proenca et al. 2008; morphological and behavioral similarity to humans: Batt 2009; size, rarity, charisma: Johnson et al. 2010; attractiveness: Frynta et al. 2010). These differences could have important implications for managing species in general and HWC in particular, meaning knowledge of differences in human behavior should inform the design of interventions, strategies, and policies (Knight et al. 2010). It is likely that context-specific species management approaches will be required.

4.3 Importance of Damage

Damage was an important factor explaining positive attitudes toward wildlife; however, stakeholder group, question type, and species group were either equally or more important (Figs. 2.3a & b). Nonpositive attitudes were presented by 39% of stakeholders who experienced no damage. These findings support the results of similar research where damage was not significant in explaining attitudes toward a species in 61% of publications (R.K. unpublished data). They are also consistent with results of other research highlighting the importance of non damage factors (Naughton-Treves et al. 2003; Skogen & Krange 2003; Dickman 2010; Shelly et al. 2011).

Damage interacted with different stakeholders (i.e., commercial farmer, communal farmers, and urban residents) and species groups (i.e., carnivores, ungulates, primates, and elephants) in complex and unexpected ways, as revealed by the CART analyses (Figs. 2.4 & 2.6). For example, damage did not explain attitudes of all stakeholder groups toward carnivores (Fig. 2.4) or attitudes of commercial farmers or communal farmers toward ungulates, primates, or elephants (Fig. 2.4). Damage was however important for urban residents and a subset of communal farmers. Urban residents displayed intuitively meaningful responses toward ungulates, primates, and elephants

(i.e., positive attitudes in cases exhibiting a low probability of damage and nonpositive attitudes where the probability of damage was high) (Fig. 2.4). However, for a subset of communal farmers the relationship with some carnivore species was unanticipated. Those who experienced a high probability of damage displayed more positive attitudes, while those with a low probability of experiencing damage were more nonpositive (Fig. 2.6). Because of this complexity, identifying the contexts in which damage drives attitudes and human tolerance is essential because HWC mitigation strategies typically assume damage to be the causal factor (Hulme & Murphee 1999; Distefano 2003; Dickman 2010). If damage is not a driver of specific stakeholders' attitudes toward species, then mitigating damage may offer a low return on investment of typically scarce conservation funds. Identifying the costs and benefits of species important to stakeholder groups is an important future research direction because damage may also fail to predict attitudes in cases where the additional costs and effort of implementing mitigation measures causes increased resentment toward species. A more holistic approach that considers both tangible and intangible costs and benefits of living with wildlife may be more effective at determining the role of damage in explaining an individual's attitude toward individual animals and groups of species. Such an approach could promote the development and implementation of spatially extensive policies and strategies, which could prove more effective than the site and species-specific approaches currently employed.

4.4 Stakeholders' Attitudes toward Species Groups

Although communal farmers were twice as likely as other stakeholders to have nonpositive attitudes, this was not uniform for all species and damage probabilities (Figs. 2.4 & 2.6). Communal farmers were more positive toward elephants, ungulates, and primates and less positive toward carnivores, irrespective of probability of experiencing damage and of question type (Fig. 2.4). However, a subset of communal farmers living in proximity to a subset of carnivore species were counter intuitively more positive when there was a large probability of undergoing damage than when there was a low probability of damage (Fig. 2.6). This suggests that at least some communal farmers are able to adapt to living with damage causing wildlife. Because adaptation is a general human propensity (Arieli 2010), we wondered why urban residents do not adapt as well; urban residents were less likely to be positive when

probabilities of damage from ungulates, elephants, and primates were high (Fig. 2.4). Fifty-seven percent of communal farmers in the high damage probability category were from developing Asian countries, while 24% in the low damage probability category were from Africa. Eastern religions may predispose people to be more sympathetic toward wildlife, in general (Waldau & Patton 2006; Manfredo 2008), and to damage causing wildlife in particular. For example, people in Nepal view damage by the snow leopard (*Panthera uncia*) as punishment from a mountain god, which shifts blame from the species (Ale 1998).

Urban residents and commercial farmers tend to be neutral or slightly more positive toward most carnivores, except coyote (Fig. 2.6), while communal farmers are typically less positive (Fig. 2.4) (except in the cases of Asian stakeholders outlined above [Fig. 2.6]). For urban residents, these differences could be explained by urban residents being exposed to carnivore species that have a lower impact on their livelihood and lives or by their general tolerance of wildlife (i.e., mutualistic wildlife value orientations [Manfredo 2008]). Mutualistic wildlife value orientations are associated with urbanization and modernization, where a reduction in the association of wildlife as a food source and an increase in wildlife as deserving of equal rights to humans are thought to result in higher tolerance (Manfredo 2008). For example, Williams et al. (2002) reported that urban residents (61%) had more positive attitudes toward wolves than rural residents (45%) and farmers (35%). However, because these studies did not differentiate between stakeholders within each group who experienced direct conflict and those that did not, it was not possible to determine if urban residents would retain their mutualistic value orientations when experiencing more extensive damage. Our finding that the positive attitudes displayed by urban residents did not extend to ungulates in communities where the probability of damage was high, in addition to the TDI not indicating a higher overall tolerance of damage by urban residents (Fig. 2.2), suggests that urban residents' mutualistic value orientations may diminish above a certain threshold of damage.

Communal farmers were the least positive toward carnivores (Figs. 2.4 & 2.6), possibly because livestock contribute substantially more to their well-being or have high cultural value. In developing countries, rural communities may have little access to credit, so livestock represent an investment or safety net that provides a diverse

range of functions and benefits to owners and to the community at large (Andrew et al. 2003). Where stock numbers are small, or where privatization of communal lands has resulted in smaller, less viable parcels of land for livestock farming (Galvin et al. 2008; Western et al. 2009), any loss may impose substantial costs. Those dependent on a single livelihood strategy may be less resilient and hence less tolerant of stock and crop losses (Shackleton & Shackleton 2004; Dickman 2010). Rural communities are also more exposed to carnivores during their daily activities because they depend primarily on locally available resources for their well-being (Koziell & Saunders 2001; Maikhuri et al. 2001; Clarke 2012). Carnivore species, such as lions and tigers, can be dangerous, meaning people may suffer disproportionately from fear, injuries, and mortality (Kaltenborn et al. 2006 Clarke 2012). In contrast, commercial farmers tend to be wealthier and so less dependent on livestock losses. They may also have greater resources for protecting livestock, such as proactive culling of carnivores, and thereby reducing the magnitude of damage (Saberwal et al. 1994). They may also benefit more from tourism opportunities on their land as well as from trophy hunting. This interpretation supports the finding that the probability of damage did not affect attitudes of commercial farmers toward carnivores.

Many populations of threatened mammals occur outside formally protected areas, and their survival depends on the willingness of communities to tolerate them. As the term suggests, HWC involves 2 parties—people and wildlife. It is therefore essential that research into the human psychological dimension of HWC increase in quantity and scope and be designed to complement the technical interventions, such as chili fences (i.e., chili crops planted around food crops) or guard dogs, that separate wildlife from the resources people value. Given the uncertainty surrounding the degree to which damage determines attitudes and the inconsistency with which damage is quantified among studies (Naughton & Treves 2003; Schwerdtner & Gruber 2007; Inskip & Zimmermann 2009), widely agreed upon standardized methods to measure the type and extent of damage incurred to different stakeholders by different species are urgently required. In addition, determining and quantifying the relative importance of factors other than damage that define a person's attitudes will be important for prioritizing conservation actions and developing effective policies that can be applied at a scale broader than the site and species-specific strategies currently employed.

Chapter 3

Key Factors Driving Attitudes Towards Large Mammals in Conflict with Humans

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Abstract

Biodiversity conflicts, and human-wildlife conflicts (HWC) in particular, are predicted to increase. Understanding drivers of these conflicts is a prerequisite for developing strategies to achieve conservation goals. People are a part of all HWC problems meaning social research methods are essential for finding solutions. We conducted a meta-analysis of the variables predicted to drive attitudes of people living in areas with damage causing carnivores, ungulates, elephants and primates so as to determine if common patterns of variables are present across a wide range of contexts. We categorized variables reported in publications into main and sub-categories and developed three indexes to describe relative frequency of category use, relative significance of categories and degree of accuracy between use and significance. From 45 suitable publications, 16 main categories and 17 sub-categories were identified. The majority of publications measured variables with a low likelihood of explaining drivers of HWC, or did not quantify variables of generally high utility. For example, only four categories (25%) were applied in over 50% of publications, and two thirds were mostly not significant in explaining attitudes. *Tangible costs* and *tangible benefits* thought to be the main drivers of attitudes were respectively, two and three times more non-significant than significant. *Intangible costs* however were the most important category to explain attitudes but was under represented in publications. *Intangible benefits* were mostly not important in explaining attitudes. *Costs* were more significant than *benefits* suggesting negative perceptions more strongly determine attitudes. Other important categories were exposure and experience with a species, stakeholder types and legal status of land. Socio-demographic variables commonly used in published studies such as gender, education and wealth, poorly

explained attitudes. We conclude that greater conceptual clarity is urgently required to guide future attitude studies so that research can reliably inform the development of species management plans and policies.

1. Introduction

Human–wildlife conflicts (HWC) are defined as occurring whenever an action by humans or wildlife has an adverse effect on the other (Conover 2002). However since conflicts cannot occur between people and animals as animals cannot consciously engage in such conflicts (Petersen et al. 2010) suggestions have been made to define HWC more broadly and consisting of two components: (i) impacts that deal with direct interactions between humans and wildlife; and (ii) conflicts that center on human interactions between those seeking to conserve species and those with other goals (i.e. biodiversity conflicts) (Redpath et al. 2013; Young et al. 2010).

Biodiversity conflicts and HWC are predicted to increase globally (Balmford et al. 2001; Henle et al. 2008; Pettigrew et al. 2012; Redpath et al. 2013) and pose a challenge for conservation managers, particularly in light of the rapid rate of biodiversity loss and the political consequences of failing to achieve Millennium Development Goals (http://www.undp.org/content/undp/en/home). The drivers of these conflicts are well recognized (Balmford et al. 2001, 2012; Woodroff et al. 2005; Young et al. 2010), however the solutions are less apparent and depend on disciplinary focus areas and the methods used within frameworks. For example ecologists and wildlife managers typically prioritize management of wildlife populations and their impacts using scientific knowledge and ecological principles rather than focusing on the human dimensions (Messmer 2009; Young et al. 2010). They generally make three assumptions when managing HWC impacts: (i) the level of wildlife damage is directly related to the level of conflict, (ii) the level of conflict elicits a response proportional to the level of damage, (iii) mitigation activities appropriate to the level of conflict and damage will result in proportional support for conservation (Dickman 2010). Under these assumptions, an obvious solution to HWC is to reduce the levels of damage through implementing technical mitigation

measures, of which a wide variety exist (e.g. Breitenmoser et al. 2005; Lamarque et al. 2008; Linnell et al. 1996; Pettigrew et al. 2012). In contrast, a development paradigm that typically prioritizes human well-being highlights the costs associated with conserving biodiversity (Brockington 2002; Neumann 1998; Sundberg 1998; West et al. 2006) and emphasizes solutions that primarily focus on increasing human well-being. More recently, inter-disciplinary and transdiciplinary approaches, which recognize the complexity of social-ecological systems (SES) (Berkes and Folke 1998), have been proposed (Decker 2012; Dickman 2010; Messmer 2009; Redpath et al. 2013; White et al. 2009). These approaches typically highlight the need to integrate ecological, economic and social perspectives using concepts and methods from a range of disciplines (e.g. conservation biology, anthropology, social psychology, economics and development studies). Within this approach effective solutions are not the preserve of any one discipline and focus equally on wildlife management as well as human dimensions.

Understanding the attitudes of stakeholders living in proximity to wildlife are recognized as essential for informing the design of wildlife management and HWC interventions (Decker et al. 2012; Manfredo 2009). Attitudes can be defined as dispositions or tendencies to respond with some degree of favorableness, or not, to a psychological object, the psychological object being any discernable aspect of an individual's world, including an object, a person, an issue or a behaviour (Fishbein and Ajzen 2010). The attitude construct is prominent in social psychology (Allport 1935; Fiske and Taylor 2013) as well as environmental psychology (Clayton 2012; Heberlein 2012), as the ability to evaluate one's environment is key to human existence. Without such evaluations we would be unable to make daily choices about how to behave (Fazio and Olson 2012). Accordingly, the attitude concept has been at the center of attempts to predict and explain human behaviour (Fishbein and Ajzen 2010; Heberlein 2012). Although attitudes do not always predict behavior because an attitude seldom includes all the specific characteristics of a specific situation (Heberlein 2012), positive attitudes towards an object or behavior are necessary conditions for behavior. For example, people who have a positive attitude towards hunting may not always partake in hunting but people with a negative attitude towards hunting will never hunt (Heberlein 2012). In HWC attitude research provides insight on stakeholder preferences for diverse management options, indicate support for

desired population sizes for a species, the extent of damage stakeholders are willing to tolerate and the desirability of different species on private or communal land (Chap. 2; Manfredo 2009). With such information conservation managers can predict and design interventions more likely to be supported by stakeholders thereby preventing or reducing the emergence of potential conflicts. In addition, when the drivers of these preferences are understood, interventions can be more appropriately designed (Heberlein 2012).

Although many HWC attitude studies have been conducted, most are site and species specific and no systematic quantitative reviews have been conducted which identify the drivers of attitudes across a broad range of species and societies (but see Williams et al. 2002 for wolves). It is then difficult to see broader patterns across landscapes and upscale lessons learnt (Madden 2004). For this reason, we conducted a meta-analysis (Glass 1976) of publications investigating attitudes towards damage causing mammalian wildlife by people experiencing direct conflict with wildlife. Our first aim was to determine if common patterns of factors are present across a wide range of species, stakeholders and contexts. More specifically, we were interested in testing the hypothesis that the costs that stakeholders incur are the primary determinant of attitudes towards damage causing wildlife, as this is often considered to be the primary driver of negative attitudes towards a species and towards conservation in general (Dickman 2010; Linnell et al. 2010; Madden 2004). Another issue in research on attitudes towards damage causing wildlife is that currently no theories exist that are applied across a wide range of studies. This has resulted in a lack of a set of agreed variables or constructs to guide the selection of variables in attitude research, preventing cross species and cross-cultural comparisons. Therefore a second aim of our meta-analysis was to categorize, describe and critically evaluate variables used in HWC attitude research. This initiates a process of identifying variables and constructs to be included in a future theoretical framework. Our approach in the current study is inductive (Babbie and Mouton 2007), meaning we do not pose a priori hypotheses of which variables are important. We identify which variables others have used and these form the basis for theory building. Designing a theoretical framework was beyond the scope of the current study however in a forthcoming publication we propose such a theoretical framework based on our findings in the current paper as well as drawing from theories and constructs from additional disciplines.

2. Methods

Meta-analysis is a statistical technique conducted on a large collection of results from individual studies that aims to integrate the findings (Glass 1976). We conducted a meta-analysis of publications in English language peer-reviewed journals that surveyed stakeholders who had experienced direct conflict with medium- and large-sized carnivores, ungulates, elephants or primates. We focused on these groups since larger mammalian species primarily occur outside protected areas (Crooks et al. 2011; Grunblatt et al. 1996; IUCN 2008); are generally more endangered (Inskip and Zimmerman 2009; IUCN 2008; Schipper et al. 2008), and are keystone species governing ecological processes (Estes 2011). Publications detailing attitudes of individuals not having direct experience with HWC were excluded, as the general public can have more positive attitudes towards wildlife when not directly affected (Kaltenborn et al. 2006; Martin-Lopez 2008; Williams et al. 2002). The inclusion or exclusion of grey literature in a review depends on the relative importance of maintaining scientific rigor versus avoiding publication bias towards significant results (Calver and King 1999; Rosenthal 1979). We preferred scientific rigor that ensures that statistical analyses were peer reviewed thereby reducing the risk of sampling bias. Furthermore, we felt there was little risk of publication bias towards significant results because when using statistical models, as was the case in most of the publications in this review, the risk of publication bias was small.

We searched Web of Science for publications using terms described in Supplementary Material 1. Publications were also identified from the reference list of each publication. Publications were filtered to include only those that quantified attitudes as a scale or index and were published post-1990, as very few publications were identified before this date and typically applied outdated methods. Publications meeting these criteria were then examined in detail and six variables extracted and compiled in an Excel spreadsheet. The variables extracted were defined by their availability across all publications and their relevance to our research questions. The variables were; 1) Species, 2) Species group, 3) Question type, 4) Stakeholder group, 5) Experience direct conflict and 6) Country development status (see variable

definitions in Table 1). Detailed analyses of these variables are reported in Chapter 2 where they were found to impact attitudes.

In addition to the above six variables, we extracted the variables that were examined by the authors in each publication for their effect on attitudes. We then recorded which variables were found to be statistically significant or non-significant when subject to statistical analyses by these authors. Each row in the dataset therefore represented a species, a species group, a question type, a stakeholder group, experience direct conflict, country development status and a variable that was either significant or non significant in explaining the attitude measure. These variables were then coded and grouped into main categories and sub-categories that emerged from the data through an iterative inductive assessment as per Babbie and Mouton (2007). We conservatively chose to split, rather than lump, categories in order to ensure all important categories were identified (Babbie and Mouton 2007). In so doing, we note that each category potentially has increased likelihoods of having low frequencies of variables. The two-tier system of main and sub-categories may compensate for lower frequencies by lumping the sub-categories into main categories. These are defined in Table 2 together with the total number of publications that applied each category.

Table 3.1 The variables that were extracted from publications to form the database on which the current meta-analysis was performed. The primary variables are defined in the second column. Primary variables consist of secondary variables and these are listed and defined in the third column.

Primary Variable	**Definition**	**Secondary Variables**
Question type	The items (i.e. questions) used by individual publications to measure respondents attitudes, perceptions and tolerance	Questions were coded into seven themes that emerged from the data and were not based on any prior theoretical concepts. These were questions seeking responses: (i) Supporting an increase, decrease or stable future population of a species. (ii) As to whether a person has or would kill or remove a species from their property. (iii) Addressing the desirability of a species on a persons' property or the desirability to live near a species. (iv) Addressing support for removal or lethal control of a species as a management option, in the context of under-abundant species. (v) Addressing support for reduction of over-abundant species using non-lethal control. (vi) To questions consisting of single or multiple questions summarized into a single index that describes an affect or cognition about a species, such as the extent to which a species is liked or should be conserved. (vii)To the degree to which an individual will tolerate damage from a species.
Species	Animals widely recognized as a biologically distinct group for which attitudes were reported	Each species was afforded a separate entry. Some publications reported on several species while others focused on a single species. The full species list is reported in Appendix S2.
Species group	The order or grand order to which a species belonged	Species were categorized into four groups as carnivores, ungulates, elephants or primates using the order or grand order according to Kingdon (2003).

Country development status	The status of a country as categorized by criteria of wealth and human well being	Countries were categorized as either developed or developing according to the United Nations criteria of Developed or Developing regions. Developing countries were those from Africa, the Caribbean, Central America, South America, and Asia excluding Japan. Developed regions were North America, Europe and Japan. (http://unstats.un.org/unsd/methods/m49/m49regin.htm#least, accessed November 2011).
Experience direct conflict	Respondents who lived within the species range of the species under consideration	Publications were initially excluded if respondents attitudes were not recorded separately for respondents who lived within the species range of the species under consideration and those who did live in areas that included the species range of the species under consideration. However, the small number of publications identified using this criteria necessitated that we included those publications that consisted of both types of respondents. Ultimately, two categories of publications were identified: Live in Conflict Zone (LCZ) and Mixed Conflict and Non Conflict Zone (MZ).
Stakeholder group	The categories of respondents surveyed in the publications included in this meta-analysis	Five categories emerged from the publications surveyed: commercial farmers, communal farmers, urban residents, "other" and stakeholders who experienced no damage. Commercial farmers are people undertaking broad-scale crop and animal producers primarily for sale. Communal farmers are defined as small-scale crop and animal producers who primarily produce for subsistence and/or possibly for sale. "Other" category comprised: 1) some or all of these categories where a publication did not explicitly identify a stakeholder type, or 2) any other type of stakeholder that experienced direct conflict but were categorized differently by the researcher, for example rural, hunters, berry pickers. This last category was necessary because there were insufficient numbers of publications with these stakeholder categories to be statistically analyzed. "No damage" stakeholders were those who, although living in an area where a species occurred, did not have costs imposed by wildlife, for example tourists visiting a nature reserve.

Table 3.2 The main and sub-categories resulting from the coding of variables that were examined by authors of each publication for their significance in explaining attitudes towards carnivores, ungulates, elephants and primates. Sixteen main categories resulted from the coding process and are listed in alphabetical order in the second column. The third column lists the number of publications that applied each category. The fourth column defines each category. The final column defines the sub-category (where present) and provides additional explanations and examples.

	Main Category	**No. of publications**	**Definition**		**Sub-categories (where present)**
1	Attitude	6	A disposition to regard the species as favorable or unfavorable	1.1	These are cases where a publication provided data on correlations between two attitude measures. In such cases one attitude variable is a dependent variable and a second different attitude measure was an independent variable.
2	Benefit	12	A perception of receiving positive outcomes from the species	2.1	Tangible benefits -those where the respondent receives direct monetary benefits due to the presence of the species on their land or in the area. For example from compensation programs, development projects, subsidies for implementing mitigation measure, hunting fees or tourism.
				2.2	*Intangible benefits* - the indirect benefits as perceived by the respondent, such as existence value of the species, aesthetic value or use for cultural purposes.
3	Context	2	A specific condition for which the attitude question is asked	3.1	For example when an animal is seen close to a village, if it has only threatened a person, injured a domestic animal, when it has killed a domestic animal or a person.

4	Cost	33	A perception of negative outcomes due to a species	4.1	Tangible costs - those where the respondent receives direct monetary losses due to the presence of the species on their land or in the area. For example the number of livestock killed, whether any damage was incurred or the severity of damage.
				4.2	*Intangible costs* - the indirect cost as perceived by the respondent, such as psychological costs of fear, danger or risk.
5	Experience species	25	The extent to which a person was exposed or interacted with the species	5.1	Distance to the conflict – in cases where respondents were surveyed adjacent to a protected area or how far they were to a known territory of the species.
				5.2	Length lived in area – for cases where the length a responded lived in the area was an indicator of how long they were exposed to living with the species.
				5.3	Personal experience – for cases where a person actually saw the species or saw signs of it or had a particular interaction or the frequency of experience /interaction.
6	Institutions	2	Attitudes or trust towards various government organizations	6.1	Examples of institutions include wildlife authorities, compensation programs, or community representatives.
7	Knowledge	6	Information that a respondent has about a species	7.1	Knowledge could be about the natural history of a species, wildlife in general or conservation in general.

8	Landscape characteristics	6	The features of the environment where the species occurs	8.1	Examples include density of properties for example rural or urban, size of community, or housing density.
9	Land-use	28	The type of activities that were undertaken on the land where the species occurred	9.1	Cohort- was used to indicate how the respondent used the land in terms of their identity or occupation. For example, hunter, farmer, forester, livestock producer, lived on a farm, obtained income from farm, was dependent on income from land.
				9.2	Activity-what types of activities took place on the land. For example livestock, game, mixed game and livestock.
				9.3	Dependency - whether the respondent was dependent on the resource that is impacted by the species. For example livestock dependency (recorded as residuals of regression of livestock numbers against crop area, presence of livestock), purpose of keeping livestock (sale, subsistence, tradition), main source of income from farm or other.
10	Legal	5	The judicial status of land on which the respondent lives	10.1	Conservancy - whether the land was managed as a conservancy or not.
				10.2	Tenure - types of land ownership were private, communal private, communal government, Wildlife Management Area.

11	Mitigation measures	4	The methods used to prevent or reduce damage from a species	11.1	Examples include whether mitigation measures were used, the number of mitigation measures used or the extent to which they were effective.
12	Property characteristics	4	Features of the land on which a species occurs	12.1	Examples include the presence of "play " trees that attract cheetah to mark at, livestock density and livestock type.
13	Salience	10	A measure of how important a species or wildlife in general or nature in general is to a respondent	13.1	Examples include attention to wildlife stories in press, general environmental concern, interest in walking in a forest, picking berries, fishing, member of a nature NGO.
14	Socio-demographic	33	A variable that measures a combination of sociological (=related to sociology) and demographic (=relating to populations) characteristics	14.1	Age
				14.2	Gender
				14.3	Education
				14.4	Tribe
				14.5	Other – included rural or urban upbringing, number of children in school, religion, household size, age of children.
15	Species characteristics	12	Features of a species as perceived by the respondent	15.1	Examples include measures of perception of presence of a species, its abundance, frequency it is seen or its density. This category is similar to *Experience species* but differs in that the variable is a measures of a

					species characteristic whereas *Experience species* measures a human characteristic.
16	Wealth	15	Measures of the monetary value of the respondent	16.1	Examples include number of livestock, size of farm, size of field, income, perceived financial stress.

2.1 Data Analysis

We constructed three indexes to describe category trends:

An *Application Index* (APP) measured the number of times each variable in a category was used in a publication expressed as a percentage. It is therefore a measure of the frequency that a category was examined in surveys because it was thought to be important by the author in explaining attitudes. This was computed according to the formula:

$$APP = n \div N \times 100$$

Where n is the number of times each category was used in a study, N is the total number of publications in the meta-analysis (45).

A *Significance Index* (SIG) measured the relative frequency that variables included in a category were found to significantly explain attitudes and is therefore a measure of how important a category is in explaining attitudes. This was computed according to the formula;

$$SIG = f(NS) \div f(S)$$

Where f (NS) is the number of times variables in a category were not statistically significant, f (S) is the number of times variables in a category were statistically significant. Dividing these two frequencies allowed one to control for the fact that there were twice as many non-significant variables as there were significant variables. A value of 1 therefore indicates equal frequencies of non-significant and significant variables in a category. A value below zero indicates that the frequency of significant variables in a category is higher than non-significant variables and therefore is important in explaining attitudes. A value above 1 indicates that frequencies of non-significant variables in a category are higher than significant and therefore the category is of low importance in explaining attitudes.

An *Accuracy Index* (ACC) measured how often category variables were found to be significant in a publication (i.e. Significance Index-SIG) relative to the frequency it was applied in a publication (i.e. the Application Index-APP) and is therefore a measure of how accurately categories are used relative to their importance in explaining attitudes. This was computed according to the formula;

ACC= rank (SIG) - rank (APP)

Rank (SIG) and rank (APP) are hierarchical rankings of these indexes and were computed by assigning each category (main category and sub - category) a rank according to their position in a hierarchy of importance. For the SIG index the lowest value received the highest rank of one, as it was the most important category that explained attitudes (Table 3.3, column 7). For the APP index the highest value received the highest rank of one, as it was the category that was applied most frequently in publications (Table 3.3, columns 8). Values of the ACC index close to zero mean that the SIG and APP ranks of a category were similar and therefore indicated that a category was applied in publications at a frequency similar to its significance in explaining attitudes. Extreme negative and extreme positive values indicate low accuracy. Extreme negative values indicate a category is highly under applied in publications relative to its significance in explaining attitudes. Extreme positive values indicate that the category is over applied in publications relative to its significance in explaining attitudes.

3. Results

We identified 45 suitable publications from 19 different countries that met the selection criteria (Appendix IV). Seven publications were from developed countries and 12 from developing countries (Appendix IV). Thirty-six species were assessed across all publications: 18 were carnivore species, 14 ungulates, 2 primates and 2 were elephant species (Appendix IV). On average, 8.7 variables (median = 8) were measured per publication, ranging from 1 to 39 variables. There were almost twice as many non-significant (66%) as significant (34%) results. Sixteen main categories

emerged from our coding of the variables (Table 3.2). Seven of these main categories could be sub-divided into 17 sub-categories (Table 3.2). Appendix V lists the publications that used each main and sub-category.

3.1 Application Index

The APP index ranged from 2 to 33 publications (4% to 73%) but most of the categories were rarely applied: eight (50%) main categories and five (29%) sub-categories were applied at frequencies of 13% or below (Table 3.3, Fig. 3.1). Only four (25%) of the main categories and three (17%) of sub-categories were applied in more than 50% of publications. The four main categories most widely applied were: *Cost* (73%), *Socio-demographic* (73%), *Landuse* (62%) and *Experience species* (56%). The three most widely applied sub-categories were: *Socio-demographic/age* (67%), *Cost tangible* (64%) and *Socio-demographic/gender* (53%) (Table 3.3, Fig. 3.1).

3.2 Significance Index

The SIG index ranged from 0.19 to 9 (Table 3.3, Fig. 3.1). Most categories were poor predictors of attitudes as only four main categories (25%) and five sub-categories (29%) had values below or equal to 1. The six best predictors of attitudes (those with values below 1) were: *Cost/intangible* (0.19), *Legal/Tenure* (0.28), *Attitude* (0.4), *Legal* (0.44), *Socio-demographic/tribe* (0.88) and *Legal/conservancy* (0.92) (Table 3.3, Fig. 3.2). However they were all applied in few publications (2-10, 4%-22%).

3.3 Accuracy Index

The ACC index ranged from -16 to 17 (Table 3.3). We divided this range into three groups corresponding to low (-11 to -16 and 11 to 16), moderate (-6 to -10 and 6 to 10) and high accuracy (-5 to 5) (Table 3.3, column 9). High accuracy means that the rank of a category in the APP was similar to its SIG rank indicating high agreement between the extent to which it was applied in publications and its importance in explaining attitudes. Only 50% of main categories and 35% of sub-categories occurred in the high accuracy group meaning that many categories that are important are not being applied while others that are not important are widely applied.

3.4 Costs and Benefits

The *cost* category was commonly applied in surveys (73%) and was of high importance in explaining attitudes (SIG=1.04) resulting in a high ACC of 5 (Table 3.3, Figs. 1&2). I*ntangible costs* (22%) (indirect costs, such as psychological costs of danger or risk, Table 3.2) were the most important variable explaining attitudes (SIG = 0.19, Table 3.3) however *tangible costs* (direct monetary losses, e.g. number of livestock killed or proportion of crop lost, Table 3.2) were measured three times more often (64%). *Tangible costs* ranked 11th (out of 33) on the SIG index (SIG=1.91) with almost twice as many non-significant as significant results, but since it was widely applied, resulted in a medium ACC of 8, meaning it was applied more often than it was important in explaining attitudes (Table 3.3, Fig. 3.2). *Intangible costs* resulted in a low negative ACC index (-11) since it was applied much less relative to its importance in explaining attitudes (Table 3.3).

The *benefit* category was applied less frequently than costs (in 27% of surveys). Benefits were also less important in explaining attitudes than costs (SIG = 2.66, Table 3.3). Contrary to costs, *tangible benefits* (direct monetary benefits; e.g. from tourism, trophy hunting, meat, Table 3.2) were applied at similar frequencies as *intangible benefits* (indirect costs, such as psychological costs of danger or risk, Table 2) (APP=16%, Table 3.3). However, similarly to costs, *intangible benefits* were more important in explaining attitudes (SIG = 1.5, Table 3.3) than *tangible benefits* (SIG=2.96, Table 3.3). This resulted in a negative ACC index for *intangible benefits* (ACC=-4), meaning it was applied less than it was important in explaining attitudes. The positive ACC index (ACC=2) for *tangible benefits* meant it was applied more than it was important in explaining attitudes. Overall the ACC indices for benefits were high (Table 3.3).

Table 3.3 Values of the three indexes used to describe meta-analysis result. The calculation of these indexes and their interpretation is described in Methods. Main categories are recorded as single words and sub-categories are recorded as two words, the first being the main category and the second the sub-category. We divided the range of values for each index into high, medium and low values. High values for all indexes are highlighted in dark cells, low values are highlighted in the lightest cells and medium values are highlighted in cells of shades intermediate between the darkest and lightest colored cells.

Main Category and Sub-category	No. Pub.	APP %	No. Sig.	No. Non-Sig.	SIG	Rank SIG	Rank APP	ACC
Legal/Tenure	3	7	36	10	0.28	2	18	-16
Legal/Conservancy	2	4	12	11	0.92	5	19	-14
Legal	5	11	48	21	0.44	3	16	-13
Context	2	4	11	11	1.00	6	19	-13
Attitude	6	13	5	2	0.40	3	15	-12
Cost /Intangible	10	22	36	7	0.19	1	12	-11
Socio-demographic /Tribe	6	13	17	15	0.88	5	15	-10
Knowledge	6	13	5	6	1.20	8	15	-7
Mitigation measures	4	9	2	3	1.50	10	17	-7
Experience sp./Personal	12	2 7	14	10	0.71	4	10	-6
Property characteristics	4	9	2	4	2.00	12	17	-5
Benefit/Intangible	7	1 6	6	9	1.50	10	14	-4
Species characteristics	12	27	17	19	1.12	7	10	-3
Landscape characteristics	6	13	6	12	2.00	12	15	-3
Land-use/Cohort	19	42	19	20	1.05	6	8	-2
Experience sp./Distance to species	11	24	6	11	1.83	10	11	-1
Salience	10	22	13	28	2.15	13	12	1
Benefit/Tangible	7	1 6	23	68	2.96	16	14	2

Institutions	2	4	0	6	6.00	22	19	3
Experience species	25	56	21	30	1.43	9	5	4
Land-use/Dependence	7	16	2	7	3.50	18	14	4
Cost	33	73	71	74	1.04	6	1	5
Benefit	12	27	29	77	2.66	15	10	5
Socio-demographic /Other	5	11	3	12	4.00	21	16	5
Socio-demographic /Education	22	49	26	64	2.46	14	7	7
Land-use/Activity	5	11	12	100	8.33	23	16	7
Cost /Tangible	29	64	35	67	1.91	11	3	8
Wealth	15	33	12	44	3.67	19	9	10
Experience sp./Length lived area	8	1 8	1	9	9.00	24	13	11
Socio-demographic /Age	30	67	27	81	3.00	16	2	14
Socio-demographic /Gender	24	53	20	76	3.80	20	6	14
Socio-demographic	33	73	93	318	3.42	17	1	16
Land-use	28	62	33	127	3.85	20	4	16

3.5 Experience, exposure and interest in a species

Experience species was the third most common main category applied in surveys (APP=56%, Table 3.3, Fig. 3.1), had a medium SIG index of 1.43 and a high positive ACC index of 4. The three sub-categories were all applied in relatively few surveys (Table 3.3, Fig. 3.1) but differed widely in the their importance in explaining attitudes. *Personal experience* of a species was the best predictor (SIG=0.71) and was applied the most (APP=27%, Table 3.3, Figs. 3.1 & 3.2). *Distance to species*, which typically was a measure of the proximity of a stakeholder to an area where a species occurred, predicted attitudes to a lesser extent (SIG=1.83, Table 3.3, Figs. 3.1 & 3.2), while *Length lived in area*, which typically measured the duration of time a stakeholder resided in an area where a species occurred, was not a good predictor of

attitudes as there were 9 times more non-significant results than significant results (SIG=9, Table 3.3, Fig. 3.2).

Species characteristics typically comprising measures of perceptions of a species presence or absence, abundance, density, or the frequency with which it was observed (Table 3.2) had medium SIG index of 1.12, was applied in 12 (27%) publications and presented a relatively high ACC value of -3 (Table 3.3, Figs. 3.1 & 3.2).

3.6 Salience and knowledge

Salience was applied in 10 (22%) of publications and had a low SIG value (2.15) and therefore high ACC index (1) (Table 3.3, Figs. 3.1&3.2).

Knowledge was also applied in few publications (6, 13%) but had a medium SIG index (1.2) resulting in a low ACC index of -7 (Table 3.3, Figs. 3.1&3.2).

3.7 Sub-groups: socio-demographic, wealth and cohort

Socio-demographic variables (e.g. age, education and gender) were applied in the majority of publications (73%), but scored low on the SIG index, presenting a low ACC index (Table 3.3, Figs. 3.1 & 3.2), meaning they were applied more often than they were significant. The sub-category *tribe* was an exception with a high SIG index but low APP index (Table 3.3, Figs. 3.1 & 3.2). The main category *Wealth* was also over represented in surveys compared to its significance (Table 3.3, Figs. 3.1 & 3.2).

Half of all *cohorts* quantified were found to significantly predict attitudes (SIG=1). This category was well applied (19, 42%) resulting in a high ACC index of -2 (Table 3.3, Figs. 3.1& 3.2).

3.8 Institutions and Legal

Legal and *institutions* were rarely applied in publications occurring in five (11%) and two (4%) of studies respectively (Table 3.3, Fig. 3.1). *Legal* however was very important in explaining attitudes (SIG=0.44) while institutions poorly explained attitudes (SIG=6).

3.9 Mitigation measures

Mitigation measures were applied in few publications (4, 9%), were of medium importance (SIG=1.5) resulting in low accuracy (ACC=-7) (Table 3.3, Figs. 3.1&3.2).

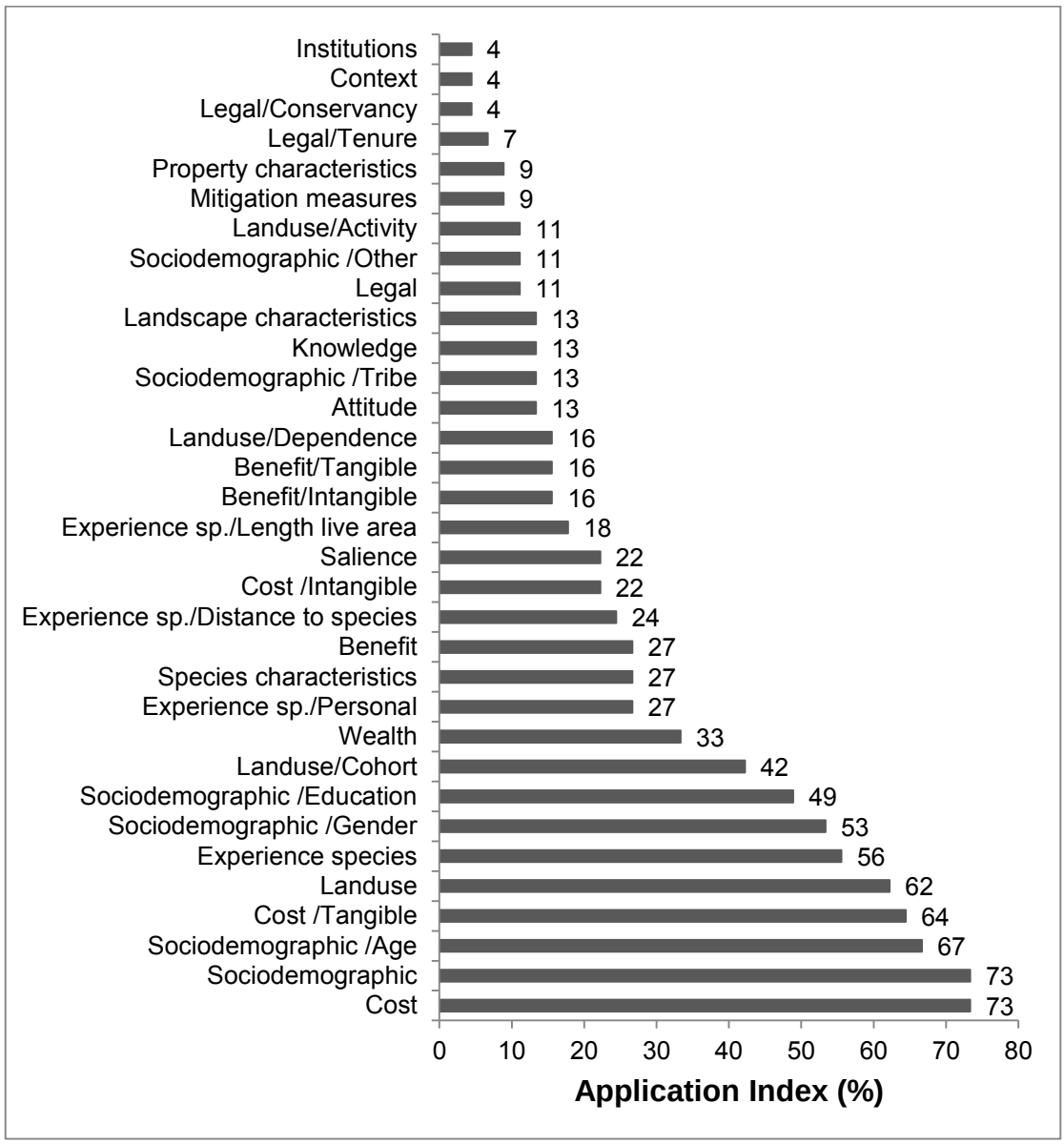

Figure 3.1 Application Index (APP) for main and sub-categories according to increasing importance. Main categories are recorded as single words and sub-categories are recorded as two words, the first being the main category and the second the sub-category.

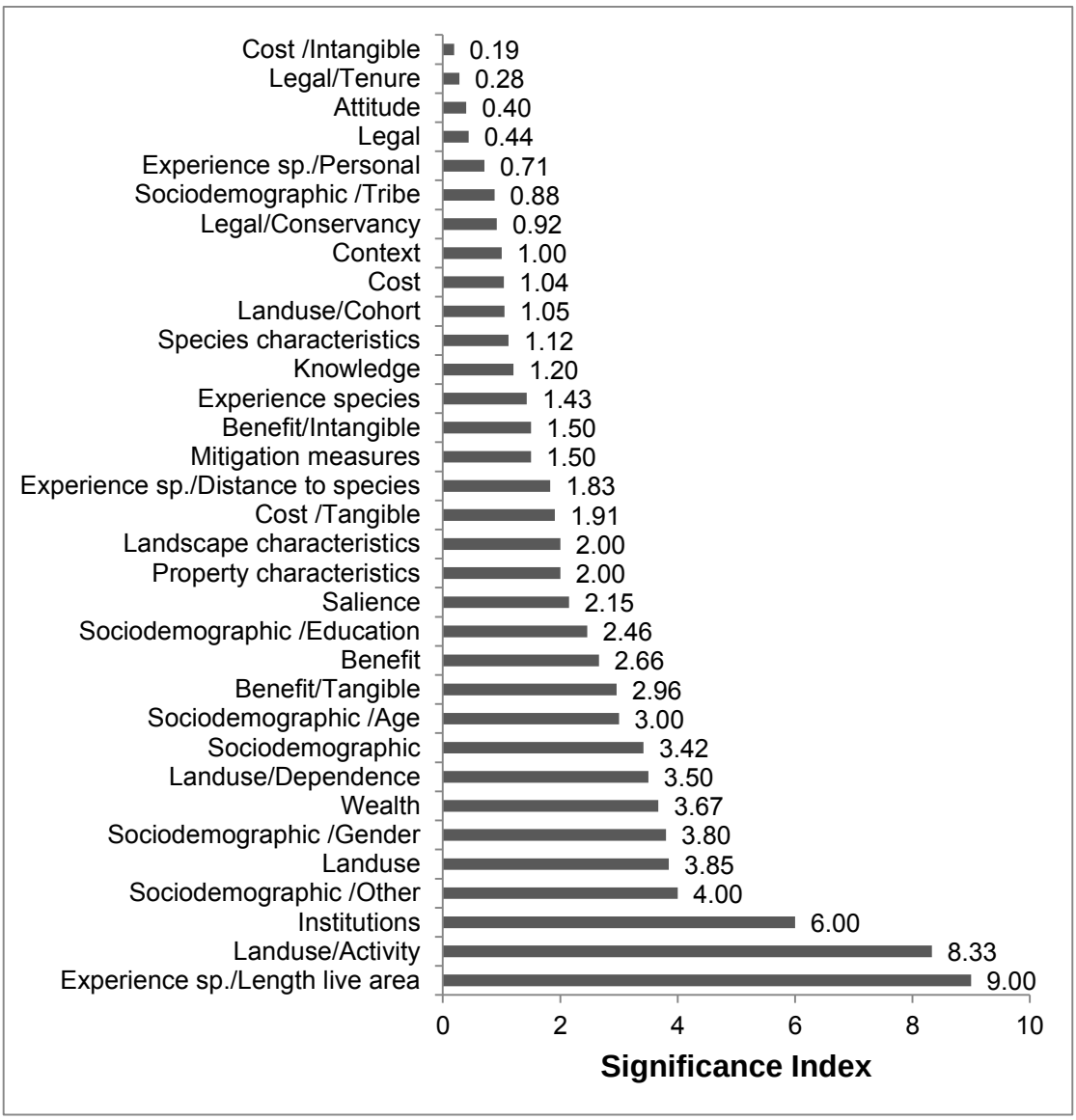

Figure 3.2 Significance Index (SIG) for main and sub-categories according to decreasing importance (i.e. low values indicate high importance). Main categories are recorded as single words and sub-categories are recorded as two words, the first being the main category and the second the sub-category.

4. Discussion

4.1 Costs and Benefits of living with damage causing wildlife

The costs and benefits associated with living with wildlife, notably for people adjacent to protected areas, have generally been considered the primary determinants of attitudes towards wildlife, and conservation initiatives more broadly (Chan et al. 2007; Linnell et al. 2010; Treves and Bruskotter 2014). Interestingly, *intangible costs* were more important than *intangible benefits* and *tangible costs* were also more important than *tangible benefits*, suggesting that negative perceptions may more strongly determine attitudes than positive perceptions. The propensity for negativity bias is well documented in economic psychology (Kahneman 2011). For example, individuals are only indifferent to a prospect involving a 50% chance of losing $50 if it also affords a 50% of winning $100. This bias increases with increased attachment to an object (Kahneman 2011). Individuals may thus require at least twice as many benefits than costs in order to tolerate wildlife particularly if they have strong attachment to their livestock (Vitterso et al. 1998). The relative importance of costs versus benefits in determining attitudes to different wildlife species would therefore be an important future research imperative as this would usefully inform the ratio and types of benefits needed in order to counter the costs of living with wildlife.

4.1.1 Costs of living with damage causing wildlife

Not surprisingly, the perceived costs of living with a species were one of two categories most commonly applied in surveys, and were of high importance in explaining attitudes. However, separating *costs* into *tangible* and *non tangible*, the high significance is mostly due to *intangible costs* which were ten times more significant than *tangible costs*. This finding supports recent qualitative reviews emphasizing the importance of non-tangible cost variables (Barua et al. 2013; Dickman 2010; Redpath et al. 2013). Caution however is required in concluding that *tangible costs* are not important due to methodological considerations. Of 29 publications quantifying *tangible costs*, 26 used a unique measure of damage meaning there was no overlap in how the damage was measured in each case. This could mean that for a particular study damage may have been significant if a different damage

variable were used. Although 13 of these 26 unique measures were from one publication, one measure (experience damage or not) was used in the majority of publications (69%). Here equal numbers of significant and non-significant results were documented suggesting damage is not always important. Although this measure is simple to apply, it accounts neither for the extent nor frequency of damage. For example, a person may incur damage once a year or 10 times a year and these events are quantified equally. Similarly, two peoples experiences would be quantified as equal when a single damage event destroys 90% of one's crops and 1% of the others. Other cost measures used were costs over a specified time frame, total financial losses, total number of livestock lost or the percentage of holdings lost. These measures are possibly also inadequate as the value placed on objects by a person is determined by various cognitive biases (Kahneman 2011).

A more useful measure may be the amount or proportion of the most substantial income source that is lost relative to the total benefit (financial or otherwise). For example, Bagchi and Mishra (2006) recorded predation by Snow Leopard in the Kibber and Pin Valleys in Spiti, India. Despite suffering greater livestock losses than farmers in Pin valley, Kibber valley farmers had more positive attitudes, possibly because in the Pin valley horses being predated were more important in contributing to people's livelihoods compared to the cash crops grown in Kibber Valley. The sub-category *dependency* within the main category *land use* provides an example of how this concept could be operationalized. However since it was rarely applied in surveys its low importance in explaining attitudes in our study (Table 3.3, Figs. 3.1 & 3.2) must be treated with caution. It is also possible that its operationalization in surveys was inappropriate as each household may be unique. For example, in the same village one household may depend on livestock while another household may depend on alternative sources of income. If however *intangible costs* are more important than *tangible costs* the use of financial incentives such as compensation schemes for livestock or crop loss will need to be reconsidered as a strategy to increase tolerance.

4.1.2 Benefits of living with damage causing wildlife

Given the importance that benefits are considered to have for determining support for species conservation (notably through provision of ecosystem goods and services:

Chan et al. 2007; Linnell et al. 2010; Nature 2005; Treves and Bruskotter 2014), it is surprising that measures of *benefits* appeared in relatively few publications both compared to *costs* and compared to other categories. Also surprising was the low importance of *benefits* in explaining attitudes. This suggests a mismatch between qualitative and quantitative researchers. Caution however is required in interpreting these results because as the number of surveys applying a category decreases, the accuracy of the SIG index decreases (see also section 4.8). Therefore future attitude surveys should aim to apply benefit categories, particularly in light of the importance qualitative reviews ascribe to this category (Treves and Bruskotter 2014). Further, methodological limitations in measuring *tangible benefits* are similar to those of measuring *tangible costs*, meaning caution is warranted when results suggest that benefits are not as important as costs. The low application of benefits in surveys may also be a consequence of a tendency to focus on the negative due to negative perceptions of the impacts of wildlife by both stakeholders and researchers and be due to the limitations in survey length and narrow focus of publications.

4.1.3 Intangible costs and benefits

For both *costs* and *benefits*, *intangible costs* and *intangible benefits* were more important in explaining attitudes than *tangible costs* and *tangible benefits*. The importance of *intangible costs* and *benefits* has also been recognized through recent research focused on the role of emotions in determining attitudes (Jacobs et al. 2011; Vaske et al. 2013) as well as the hidden health, opportunity and transactions costs of living with damage causing wildlife (Barua et al. 2013). Understanding *intangible costs* will greatly improve our identification of factors determining attitudes. *Intangible benefits* such as positive emotions, existence values aesthetic or cultural values as well as ecosystem services have been less applied and is an important future research imperative.

One of the aims of this study was to test the hypothesis that the costs and benefits that stakeholders incur are the primary determinant of attitudes towards damage causing wildlife. Our study found that while *intangible costs* were highly important, *tangible costs* and both *tangible* and *intangible benefits* were of low importance in explaining attitudes. We cautioned however against concluding that costs and benefits are of less

importance because of methodological issues. To overcome these, we recommend that at the start of a study qualitative research is conducted to determine types of costs and benefits operating at a site and the resources that are being impacted by different species of wildlife. Once this is understood these can be incorporated into a multi item construct (Worthington and Whittaker 2006). These items can then be examined for their contribution to a cost construct, which in turn can be analyzed for explaining attitudes. This will allow conservation managers to target the most important costs to reduce and benefits to increase.

4.2 Experience and exposure to wildlife

Learning from experience is a fundamental concept of life. Failure to learn increases the risk of death and therefore should be highly adaptive. Learning is defined as "a change in behavior due to experience" (Chance 2013). Stronger experiences are more likely to be retained in memory and more rapidly recalled, resulting in stronger attitudes and more congruence between attitudes and behaviour (Glasman and Albarracin 2006; Heberlein 2012). Therefore the extent to which a person is exposed to a species and the extent to which exposure results in interactions with a species are likely to be important predictors of attitudes towards a species. It is therefore not surprising that our category of *experience species* was the third most common main category applied in surveys suggesting that most researchers recognize the importance of experience in predicting attitudes. However, of the three sub-categories used *personal experience* was the best predictor but was only applied in a third of publications. It is also the most direct measure compared to *distance to species* and *length lived in area*. Given the significance of this sub-category, and of the power of negative experiences in explaining attitudes (Baumeister et al. 2001; Rozin and Royzman 2001), adoption of direct measures of the nature, extent and frequency of *personal experience* of a species should be a priority in future surveys.

The main category *species characteristics*, typically comprising measures of perceptions of a species presence or absence, abundance, density, or the frequency with which it was observed can also be considered an indicator of experience of a species. This is because the greater its abundance, density or frequency it is seen the

higher the probability of experiencing a species. This category however differs to the *experience species* category in that it measures attributes of a species whereas *experience species* measures attributes of people. *Species characteristics* could also be a separate measure of the extent to which a person is exposed to a species. In other words how often a species is present at a specific distance to a person is different to the type of experience a person has when in the presence of a species. Therefore we suggest application of two distinct measures; exposure and experience. It will then be more accurate to compare attitudes between stakeholders while controlling for exposure since higher exposure would increase the probability of incurring costs and therefore negative attitudes.

4.3 Salience and knowledge

The main category *salience* was generally measured by indicators such as attention to wildlife stories in the press, general environmental concern, interest in walking in a forest, picking berries, fishing or membership of an environmental group (Table 3.2). We assume the rationale of these indicators is that higher interest in nature or wildlife motivates action on that interest and increases the probability of positive experiences resulting in positive attitudes. The low importance of *salience* in explaining attitudes however suggests that this assumption may not be valid. However, we caution against this conclusion, due to the low application of this category in studies (see 4.8) as well as the possibility that measures used may not be sufficiently specific. The Theory of Planned Behavior (TPB) specifies that general attitudes towards an object or issue may result in poor prediction of specific attitudes or behaviors (Fishbein and Ajzen 2010). We hypothesize that specific interest in animals and wildlife would be an important predictor of attitudes towards damage causing wildlife and suggest future surveys test this using more specific indicators rather than general interest in nature or the outdoors.

The main category *knowledge* may be suitably categorized with *salience* as it could indicate the level of interest in a species, the assumption being that people will be more knowledgeable on objects or topics they are interested in. The higher importance of *knowledge* over *salience* suggests that *knowledge* questions may be better predictors of interest in a species than the behaviors' measured under *salience*.

If, however, people's level of knowledge is tested under the assumption that knowledge per se about wildlife or conservation translates into positive attitudes, i.e. that there is a causal relationship between knowledge and positive attitudes, this assumption is more tenuous as knowledge of accurate facts does not necessarily translate into positive attitudes or behavior (Ajzen et al. 2011; Heberlein 2012). For instance, knowledge about saiga antelope (*Saiga tatarica*) ecology and population decline was high but individuals with accurate knowledge were not less likely to poach (Kuhl et al. 2009). A pertinent future research question is what type of knowledge is important in the context of HWC, if at all? In the TPB subjectively held knowledge (i.e. beliefs) are the only type of relevant knowledge that predicts behaviour (Fishbein and Ajzen 2010). In theories of pro-environmental behavior (Klockner 2013) knowledge of the environmental problem is an important mediator of pro environmental behavior. For instance perceived severity of water shortage during a drought predicts households' efforts to conserve water (Van Vugt and Samuelson 1999). In HWC lack of problem awareness is unlikely. Working knowledge, defined as the information a person has at their disposal when evaluating or processing information about an object or issue (Wood et al. 1995) may be relevant for HWC. For example knowledge of different types of prevention methods to reduce or prevent damage may determine whether they are implemented or attitudes towards implementing them. We therefore recommend that future surveys refrain from using general knowledge type questions and focus on questions of working knowledge when relevant to the context of the study.

4.4 Sub-groups as useful targets for conservation interventions

Exposure of sub-groups within a population to diverse learning experiences may produce different attitudes or behaviours. Understanding these differences allows for specific interventions to be designed and targeted for different sub-groups (Carpenter et al. 2000; Fishbein and Ajzen 2010). *Socio-demographic* variables such as age, education, gender and wealth were generally poor predictors of attitudes despite being widely applied. Overall they are therefore not useful target subgroups for mitigation interventions. However, they may be useful for describing populations, for example to ensure equal representation of gender, age, education and wealth in a sample. The sub-category *tribe* was an exception showing high importance in explaining attitudes.

Since different tribes are likely differ culturally, this finding is unsurprising. However since it was applied in few surveys, it should be investigated in future surveys.

Wealth was also over represented in surveys compared to its significance. When framed in the traditional HWC perspective where costs are considered the primary driver of attitudes, this seems counter intuitive. A wealthy person could be expected to have more positive attitudes as their wealth could provide resilience to damage. Alternatively they could be expected to have negative attitudes as they are more able to manipulate their context (i.e. environment) to be as they want it, meaning they are less used to costs when they unexpectedly occur. A possible explanation for the low significance of *wealth* may be that the measures used do not incorporate the total wealth of a person. For example, each household may have a different primary income sources so measuring only number of livestock when the household has income from outside work or other assets would underestimate the wealth and therefore resilience of a household. Therefore, we suggest using multiple indicators of wealth such as those often used in national population censuses to create a wealth index rather than relying on one indicator. Choice of indicators that are comparable across wide ranges of wealth such as those occurring between developed and developing countries would be useful for cross-cultural studies.

The *cohort* sub-category was useful in defining sub-groups as half of all *cohorts* quantified were found to significantly predict attitudes. This suggests studies have targeted meaningful groups. Contexts where sub-groups are not significant may usefully indicate that interventions are not required for these groups. *Salience* and *cohort* are similar, but different, measures of an individual's activities. *Cohort* proved twice as important as *salience*, which may be a result of higher relevance of these groups to activities on the land and therefore more closer experience of the impacts of a species compared to the more indirect experiences by individuals in the *salience* grouping.

4.5 Institutions

Institutions are defined as "durable systems of established and embedded social rules (convention, norms and legal rules) that structure social interaction (Hodgson 2006).

The definition of HWC as consisting of two components; (i) impacts that deal with direct interactions between humans and wildlife species; and (ii) conflicts that center on human interactions, indicates four key stakeholder groups: wildlife, people who are impacted by wildlife, stakeholders not directly impacted by wildlife (e.g. Non Governmental Organizations) and authorities. It follows that institutions and relationships between stakeholder groups and institutions are critical. However, the two categories in our meta-analysis *legal* and *institutions* were rarely applied in publications. There is a strong indication from managing common pool resources that institutions and their relationships with stakeholders are important factors in sustainable resource management (Brooks et al. 2013; National Research Council 2002; Ostrom 1990). There is also a high level of institutional failure in resource management (Acheson 2006; Anthony et al. 2010). Therefore incorporation of institutional issues into future HWC attitude research is an urgent future research imperative (Decker et al. 2013; White et al. 2009). This could be incorporated into surveys by evaluation of support for relevant organizations and laws related to wildlife and natural resource management in an area. Communities or individuals who have low trust and support for a particular organization or legislation are less likely to support interventions or laws promulgated by them. Further, when there is a mismatch between the attitudes of stakeholders and organizations, mitigation strategies or policies they are not likely to be up taken by stakeholders therefore increasing conflict (Heberlein 2012).

4.6 Mitigation measures

Documenting and understanding stakeholder use of and reasons for implementing mitigation measures (or not) is important as mitigation measures have the potential to prevent or reduce the costs of living with wildlife. However, *mitigation measures* were applied in few publications in our study. They are also often not used by stakeholders (Frank et al. 2006; Maclennan et al. 2009). The reasons for their lack of use has rarely been investigated. Understanding the relationship between attitudes and the types of mitigation measures used is also important since positive attitudes although in some cases may be associated with less lethal and more integrated pest management (Canavelli et al. 2013), is not always a good measure of sustainable management practices (Heberlein 2012). For example in a meta-analysis (Chap. 2)

commercial farmers tended to hold more positive attitudes to damage causing wildlife than communal farmers however one could not assume that these farmers engaged in more sustainable management practices as commercial farmers may have relatively more resources to manage and extirpate wildlife. The TPB (Fishbein and Ajzen 2010) could be used to investigate use of mitigation measures as well as factors that enable or constrain their use.

4.7 Context

Although applied in only two publications context is generally considered an important aspect in attitude surveys as slight changes in context can result in different interpretation of a question and therefore different results (Heberlein 2012; Zin et al. 2000). For example in the TPB (Fishbein and Ajzen 2010) four elements must be part of an attitude question; the action performed, the target at which the action is directed, the context in which it is performed and the time at which it is performed. Compare for example, the difference between a general question such as: Do you support elephant conservation, compared to: Do you think an elephant should be culled when it is seen 100 meters from your house two times a week? Not surprisingly significant differences in attitudes towards different wildlife species and willingness to pay for their conservation have been reported in studies where questions were categorized into different types (Chap. 2; Martin-Lopez et al. 2007). We recommend future attitude questions be operationalized as constructs rather than single item questions (Worthington and Whittaker 2006). This will allow incorporation of a diversity of contexts.

4.8 Limitations of study

This study has some limitations that should be noted. Firstly, the majority of publications involved carnivores. Ungulates were moderately represented but very few studies involved elephants and primates, meaning caution is required when generalizing results. We do not think this would affect the list of variables and categories examined because we surmise that the categories of drivers in these conflicts would be similar for all wildlife species. Where differences most likely occur are in relative importance of categories for different animal species. For

example *tangible costs* may be more important for species that particularly target important income generating crops while *intangible costs* may be more important for particularly dangerous species. Similarly *tangible benefits* may be more important for species that generate larger contributions to livelihoods, while *intangible benefits* may be more important for species that are particularly attractive or have high symbolic importance. This in turn may impact the relative importance of other categories. For example where *tangible benefits* are important, the role of *institutions* may become more important as the presence of laws, policies and relations with authorities could enable or limit the ability of stakeholders to capitalize on these benefits.

A second limitation is the low coverage of species, stakeholders, question type and sites for each category and sub-category since these variables have been shown to affect attitudes (Chap 2). Controlling for these variables would require an extensive number of publications that were not available in this study.

A third limitation was the low application of many categories in publications, which was also a major finding. This impacts on the accuracy of the SIG and ACC indices because the less a category is applied the higher the chance that the number of times it was found to be significant or not will be random. For this reason the indexes are not the sole basis of our evaluation of categories; we also use concepts and theories from other disciplines and qualitative reviews.

5. Conclusions

Increasing pressures on biodiversity will increase the frequency and magnitude of HWC events. An understanding of the causes of these conflicts is a prerequisite for developing effective and cost-efficient management strategies to ensure achievement of conservation goals. People are a part of all HWC problems meaning social research methods are essential for understanding what solutions are more likely to be effective because congruence between attitudes and policies are essential (Heberlein 2012). Surveys and interviews can provide quantitative assessments of the attitudes of stakeholders and this information can guide management strategies (Decker et al. 2012; Heberlein 2012; Manfredo et al. 2009). Quantitative surveys are particularly useful to identify the extent and magnitude of a problem because without such

surveys powerful individuals or groups can distort reality. However, for research to usefully contribute to providing solutions to HWC problems, research must be targeted on the most soluble dimensions of these problems.

Despite the limitations of this study it is valuable in several ways. Firstly, it is the first attempt to consolidate the large body of research on this topic. Secondly, we have initiated a process of evaluating potential drivers of attitudes and how they may contribute towards building a comprehensive theory of factors that determine attitudes towards damage causing wildlife. Thirdly, a combination of our indices together with critical evaluation of categories based on available theory allowed us to identify a relatively small subset of specific variables of significance for explaining attitudes across a range of mammal species and contexts. The review also identified a large sub set of categories with low importance in explaining attitudes. This is useful because it allows for research to be more effectively targeted and creates opportunities to critically examine the theory behind their use.

Our intention was to find broad patterns of factors that explain attitudes so as to determine if these can be applied across a wide range of species and contexts therefore our indices were designed for this purpose. However, variables that were not found to be important with our indices should not necessarily be discarded in future surveys because they may be relevant in a particular context.

Ultimately management strategies need to be designed on a case-by-case basis but application of broader strategies and policies should be the aim in order to reduce costs and increase efficiency. This could also avoid conflicts between organizations responsible for different species (McCracken 2009) by promoting more effective coordination across the different jurisdictions of management and policy-making organizations. For this to be achieved, a broad conceptual framework for understanding and managing HWC is necessary.

Chapter 4

A Wildlife Tolerance Model for Understanding Stakeholders Living With Damage-Causing Mammalian Wildlife

Abstract

Human-wildlife conflicts (HWC) are recognized as a major priority due to the costs incurred to both stakeholders and wildlife that result in a lack of support for conservation in general. Research on stakeholder attitudes to living with wildlife has expanded recently with the goal of understanding the drivers of tolerant attitudes and behavior, recognizing that stakeholders can differ widely in ability to cope with wildlife. This research is largely undertaken as case studies and to date no quantitative synthesis of the outcomes of these studies has occurred. Further, there is no unified theoretical framework that is based on a synthesis of these studies resulting in a lack of information of the important drivers of tolerance and the extent to which they can be applied at broader spatial scales. Here we propose the Wildlife Tolerance Model (WTM) based on quantitative meta- analyses as well as constructs and theories from additional disciplines. The WTM proposes an *outer model* where the net outcome of the extent to which a person is exposed to a species as well as the types of meaningful events (positive or negative) determines perceptions of the costs relative to benefits of living with a species. This in turn determines tolerance. A second component predicts eleven inner model variables that may further drive perceptions of costs and benefits. These are: Interest in Animals, Empathy, Anthropomorphism, Taxonomic bias, Values, Wildlife Value Orientations, Institutions, Personal Norm, Self-efficacy/behavioral control, Social Norms and Habit. Application of the WTM to identify the most important drivers of tolerance and operationalized to be comparable across species and sites will enable accumulation of relevant knowledge allowing adaptive management of intervention strategies to manage HWC's across landscapes.

1. Introduction

Biodiversity conflicts and Human-Wildlife Conflicts in particular are increasing (Balmford et al. 2001; Henle et al. 2008; Redpath et al. 2013) and challenge conservation managers as they can reduce support for the general conservation of biodiversity (Allendorf et al. 2006; Wang et al. 2006; Gubbi et al. 2009). We define Human wildlife conflicts (HWC) as a type of biodiversity conflict (Bennett et al. 2001) consisting of two components: (i) impacts that deal with direct interactions between humans and wildlife species (Young et al. 2010); and (ii) conflicts between humans over how to manage the impacts between humans and wildlife.

The human dimensions of HWC pose a number of challenges for managers. Firstly, there is a need to objectively determine the extent of conflict within or between communities and secondly, to understand diverse viewpoints of stakeholders. This is necessary because inequalities may exist within or between communities or stakeholder groups that can result in powerful individuals or those with extreme views more likely to be heard. This increases the probability that species are managed based on non-representative views. Obtaining objective evaluations of the conflict is particularly important where institutions or specialized interest groups are unrepresentative of stakeholders. A third challenge is dealing with variation in tolerance between individual stakeholders and between stakeholder groups (Chap. 2). For example some stakeholders will remove wildlife species despite no problems while others with problems will not remove species (Marker et al. 2003). Some stakeholders will implement mitigation measures to prevent or reduce damage while others will not (Maclennan et al. 2009) and some farmers will sacrifice different numbers of livestock to different species of wildlife (Romanach et al. 2007). Determining the extent of stakeholder tolerance and the factors driving tolerance is therefore critical (Treves and Bruskotter 2014). For these reasons quantitative randomized surveys are best suited to objectively determine the extent of a problem and the tolerance of communities living in close proximity to damage causing wildlife.

Research on stakeholder attitudes and perceptions to living with wildlife is increasing and aims to understand drivers of tolerant behavior (Chap. 3). This research is largely

undertaken as individual case studies and to date no quantitative synthesis of the outcomes of these studies are available and therefore hinders progress in the field (but see Chaps. 2&3). Further, although a number of reviews and theoretical frameworks that identify drivers of tolerance have been proposed (for e.g. Carpenter et al. 2000; White et al. 2009; Dickman 2010, 2012; Carter et al. 2012; Bruskotter & Wilson 2014; Jochum et al. 2014) these are not based on a quantitative syntheses resulting in a lack of widely accepted or used frameworks. This prevents identification of key drivers of tolerance and the extent that they can be applied at broader spatial scales. Landscape approaches are increasingly being recognized as most cost effective in conservation policy (Millennium Ecosystem Assessment 2005; Sayer et al. 2013). Recently, the first meta-analysis of attitudes of people living with damage causing mammals was undertaken where several important drivers of tolerant attitudes were identified that were apparent globally and across four mammal groups (Chaps. 2&3). In this paper we integrate these variables and propose the Wildlife Tolerance Model (WTM). We also reviewed a wide range of disciplines and sub disciplines such psychology, social psychology, economic psychology, anthropology, human-animal relations (geography), Human Dimensions of Wildlife in order to identify additional potentially important variables that could be important for the practical management of HWC. These were incorporated into the WTM. The model aims to identify variables comparable across species, stakeholder groups and contexts in order to provide the potential for application of interventions and policies over landscapes. Such broad scale strategies are urgently required due to the rapid rate of species declines and global environmental change.

2. Tolerance

Tolerance seems like an ideal most agree is importance but attempts to explicate and operationalize it are tricky and elusive (Williams 1996; Afdal 2010). The Oxford dictionary defines the verb *to tolerate* as *1.*allow the existence, occurrence, or practice of something that one dislikes or disagrees with without interference *2.* accept or endure (someone or something unpleasant or disliked) with forbearance. Since anyone living in an area with wildlife has to bear the risk of added costs that would not be

present if there were no wildlife in the area, we define tolerance as "The ability and willingness of an individual to absorb the extra potential or actual costs of living with wildlife".

In a meta-analysis (Chap. 2) seven categories of questions were identified to elicit attitudes, perceptions or tolerance towards damage causing mammals. Based on a critical evaluation of these results (Appendix VI) five tolerance indicators are proposed:

1. Spatial - tolerance to spatial proximity at four distances.
2. Damage - tolerance to undergoing monetary costs due to a species
3. Killing - tolerance to killing under seven different contexts (Appendix VI) for two conditions: i) when a species is perceived to be common ii) when a species is perceived to be rare.
4. Population size - the population size of a species that a person is willing to accept.
5. Prevention - the ability and willingness to undergo the extra costs (tangible and intangible) to apply prevention or mitigation measures that are effective, sustainable, legal and comply with welfare norms.

3. The Conceptual Model

3.1 Overview

The WTM consists of two components; an *Outer model* (OM) with six variables and an *Inner model* (IM) with 11 variables (Fig 4.1) In the OM the net outcome of the extent to which a person experiences a species determines their perceptions of the costs and benefits of living with a species. These in turn determine tolerance. The IM predicts eleven variables that impact on tolerance through costs and benefits. The OM and IM variables differ in their functionality for conservation interventions. Managing species can modify the OM variables, for example by reducing the extent of exposure of stakeholder to a species. Conversely, IM variables relate to the human dimentions and may be more difficult to modify through conservation interventions. The two components of the model are not When IM variables are particularly strong we hypothesize that these may override the effects of the OM variables of exposure and meaningful events and be more important in driving tolerance. In Table 4.1 we

provide hypotheses that could be tested to support the WTM. In Appendix VI we provide additional discussion of WTM variables.

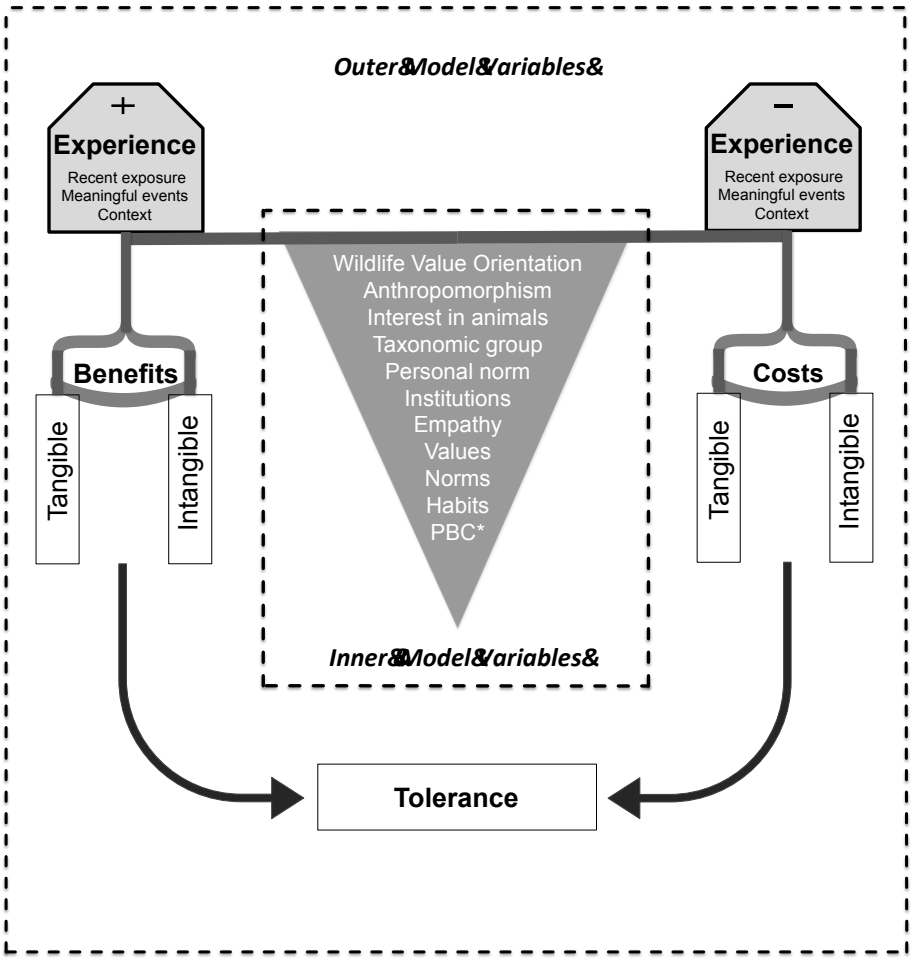

Figure 4.1 Diagrammatic representation of the Wildlife Tolerance Model (WTM) proposed in this paper. The two - tiered model consists of an *outer model* that proposes that the extent to which a person is exposed to wildlife and the types of meaningful events they undergo drives perceptions of costs and benefits of living with a species. This in turn determines tolerance. A second *inner model* consists of 11 variables that may affect perceptions of costs and benefits. When these are stronger than *outer model* variables they will be more important in driving tolerance. The order of *inner model* in the triangle is random.

*PBC=Perceived Behavioral Control.

3.2 Outer Model Variables

3.2.1 Experience

When a behavior (or attitude) changes as a result of experience learning occurs (Chance 2013). Strong selection to learn from experience is expected as failure to learn would increase mortality. When experiences are coupled with strong emotions they are more likely to be retained in memory and rapidly recalled (Glasman & Albarracin 2006). When these are linked to an object, they contribute to its evaluation and associated beliefs. In this way attitudes are formed (Heberlein 2012). Personal experience was identified as an important predictor of attitudes of stakeholders living with damage causing wildlife in a meta-analysis (Chap. 3). Two variables are used in the WTM to operationalize experience: *Exposure* and *Meaningful Events. Exposure* measures the frequency, spatial proximity and number of animals a person has been exposed to in a particular time frame. *Meaningful Events* measures the presence of particularly positive or negative personal experiences an individual has had, with no specific timeframe.

The relative contribution of negative and positive *Meaningful Events* will depend on the context of the experience, the higher the negative emotion associated with the experience the higher will be its contribution. A future research imperative is therefore to determine to what extent the ratio of positive to negative events is similar across species and sites and how dependent it is on the context of the experience (Table 4.1).

3.2.2 Costs and Benefits

Rational choice theory (Scott 2000) predicts humans as making rational choices towards outcomes with a narrow self-interest. Although people do not always behave rationally (Ostrom 1998; Kahneman 2010), the theory provides a baseline for evaluating human behaviour as it can identify the contexts where people may deviate from rational and selfish behavior (Ostrom 1998). The costs and benefits of living with wildlife are generally considered primary determinants of attitudes towards wildlife (Bruskotter & Wilson 2014; Jochum et al. 2014) and acceptability of conservation initiatives more broadly (Chan et al. 2007; Linnell et al. 2010). They were also found to be important predictors of attitudes of stakeholders living with

damage causing wildlife (Chap. 3). Costs and benefits therefore form the core of the WTM where it is predicted that stakeholders who perceive more benefits than costs will evaluate living with wildlife more positively and therefore be more tolerant. We distinguish between tangible and intangible costs and benefits as these were found to differ in their importance as drivers of attitudes (Chap. 3). (Table 4.1, Appendix VI).

Table 4.1 Proposed hypotheses for variables in Wildlife Tolerance Model.

Variable	Hypotheses
Outer Model Variables	
Exposure	Ho: The more a person is *exposed* to a species the higher the probability of experiencing *costs* and the lower the probability of experiencing *benefits*
Meaningful Events	Ho: The more negative *Meaningful Events* a person experiences the greater the perceived *costs* while the more positive *Meaningful Events* a person experiences the greater the perceived *benefits.*
Tolerance	Ho: Perceptions of *costs* relative to *benefits* of living with a species will determine *tolerance* to a species.
Inner model variables	
Interest in Animals	Ho: The more a person is interested in animals in general, wildlife in particular and the more experiential the interest in wildlife the more benefits and less costs will be perceived to living with wildlife.
Empathy	Ho: People low on trait empathy will perceive more costs than benefits and therefore show less tolerant behavior towards wildlife. Ho: Women will have higher empathy scores than men and therefore perceive more benefits than costs to living with wildlife
Anthropomorphism	Ho: Taxonomic groups, species or individual animals that are attributed more mind will be seen as more beneficial than those with less mind attribution and therefore tolerated. Ho: People with low interest in animals will have less non-human representations than those with high interest in animals. Negative animal behavior will be interpreted as being similar to human

	negative behavior resulting in low tolerance.
Taxonomic bias	Ho: Taxonomic groups, species or individual animals that are large, attractive, useful, rare, not dangerous, have positive cultural symbolism look and behave similarly to humans will be perceived as more beneficial than taxonomic groups, species or individual animals that are small, unattractive, not useful, common, dangerous, negative cultural symbolism and behave and look differently to humans.
Values	Ho: Individuals and groups prioritizing *self-transcendence* value orientations will perceive more benefits to living with damage causing wildlife than individuals prioritizing *self enhancement* values who will perceive more costs to living with wildlife.
Wildlife Value Orientations	Ho: Individuals and groups who prioritize mutualistic WVO will perceive more benefits to living with wildlife compared to individuals and groups who prioritize utilitarian WVO.
Institutions	Ho: Individuals or communities who have negative perceptions of wildlife governance systems will perceive more costs than benefits of wildlife.
Personal Norm	Ho: Individuals or groups who have feelings of moral obligation towards a species will perceive more benefits than costs of living with wildlife and will be more tolerant.
Self-efficacy/behavioral control	Ho: Low self-efficacy in ability to reduce costs of living with wildlife will increase perceptions of costs of living with wildlife and reduce tolerance
Social Norms	Ho: Individuals who belong to groups or communities where wildlife are perceived to be more costly than beneficial and who have a high need to follow social norms will also perceive more costs than benefits. Ho: Individuals who belong to groups or communities who implement unsustainable wildlife management interventions and who have a high need to follow social norms will implement unsustainable wildlife management interventions.
Habit	Ho: Individuals or groups who perform habitual activities that are difficult to change in response to living with wildlife will perceive more costs of living with wildlife. The greater the habit strength of these activities the greater the perceived costs.

3. 3 Inner Model Variables

The eleven IM variables (Fig. 4.1) were identified from meta-analyses (Chaps. 2&3) as well as from additional disciplines so as to address the complexity inherent in HWC. These were social psychology, conservation psychology, conservation biology and human-animal studies.

3.3.1 Interest in Animals

Interest in animals in general and wildlife in particular is predicted as important due to meta-analysis results (Chap. 3) as well as a link to self-identity. When attitudes towards an object are tied to personal identity the attitudes gain strength (Heberlein 2012). Individuals for whom animals are salient may identify themselves as an "animal" person and can be expected to have stronger positive attitudes and tolerance towards wildlife. Evidence for this is seen from research on pet ownership or growing up with pets and attitudes towards wildlife (Kafer et al. 1992; Bjerke et al. 2003; Prokop & Tunnicliffe 2010). However, pet ownership may not be a valid indicator of interest in wildlife because not all wildlife are valued equally (Bjerke et al. 2003), the presence of pets in a household may not reflect the preferences of all household individuals and lastly, pet ownership may be culturally determined (Pagani et al. 2007) and therefore not useful for cross-cultural studies. We therefore suggest using a direct measure of interest in animals and wildlife, for example the extent to which a person is interested in animals and the magnitude of their interest (e.g. reading or watching animal programs versus walking in nature to observe them) (Table 4.1).

3.3.2 Empathy

Empathy has not been measured in quantitative HWC surveys (Chap. 3) but is predicted to be important since high trait empathy predicts pro social behavior towards humans (Konrath et al. 2011) as well as animals (Daly & Morton 2006; Signal & Taylor 2007; Erlanger & Tsytsarev 2012). Empathy towards humans and animals is mediated by perceived similarity. For humans similarity can be in features such as personality (Gruen & Mendelsohn 1986) and appearance (Forgiarini et al. 2011). For animals similarity can be represented by evolutionary proximity (Westbury & Neumann 2007) or in mind attribution (Hills 1995; Harrison & Hall 2010). (Table

4.1, Appendix VI).

3.3.3 Anthropomorphism

Qualitative HWC studies report attribution of mental capacities and intentions to a wide range of wildlife species that affects attitudes and tolerance towards them (Goedeke 2005; Hill & Weber 2010; Douglas 2011). Negative perceptions result when expectations of human-like social behavior arise that non-human species cannot satisfy (Root –Bernstein et al. 2013). Anthropomorphism has not been measured in quantitative HWC surveys (Chap. 3). The tendency to attribute mental states to non-human entities is universal (Boyer 1996; Epley et al. 2007) and is most likely a result of the human ability to impute mental states to oneself and to other humans (Cullen et al. 2013) so as to allow predictions about another person's behavior (Epley et al. 2007). This satisfies a basic need to understand, predict and control our environment in order to avoid danger and stress (Weiner 1985). Because people do not perceive others' mental states directly but must infer them from indirect methods "mind reading" mistakes are common (Epley 2008). When this happens, miscommunication, misunderstanding, social conflict, and poor decision-making can result (Epley 2008). When non-human knowledge is unavailable to the human mind, anthropomorphism is triggered because the most readily available human model is the self (Epley 2008). Anthropomorphism can then be seen as attempts to understand, control and reduce stress in relations with non-human entities (Epley et al. 2007). But what triggers the perceived similarity when some entities are clearly very different to humans? In Appendix VI we provide additional discussion based on the three factor theory of anthropomorphism (Epley et al. 2007) (Table 4.1).

3.3.4 Taxonomic bias

Evidence of the human propensity to value animal species differently is widespread (Bonnet et al. 2002; Serpell 2004; Stokes 2007; Batt 2009; de Pinho et al. 2014; Chap. 2). Many attributes of animals explain these differences including similarity to humans in morphology, behavior, natural history traits and phylogeny, as well as attractiveness, utility, size, rarity, danger and cultural symbolism (Appendix VI). Understanding these biases in the general public and how they translate into behavior

towards species in HWC has rarely been studied. This is important because strategies and policies will be needed to mitigate these biases. (Table 4.1, Appendix VI).

3.3.5 Values

Differences in values are acknowledged as driving conflicts in general and biodiversity conflicts in particular (Heberlein 2012; Madden & McQuinn 2014). However, in a meta-analysis values were not examined in quantitative HWC attitude studies (Chap. 3).

Values are important life goals that serve as guiding principles in a person's life (Schwartz 1992). People and groups may differ in their value priorities, i.e, which values are important to them as guiding principles in their life. The more important a value the more it is likely to guide goals. Differences in the importance of values arise from unique biological endowments, social experiences, and exposure to cultural norms and habits (Schwartz 1992; Rohan 2000). Once formed values are slow or unlikely to change (Manfredo 2008; Bardi et al. 2009; Heberlein 2012). Values are typically viewed as determinants of attitudes and behaviors and this hierarchy of cognitions (Value-attitude-behaviour-hierarchy (VAB) can usefully predict attitudes and behaviors on a variety of specific issues (Bardi et al. 2008; Maio 2010). For example *universalism* values; those aimed at understanding, appreciating, tolerating, and protecting the welfare of all people and nature (Schwartz et al. 2012), would be expressed in attitudes on a significant number of topics, (e.g. protecting endangered species, minority rights, humanitarian causes). These attitudes in turn would lead to behaviour in a way that is consistent with such values (e.g donating money, vote and express views in support of these topics) (Manfredo 2008; Heberlein 2012).

Schwartz' value theory (Schwartz et al. 2012, Table 4.2, Fig. 4.2) is a set of 19 value priorities that have been tested cross culturally and found to exist in 70 different countries (Schwartz 2011) suggesting a universal organization of human motivations.

The values concept has been applied in investigations of environmental issues (for reviews see Dietz et al. 2005; Manfredo 2008; Klockner 2013) where support for the VAB hierarchy has been reported (Klockner 2013). As a general principle, the more

strongly individuals subscribe to values beyond their immediate own interests (self transcendence values), the more likely they are to engage in pro-environmental behaviour. Schwartz's value theory has rarely been applied in human-wildlife relations (but see Hrubes et al. 2001; Kaltenborn & Bjerke 2002). Understanding differences in values are key to designing conservation mitigation interventions (Heberlein 2012) as well as in stakeholder mediation (Madden & McQuinn 2014). (Table 4.1).

3.3.6 Wildlife value orientations

Expanding on the notion that individuals and groups may have different value "priorities" in relation to wildlife, the concept of wildlife value orientations (WVO) was developed (Fulton et al. 1996; Manfredo 2008). Two WVO dimensions are recognized: utilitarian and mutualistic. Utilitarian's believe wildlife are primarily for human benefit, prioritize human well-being over wildlife treatment and support activities that result in death or harm to wildlife. Mutualists believe wildlife as deserving rights and less likely to support actions resulting in death or harm to wildlife. They engage in welfare-enhancing behaviors for individual wildlife (e.g., feeding) and view wildlife in human terms (Teel & Manfredo 2009). WVO predict support for recreational trapping (Manfredo et al. 1997), intention to support reintroduction of wolves (Hermann & Menzel 2013) and destruction of damage causing wildlife (Zinn et al. 1998). A micro-macro model to investigate changing WVO across the USA strongly predicts attitudes towards a variety of fish and wildlife issues (Manfredo & Dayer 2004). (Table 4.1).

Table 4.2 Schwartz value theory – definitions of value priorities (from Schwartz et al. 2012).

Value	**Goal/motivation**
Self-Direction	Self-Direction—Thought (the freedom to cultivate one's own ideas and abilities) Self-Direction—Action (the freedom to determine one's own actions)
Stimulation	Stimulation— Excitement, novelty, and challenge in life
Hedonism	Hedonism— Pleasure and sensuous gratification for oneself
Achievement	Achievement— Personal success through demonstrating competence according to social standards
Power	Power—Dominance (power through exercising control over people) Power—Resources (power through control of material and social resources) Face (security and power through maintaining one's public image and avoiding humiliation)
Security	Security—Personal (safety in one's immediate environment) Security—Societal (safety and stability in the wider society)
Conformity	Conformity—Rules (compliance with rules, laws, and formal obligations) Conformity—Interpersonal (avoidance of upsetting or harming other people)
Tradition	Tradition (maintaining and preserving cultural, family or religious traditions) Humility (recognizing one's insignificance in the larger scheme of things)
Benevolence	Benevolence—Dependability (being a reliable and trustworthy member of the in-group) Benevolence—Caring (commitment to the welfare of in-group members)
Universalism	Universalism—Concern (commitment to equality, justice and protection for all people) Universalism—Nature (preservation of the natural environment) Universalism—Tolerance (acceptance and understanding of those who are different from oneself)

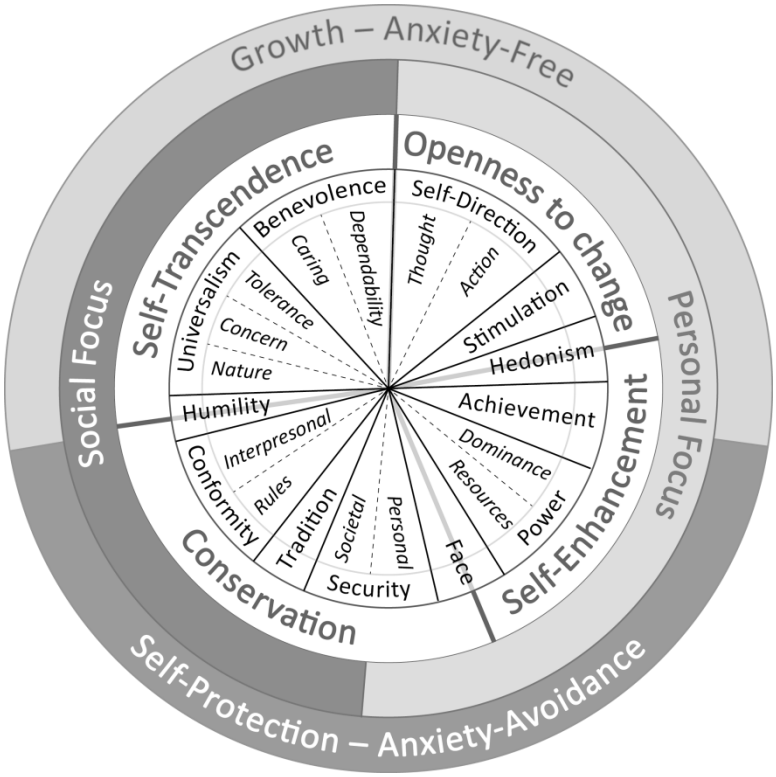

Figure 4.2 Schwartz value theory-circular structure. One dimension contrasts *'openness to change'* and *'conservation'* values and captures conflict between values that emphasize independence of thought, action, and feelings and readiness for change (self direction, stimulation) and values that emphasize order, self-restriction, preservation of the past, and resistance to change (security, conformity, tradition). The second dimension contrasts *'self enhancement'* and *'self-transcendence'* values. This dimension captures the conflict between values that emphasize pursuit of one's own interests and relative success and dominance over others (power, achievement) values that emphasize concern for the welfare and interests of others (universalism, benevolence). Hedonism shares elements of both openness to change and self-enhancement (from Schwartz et al. 2012).

3.3.7 Institutions

Human –wildlife interactions can be framed as occurring within Social– Ecological System (SES) where interactions between ecosystems, biodiversity and people take place (Jochum et al. 2014; Mosimane et al. 2013). Institutions are defined as "durable systems of established and embedded social rules that structure social interaction (Hodgson 2002) and are therefore key components of social systems (Folke et al. 2004). Social rules can be applied within government organizations , nongovernment organizations , network structures , property-rights systems, operational rules ,

collective-choice rules, constitutional rules , monitoring and sanctioning processes (Ostrom 2009). In human –wildlife interactions institutions provide structure and regulate relationships between stakeholders and wildlife and between stakeholders regarding wildlife management. The role of institutions and their perceptions by stakeholders in HWC is therefore important (White et al. 2009; Sponarski et al. 2014) but rarely applied in HWC surveys (Chap. 3). Factors predicted as important drivers of costs and benefits are: i) laws regulating wildlife use and management ii) number, role and efficacy of organizations, iii) quality of relationships between stakeholders and organizations, iv) Property-rights systems and relation to wildlife ownership (Table 4.1).

3.3.8 Personal Norm

Personal norms are the rules and expectations one has for oneself that guide behavior. Norm Activation Theory (NAT) (Schwartz & Howard 1998) predicts that pro-social behavior is activated by feelings of moral obligation (guilt) to help in a given situation. Building on this model to explain pro-environmental behavior, personal norms are important drivers of pro-environmental behaviors (Klockner 2013). In HWC research personal norms have not been included in attitude surveys (Chap. 3). Personal norms are expected to be particularly important regarding implementation of mitigation measures (Table 4.1, Appendix VI).

3.3.9 Self-efficacy/behavioral control

Self-efficacy is the belief in one's capabilities to organize and execute actions required to manage situations (Bandura 2012). It is a key concept in psychology as it impacts on how goals, tasks, and challenges are approached. People with high self-efficacy are more likely to perceive challenging problems as tasks to be mastered than avoided and recover quickly from setbacks (Bandura 2012). When operationalized as Perceived Behavioral Control (PBC) it often predicts if a behavior will be undertaken (Fishbein & Ajzen 2010). It also predicts general pro environmental behaviors (Klockner 2013) and behaviors important in human wildlife conflicts (Sakurai et al. 2014) but is rarely applied in HWC studies (Chap. 3). Understanding factors that

enable or prevent PBC will be important in design of interventions to assist stakeholders implementing mitigation measures to reduce damage or with coping strategies to living with wildlife (Table 4.1, Appendix VI).

3.3.10 Social Norms

Social norms are the rules and expectations about how group members should behave, and are the building blocks of culture (Taylor et al. 2005). Social norms exert social pressure on individuals or groups because of a desire, consciously or unconsciously to conform to the social and cultural norms of ones social environment. Social norms predictor general behavior (Fishbein & Ajzen 2010), pro-environmental behavior (Heberlein 2012; Klockner 2013) and in HWC (Manfredo 2008) but is rarely applied in quantitative HWC surveys (Chap. 3). In HWC's we predict three important issues relating to social norms; i) the extent to which social pressure drives stakeholder perceptions of costs and benefits, ii) the extent to which wildlife norms are being driven by potentially influential individuals 3) what mitigation measures are considered the norm and the extent to which these result in sustainable wildlife populations and welfare considerations (Table 4.1, Appendix VI).

3.3.11 Habit

Habits are behaviors that develop in response to specific stable contextual cues that are repeated in the same situation because rewards (goals) are achieved by the repetition (Verplanken & Aarts 1999). Habits are important predictors of pro-environmental behaviours, that is habits can prevent behavior change (Klockner 2013). In HWC habits may prevent the adoption of mitigation measures to prevent damage. For example livestock farmers may have habitual methods of farming which make it difficult to change if HWC's develop. Defining habits that increase the costs of living with wildlife and knowledge of their strength will be important information in designing strategies and interventions to reduce them (Table 4.1, Appendix VI)

4. Applying the Conceptual Model

The WTM proposes relevant variables on which research and management should focus in order to understand, predict and manage tolerance to damage causing wildlife. When applied and tested across a diverse range of stakeholders, species and landscapes using methods and operationalized with comparable constructs knowledge can accumulate. Identification of important factors driving tolerance and the extent to which they can be applied across broader spatial scales will then enable efficiency in conservation management.

The WTM is flexible so as to be applied to stakeholders and species living in close proximity to wildlife as well as to evaluate tolerance of general public not living with wildlife. This is possible as the model predicts that IM variables will exclusively predict perceptions of costs and benefits in the absence of exposure to a species. Such comparisons are important since those not living with wildlife often fund and design projects and policies for wildlife management.

The model will be particularly useful for students, practitioners and newcomers to the field who may not have the time or resources to review HWC literature to identify relevant variables. The WTM can be used as a monitoring and evaluation framework to evaluate changes in tolerance resulting from interventions being tested. It can also be a tool for conservation planners to identify areas of spatial tolerance. We did not find longitudinal studies examining evidence for tolerance thresholds- fixed tolerance levels that do not change despite interventions to reduce the costs of living with wildlife. These are urgently required to determine the effectiveness of interventions. The WTM would be suitable for evaluating such studies. If tolerance does not change with a reduction in OM variables, IM variables would be considered more important drivers than the OM variables. However if OM variables were more important then a reduction of these would result in a change in tolerance.

The WTM has a number of advantages over other models. Firstly, it is the first based on outcomes from quantitative meta-analyses (Chaps. 2&3) meaning that the variables that have been shown to be important across a range of species, stakeholders and contexts are included in the model. Secondly, the five tolerance indicators were

chosen from the suite of indicators that emerged from the meta-analyses meaning a broader spectrum of tolerance dimensions is included. This reduces error in the construct (Podsakoff et al. 2003) and allows understanding of the different dimensions of tolerance. Thirdly, the WTM and its two-tiered structure allows for a level of complexity that is intermediate between more simple models (e.g. Carpenter et al. 2000; Bruskotter & Wilson 2014) and more complex models (e.g. White et al. 2009; Jochum et al. 2014). The OM consists of immediate drivers that are more easily manipulated while the IM identifies variables that are more deeply embedded in the human psyche and therefore more difficult to change. Identification of the role of IM and OM variables at play for a particular sight will increase efficiency by targeting interventions at the appropriate level. Fourthly, the WTM balances flexibility with specificity. Flexibility allows adaptation for different contexts while specificity allows comparisons across sites. For example, costs and benefits are likely to differ between sites. Researchers can define these for each sight and then group these into tangible and intangible costs and benefits. Comparisons of these broad categories will then allow evaluation of their importance over landscapes. Other variables such as Schwartz Values, WVO, empathy, anthropomorphism, habits, personal norms are well defined constructs that have been operationalized cross culturally and therefore will enable comparisons across sites.

Chapter 5

Testing the Wildlife Tolerance Model: the Case of Human-Baboon Conflict in Cape Town, South Africa

Abstract

The Wildlife Tolerance Model (WTM) is a theoretical framework recently developed to guide research aimed at identifying primary drivers of tolerance to living with damage causing wildlife. The WTM was developed from meta-analytic reviews as well as theories and concepts from a variety of disciplines. It proposes that the net outcome of the extent to which a person is exposed to a species as well as the types of experiences (positive or negative) determine perceptions of the costs relative to benefits of living with a species. These in turn determine tolerance. A second component predicts eleven variables that impact on tolerance through two of the proximate variables; costs and benefits. Here we use urban baboon-human conflict on the Cape Peninsula of South Africa as a case study to test the first component of the model. Baboons are one of the most common primate species involved in human-wildlife conflicts in Africa but few studies have examined the attitudes and tolerance of people towards them. We surveyed 403 residents living in five urban areas adjacent to the Table Mountain National Park and the Cape Peninsula Protected Natural Environment. Using Structural Equation Modeling we found support for the model. Overall 60% of tolerance was explained by perceptions of costs and benefits. We distinguished between tangible (monetary) and intangible (non monetary) costs and benefits and found that while intangible costs and benefits equally contributed to driving tolerance, tangible costs had no significant effect on tolerance. Exposure and experiences explained 30% of variance in costs and benefits but exposure drives costs more than benefits. Exposure explained 10% of variance in negative experience but did not explain any variance in positive experiences. We conclude that while conservation managers could reduce perceptions of costs and increase perceptions of benefits (and therefore increase tolerance) by reducing exposure to baboons to some extent, there remains a large amount of unexplained variance in costs and benefits and

therefore other factors driving perceptions of costs and benefits will need to be identified. These could be the inner model variables identified in the WTM.

1. Introduction

Predicting the key drivers of tolerant attitudes and behavior towards damage causing wildlife is important in order to design strategies and policies to mitigate human-wildlife conflicts (HWC)(Woodroffe et al. 2005; MacDonald & Loveridge 2010; Bruskotter & Wilson 2014). This is because intolerance is a major direct and indirect driver of the decline of many medium and large mammalian species (IUCN 2008; Inskip & Zimmerman 2009; Treves & Bruskotter 2014). HWC can have large impacts on stakeholders that in turn can reduce support for the conservation of biodiversity in general (Maikhuri et al. 2001; Allendorf et al. 2006; Clarke 2012). Predicting the most important drivers of tolerance was the aim of the Wildlife Tolerance Model (WTM) (Chap. 4, fig 4.1). The WTM is a theoretical framework recently developed from meta-analytic reviews as well as theories and concepts from a variety of disciplines (Chaps. 2, 3&4). The need for a comprehensive theoretical model arose due to the lack of a widely accepted and applied framework to guide HWC research and management such as the frameworks that exist for managing communal natural resources (Ostrom 2009) and pro-environmental behaviour (Klockner 2013). Here we use human-baboon conflict in an urban environment on the Cape Peninsula, South Africa as a case study to test the utility of the WTM.

1.1 Primates in Human Wildlife Conflict

Primates involved in Human Wildlife Conflicts (HWC) are often defined as commensal, those that utilize human food, waste or crops to supplement their diet or as their main food source (Gautier & Biquand 1994). Commensal primates exhibit a range of traits that enable them to exploit human modified landscapes: semi-terrestrial locomotion, large and complex social groupings, flexible and varied diets, intelligence, manual dexterity and agility, and an “outgoing” temperament (Strum 1994; Knight 1999). Baboons are among the most successful primates in Africa and occupy practically all habitat types except extreme desert (Kingdon 2003). Given this ecological adaptability, it is unsurprising that baboons are one of the most common

commensal species (Kingdon 2003).

Crop-raiding seems to be less common in the Neotropics than in the Paleotropics possibly because Neotropical primate species assemblages are generally arboreal in contrast to the many semi-terrestrial forms of the Paleotropics (Estrada et al. 2012). Three groups of primate are particularly successful at exploiting the human–primate interface. These are the baboons (*Papio* spp.), vervet and tantalus monkeys (*Chlorocebus* spp.) in Africa and the macaques in Asia (Preston & McLennan 2013). Common problem behaviours include crop raiding, physical aggression towards people, damaging property, taking food, bags and other items, fouling and raiding garbage (Preston & McLennan 2013). A further conflict potential is for zoonotic disease transmission (Lane et al. 2010).

Foraging in human modified landscapes can be a double-edged sword for many primates. Crops offer energetic advantages over many natural foods (Forthman-Quick & Demment 1988; Naughton-Treves, 1998; El Alami et al. 2012) but increased injury and predation, skewed sex ratios (Hill 1999; Kansky 2002), increased levels of aggression both towards humans and between primate groups (Wheatley 1999; Hsu & Agoramoorthy 2009; El Alami et al. 2012) can result. The responses of individual taxa range from local extinction (inability to adapt) to apparent benefit (ecological and behavioural adaptation) (Richard et al. 1989; Gautier & Biquand 1994; Estrada et al. 2012). Fifty-seven primate taxa have been recorded in 38 types of agroecosystems and 49% of these are classified as threatened or near threatened in the IUCN Red List database (Estrada et al. 2012).

1.2 Baboons on the Cape Peninsula, South Africa

The Cape Peninsula was populated by a variety of medium to large mammals in the past but probably never supported large numbers due to the infertile soils and general low quality of forage (Skead 1980), recurrent fire and strong winds (Cowling et al. 1996). Baboons however seem to be an exception as they have adapted to the harsh conditions on the Peninsula by exploiting a variety of protein-rich geophytic plant species (Davidge 1976), limpets and shark egg cases on the rocky shores, and mining for minerals in clayey soil (Kansky 2002).

Human-baboon conflict has continued for 300 years since the establishment of the first vegetable gardens at the foothills of Table Mountain (Skead 1980). Past human activities resulted in a marked decline of the population that was historically contiguous throughout the Cape Peninsula. In 1990 the population was legally protected due to their genetic isolation from other baboon populations off the Cape Peninsula. In 1998 mortality rates from conflict with people were unsustainable resulting in highly skewed sex ratios with only 15 adult males remaining (Kansky & Gaynor 2000). A pro-active management strategy was then implemented by the authorities that included re-introduction of dispersing adult males to troops with few males and the Baboon Monitoring Program that comprised men from local communities employed to curtail baboon access to residential areas (Brownlie 2000; Kansky & Gaynor 2000). Currently the population consists of 484 individuals in 15 troops (R. Kansky unpublished data 2012).

1.3 The Wildlife Tolerance Model

The WTM consists of an *outer model* (OM) with six variables and an *inner model* (IM) with 11 variables (Chap. 4, Fig 4.1) In the OM the net outcome of the extent to which a person experiences a species determines their perceptions of the costs and benefits of living with a species. These in turn determine tolerance. The IM predicts eleven variables that impact on tolerance through costs and benefits. In this paper the OM of the WTM is tested using Structural Equation Modeling (SEM) while in chapter six the IM is tested. More specifically human-baboon conflict in an urban environment on the Cape Peninsula, South Africa is used as a case study to test the utility of the WTM. The following hypotheses regarding the OM of the WTM are evaluated: 1. Exposure and meaningful events (positive and negative) drive costs and benefits 2. Costs and benefits drive tolerance (Fig 4.1).

2. Methods

2.1 Study area

The Cape Peninsula (CP) is an area of 470 km^2 located at the south-western tip of South Africa (latitude: -34.270836, longitude: 18.459778, Fig 5.1). The Table Mountain

Chain traverses the length of the CP and is surrounded by the Atlantic Ocean. The predominant vegetation is fynbos, a fire-adapted shrubland that forms part of the Cape Floristic Region (CFR), the only region of the smallest, most biodiverse of the world's six floral kingdoms, the Cape Floral Kingdom. Many of the 8 200 plant species are threatened (Cowling et al. 1996). The CP in particular is a global biodiversity hotspot for higher plants and invertebrates (2285 plant species, 90 endemic and 112 endemic fauna species) (Cowling et al. 1996). Topographically the Peninsula is heterogeneous, rainfall variable and soils of a great variety but mainly sandy and nutrient poor. Development pressure is intense with the population of the greater Cape Town area 3.74 million (in 2011) having increased by 29% since 2001(City of Cape Town 2011). Sixteen percent of the population is of European decent (City of Cape Town 2011). This sector, also the wealthiest, was the focus of our survey due to an overlap with baboon home ranges. The Table Mountain National Park (TMNP), proclaimed in 1998 is managed by South African National Parks (SANP) and includes 25 000 hectares of the Peninsula. The remaining natural habitat forms part of the Cape Peninsula Protected Natural Environment (CPPNE) a municipal zoning scheme that aims to restrict further urban development. TMNP and the CPPNE are surrounded by the City of Cape Town metropolis area and are therefore fragmented by urban development and privately owned natural areas. Despite its proximity to a major urban metropolis, the CP is home to a number of small and medium mammal species including Chacma baboons (*Papio hamadryas ursinus*), the focus of the current study (www.TMNP website).

2.2 Sampling and Survey instruments

Five communities surrounding TMNP and CPPNE who had a history of experiencing baboon visits in their neighborhoods were chosen: Capri (CP), Kommetjie (KM), Scarborough (SC), Tokai (TK) and Welcome Glen (WG) (Fig 5.1). Communities were surveyed between October 2012 and January 2013. All households in streets where baboons frequented were the target of our survey and were visited outside working hours or on weekends to ensure non-bias against working individuals. One adult from each household was requested to complete a survey. Residents were informed that the survey was being conducted by Stellenbosch University with the aim of determining how residents were coping with living with baboons. The survey

was completed at their convenience. Completed surveys could be deposited in a sealed box at a number of locations in their neighborhood, or were collected from the house. Contact information (email and telephone) was requested from respondents in order to send them reminders. After 2 weeks and every consecutive 2 weeks residents were sent reminders by email, SMS or phone call. A random sample of 32 respondents who agreed to complete a survey but did not return it, were approached telephonically and by email to respond to 13 short questions to determine non-response bias. Differences between this group and those who did return surveys were compared using t-tests and two tailed significance levels. The survey instrument was designed to test the WTM as described in chapter 4. Variables and the questions used in their operationalization are described in Appendix VII. The questions used for the variables and constructs *Exposure*, *Meaningful Events*, *Costs*, *Benefits* and *Tolerance* were developed specifically for this study and were guided by theory emanating from the quantitative reviews and the WTM.

2.3 Data Analysis

Partial Least Squares Structural Equation Models (PLS-SEM) (Hair et al. 2014) were used to evaluate the relationships between the constructs in the OM of the WTM. PLS-SEM are suitable for testing developmental theories, and have good statistical power with small sample sizes and variables with non-linear distributions. It is also possible to input variables in the same model as constructs (latent variables) or single item variables (Reinartz et al. 2009; Hair et al. 2014). SmartPLS (Ringle et al. 2014) was used to run the model.

SEM's consist of two sub models; a structural model and a measurement model. The structural model specifies the relationships between the independent and dependent latent variables, whereas the measurement model specifies the relationships between the latent variables and their observed indicators (Hair et al. 2014). In SEM, a variable is either exogenous or endogenous. An exogenous variable has path arrows pointing outwards and none leading to it while an endogenous variable has at least one path leading to it and represents the effects of other variable(s) (Wong 2013). Variables and the items used in their operationalization are described in Appendix VII. In the WTM, *exposure (EXPO)* is an exogenous variable, while *positive meaningful event*

(PME), negative meaningful event (NME), cost tangible (CT), cost intangible (CI), benefit intangible (BI), and tolerance (TOL) are endogenous variables (Appendix VII, Fig. 4.1).

A sample size of 100 to 200 is considered sufficient in carrying out path modeling (Hoyle 1995) however higher sample sizes are recommended if low-value factor inter-correlations with indicators that have poor quality are expected. Given the exploratory nature of the model, a final sample of 345 respondents was suitable for identifying correlations with low values. We report the following tests of our model: target endogenous variable variance; inner model path coefficient sizes and significance; OM loadings and significance; Indicator reliability; Internal consistency reliability; Convergent validity; Discriminant validity; Checking Structural Path Significance in Bootstrapping (Wong 2013; Hair et al. 2014).

Missing values were replaced using K-Nearest Neighbors, so as to include as many respondents as possible. Respondents with over 50% missing values were not considered for replacement and excluded from the analyses. Model construct scales were standardized by subtracting the mean, and dividing by the standard deviation (z score). All constructs were considered reflective (Hair et al. 2014).

SPSS was used to compute descriptive statistics for the variables. For most variables the scores reported directly by respondents were used. Additional variables were computed as follows: Avg_neg_emotion and Avg_pos_emotion (Appenidx VII) – were the average intensity of the 23 negative emotions and 12 positive emotions on the list for each respondent. Cost_bab_avg (Appenidx VII) – was the average score for five questions concerning difficulties residents experienced with baboons. Tot_neg_tot_pos_emotion (Appenidx VII) – the sum of the intensity of negative emotions minus the sum of the intensity of positive emotions for each respondent. Since there were more negative emotions in the list (23) compared to positive emotions (12), a score below zero indicates relatively more positive emotions while a score above zero indicates relatively more negative emotions. For the tolerance to killing question (Tol_kill_indx_first_uns_COM and Tol_Kill_Indx_first_uns_RAR, Appendix VII) we computed two scales: the more conservative-"first uncertain" and a less conservative "first yes". For both each context scenario was first numbered

according to increasing severity. Then, for the “first uncertain” index the number of the context scenario where a respondent first report uncertainty of support for killing was recorded and this value was used. For the “first yes” index, the number of the context scenario that a respondent first report “yes” for support for killing was recorded and this value was used. The problems residents identified (see “prob_bab” Appendix VII) were coded into tangible and intangible costs in line with these categories in the WTM. These were further coded into sub-categories.

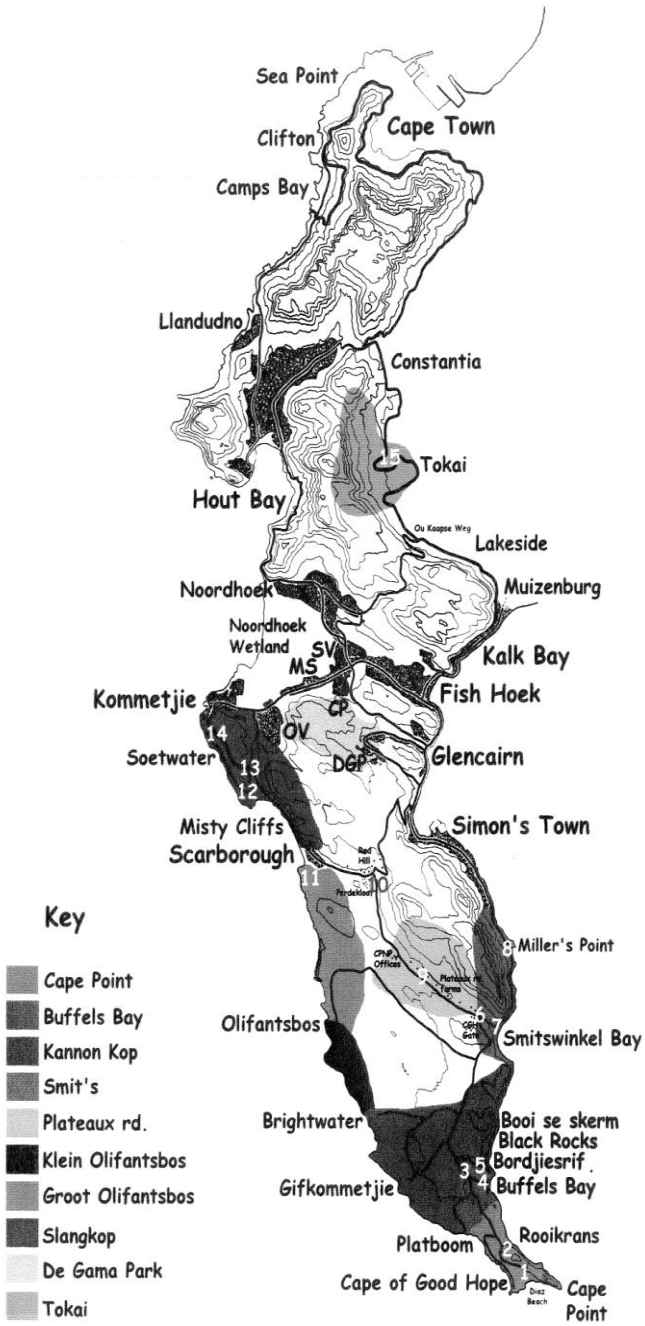

Figure 5.1 Map of Study sites on the Cape Peninsula showing baboon troops (shaded areas with key) and the suburbs surveyed.

3. Results

The majority of residents (92.1%) were willing to complete the survey. Of the 7.9% that did not, 3.8% were from WG, 13.7% from SC, 8.7% CP, 4.6% KM and 11.9% TK. Those who did not want to complete the survey were asked for their reasons. The most common reasons were that they were too busy or not interested. Many were elderly. We obtained 707 residents who agreed to complete surveys (182 from SC, 196 from KM, 127 from CP, 160 from WG and 42 from TK). Of these 403 (57%) were completed and returned by the cut-off date. Thirty percent (n=124) were from SC, 103 KM (26%), 92 WG (23%), 64 CP (16%), 19 TK (5%).

3.1 Non- response

There were no significant differences between respondents who did and did not complete the survey for 12 of the 13 questions asked (Appendix VIII). The age of non-respondents was significantly lower than those of respondents and there was a trend for non- respondents to be less interested in baboons, but this was not statistically significant. (Appendix VIII).

3.2 Profile of respondents

There were more female (227, 57%) respondents than males (174, 43%). Most respondents were full time residents (95%). The average number of children per household was 0.79 ± 1.03 and pets 2.1 ± 2.7. Most respondents (80%) were over 40 years of age (Appendix IX -fig 1) and had more that 12 years of schooling (68%). The average yearly income was between R120,000 - R240,000 and the average property value was between R801,000 – R1.6 million (Appendix IX –fig1). Most had never hunted (89%) but most ate meat (92%). Most recycle waste (93%) and grew up with pets (95%). The average years residents had lived in a village was 11 ± 8.9 and most grew up either in a city (42%), large town (19%) or small town (25%) (Appendix IX – fig1). Most residents were interested in baboons (95%) and baboon management (97%). On a scale of 1 to 5 where 1 was not interested at all and 5 very interested, the average interest in baboons was 3.8 ± 1.2 and the average interest in baboon management was 4.0 ± 1.1.

3.3 Extent and types of problems due to baboons

Almost half of respondents rated their overall experience of baboons (see "General" Appendix VII) as positive (43.6%), one quarter rated their experience as negative (24.3%) and a third as neutral (32.3%) (Appendix IX –fig1). Most respondents had some problems (see "General" Appendix VII) with baboons (78.6%). Of these a third had small problems (34.7%), a quarter had moderate problems (24.1%) and 20% had a serious baboon problem (Appendix IX –fig1). Overall the mean extent of baboon problems was moderate, 3.9 ± 1.98 on a scale of 1 to 7 where 7 is a crisis.

For the qualitative section of the "problem" question, 42% of respondents did not list specific problems with baboons, and the mean extent of problem in the quantitative section of the question was 2.4 (Table 5.1). For the remaining 64% of respondents, 465 problems were listed. Of these, 149 (32%) related to tangible costs and 316 (68%) to intangible costs. For those respondents who listed tangible costs only, the average extent of the problem was 3.49, while for those who only listed an intangible cost was 3.81. Those listing both tangible and intangible averaged 4.55. Further, nine sub-categories were present (Table 5.1). There was no relationship between the extent of the problem score and the frequency with which a problem was reported (Spearman's rho =-0.382, p=0.25). The categories with the highest extent of the problem score were; *self, opportunity costs, prison* and *children* (Table 1, Appendix IX –fig1g). Categories with lower extent of problem scores were; *mitigation measures, mess* and *pets.* The categories with the highest frequencies were: *children, prison* and *mess* and to a less extent *mitigation measures* and *dogs* (Table 5.1, Appendix IX –fig1g). However for the questions for the construct Cost_bab_avg (see "Cost Intangible" Appendix VII), 62% disagreed to some extent (Appendix IX-fig1g).

Table 5.1 Types of problems residents have when living with baboons. Frequency is the number of times a problem category was reported by a respondent. Mean extent of problem in the mean score of the extent of problem scale where 1 was not a problem at all and 7 a crisis.

Problem type	Definition and examples	Frequency	Mean extent of problem
No problem listed	-	169	2.43
Intangible only	Cases where only intangible costs were reported	-	3.81
Tangible only	Cases where only tangible costs were reported	-	3.49
Intangible + Tangible	Cases where both tangible and intangible costs were reported	-	4.55
Damage	Monetary losses to property and food	149	4.27
Prison	A feeling of confinement indoors due to the necessity to keep the house locked up and windows closed	60	5.07
Mess	A feeling of resentment or stress at having to clean up after baboons have made a house untidy or pulled rubbish out of bins	57	4.09
Children	Worry about welfare of dependents and inconvenience at having to manage them	55	5.09
Mitigation measures	Frustration or difficulty implementing mitigation measures	36	4.2
Pets/dogs	Worry about welfare of pets, inconvenience at having to manage them and annoyance of noise created from barking	34	4
Opportunity costs	Relating to the loss of ability to undertake certain activities such as having a vegetable garden, fruit trees or eating in garden	22	5.14
Baboons	Relating to baboon aggressive behavior	19	5.06
Self	Worry about personal safety, fear and stress of baboons	17	5.53
General	A non specific description such as raiding, trying to get into house	16	4.25

3.4 Descriptive statistics of Wildlife Tolerance Model constructs

Since the WTM constructs were standardized the descriptive statistics from the SEM results are not meaningful. Separate descriptive statistics are reported for each construct indicator in order to provide context (Appendix IX). Here we provide an overview of these results.

3.4.1 Exposure

Fifty-six percent of residents were exposed to baboons weekly in their neighborhoods (2-7 days a week). A further 14% were exposed on a monthly basis (1-4 days a month) and a further 14% rarely saw baboons (1-4 days in 3 months). This rate decreased for winter months, as well as on their properties. In the summer, 39% were exposed to baboons on their property on a weekly basis, 31% on a monthly basis and 25% rarely (Appendix IX-fig 2).

During the summer when baboons most frequently visited neighborhoods and properties, 61% of residents had at least one baboon inside their home. Of these a third (34%) had between 1-2 visits, 25% between 3-10 visits and 2% had over 10 visits (Appendix IX-fig 2).

3.4.2 Experiences

Approximately half of all residents have had at least one positive (54%) or negative (60%) experience with baboons. Of those that had a positive experience, a third have had up to 30 positive experiences, while 20% have had more than 30. Of those that had negative experiences most (43%) reported up to 4 negative experiences (Appendix IX-fig 4).

3.4.3 Tangible costs

Fifty-four percent reported some monetary damage due to baboons but for the majority of those that reported some damage (37%), damage was less than R1000 (US100). Twelve percent had up to R5000 (US500) and 4% had over R5000 (US500). In the winter of 2012, 75% of residents experienced no damage and of those that did 19% experienced damage of less than R500 (US50) (Appendix IX-fig 2).

Almost all residents (97%) implement at least one type of mitigation measure to prevent or reduce baboon impacts. The majority (65%) implemented between 5-10 different types of measures and most (74%) found these moderately to quite difficult to implement (Appendix IX-fig 3).

3.4.4 Intangible costs

Most residents find living with baboons stressful (64%), but of these most (48%) find it a small or medium stress. More residents find living with baboons a nuisance (73%) to some extent but most of these (54%) find them a small-medium nuisance. Most however disagree to some extent that living with baboons is difficult (62%): some feel trapped in their home, the need to be vigilant at all times, worry about the safety of their children and pets, or feel it takes a lot of time to deal with baboons (Appendix IX-fig 3).

Eighty-four percent believe baboons are dangerous to some extent although most (60%) think they are a small-moderate danger. Sixty percent are afraid of baboons in general but of these most (45%) are somewhat or moderately afraid. When baboons enter homes 84% of respondents are afraid to some extent. Of these most (49%) are somewhat to moderately afraid and 35% are very afraid. When baboons enter homes 89% of respondent thought other members of their household were afraid to some extent. Of these 53% are very afraid and 37% are somewhat or moderately afraid (Appendix IX-fig 3).

3.4.5 Intangible benefits

Overall respondents reported more positive emotions than negative emotions in both number and intensity (Appendix IX-fig 4). Most respondents find baboons beneficial to some extent for themselves, their community, mankind and nature (79%-95%) and this benefit is mostly larger than smaller (Appendix IX-fig 4).

3.4.6 Tolerance

Residents varied in tolerance dimensions. Most (63%) would not tolerate any financial losses. Of the 36% who would tolerate some losses a quarter (26%) would tolerate up to R500 (US$50) while the remaining 12% would tolerate more than R500 (Appendix IX-fig 4).

Residents were more tolerant regarding proximity to baboons. Most (79%) will tolerate baboons to some extent in their neighborhood and to a lesser extent on their property (69%). Of these, most (48%) will tolerate them for approximately 30 days a year (1 month) while a further third (30%) will tolerate them for 3 months or more per year in their neighborhood (20% on property). However there is little proximity tolerance for baboons when they enter a home (75%) (Appendix IX-fig 5).

A similar trend to proximity tolerance was seen for population size tolerance, as 72% would not like to see the population decrease in their area, the Cape Peninsula (78%) or in Africa (96%). Most would like the population size to remain the same in their area (51%) and Cape Town (46%) (Appendix IX-fig 5).

Most respondents (80%) think there are contexts when a baboon should be culled. Of these half (41%) think it should be killed only after it has injured (22%) or killed (19%) a child or adult person. A further 35% think a baboon should be killed if it has injured or killed a domestic animal or has raided houses (14%), has never harmed any person but causes repeated problems for them or their community (12%) or it has threatened a human (9%) (Appendix IX-fig 5).

3.5 Structural Equation Model

3.5.1 Evaluation of measurement model

Indicator reliability

Indicator reliability is the square of a standardized indicator's outer loading. It represents how much of the variation in an item is explained by the construct and is the results of single regressions of each indicator variable on their corresponding construct (Hair et al. 2014). At a minimum all outer loadings should be statistically

significant (Hair et al. 2014). A value of 0.70 or higher is preferred. If it is exploratory research, 0.4 or higher is acceptable (Hulland 1999). Since our research is exploratory, we retained items with values above 0.5. These are reported in Table 5.2

Internal consistency

Internal consistency is used to determine whether the items measuring a construct are similar in their scores (i.e. if the correlations between the items are large) (Hair et al. 2014). Traditionally, Cronbach's α is used but composite reliability is considered more suitable in PLS-SEM (Hair et al. 2014). Composite reliability should be between 0.7 -0.9. For exploratory research 0.6 is acceptable. (Hair et al. 2014). All values were between 0.7-0.9 (Table 5.2).

Convergent validity

Convergent validity is the extent to which a measure correlates positively with alternative measures of the same construct and is a measure of communality of a construct, measured by average variance extracted (AVE) (Hair et al. 2014). An AVE value of 0.5 or higher indicates that on average the construct explains more than half of the variance of its indicators. An AVE value of 0.5 or higher is required (Bagozzi & Yi 1988). All values were close to 0.5 or above (Table 5.2).

Discriminant validity

Discriminant validity is the extent to which a construct is truly distinct from other constructs and therefore captures phenomena not represented by other constructs in the model (Hair et al. 2014). The Fornell-Larckner criterion compares the square root of the AVE values with the latent variable correlations, which should be greater than its highest correlation with any other construct. The logic of this method is based on the idea that a construct shares more variance with its associated indicators than with any other construct (Hair et al. 2014). All constructs were significantly unique (Table 5.2).

Table 5.2 Evaluation criteria of Structural Equation Model (SEM) measurement model. Indicators are described in Appendix VII.

Latent variable	Indicators	Indicator reliability (outer loadings)	Internal consistency (composite reliability)	Convergent validity (AVE)	Discriminant validity
Exposure	Enter_house_sum	0.53	0.873	0.584	yes
	Visit_neigh_sum	0.82			
	Visit_neigh_win	0.76			
	Visit_prop_sum	0.87			
	Visit_prop_win	0.8			
Positive meaningful event	PME	-			
Negative meaningful event	NME	-			
Cost tangible	Tot_yes_no_mit_meas	0.67	0.785	0.478	yes
	Damage_sum	0.71			
	Damage_win	0.67			
	Extent_damage	0.77			
Benefit intangible	Avg_pos_emotion	0.77	0.910	0.629	yes
	Benefit_community	0.86			
	Benefit_mankind	0.82			
	Benefit_nature	0.64			
	Benefit_you	0.88			
	Enjoy	0.78			
Cost intangible	Avg_neg_emotion	0.8	0.922	0.60	yes
	Cost_bab_avg	0.89			
	Afraid_other_house	0.6			
	Afraid_you	0.75			
	Afraid_you_house	0.68			
	Danger_humans	0.68			
	Nuisans_babs	0.86			
	Stress_babs	0.89			
Tolerance	Tol_kill_indx_first_uns_com	0.67	0.50	0.87	yes
	Tol_kill_indx_first_uns_rar	0.64			
	Pop_ct	0.8			
	Pop_africa	0.64			
	Pop_area	0.79			
	Tol_neigh	0.7			
	Tol_prop	0.67			

3.5.2 Evaluation of Structural model

Collinearity assessment

Collinearity arises when two constructs are highly correlated in the structural model. To asses collinearity a "tolerance" value was computed. Tolerance represents the variance of one construct not explained by other constructs (Hair et al. 2014). A tolerance value of 0.2 or lower indicates potential collinearity problems because this level indicates that 80% or more of a constructs variance is accounted for by other constructs. (Table 5.3).

Table 5.3 Collinearity assessment of latent variable. In the first set we ran three separate regressions with Positive Meaningful event, Negative Meaningful Event and Exposure as predictors of Benefit Intangible, Cost Intangible and Cost Tangible. In the second set we ran a regression with Positive Meaningful event, Negative Meaningful Event, Exposure, Benefit Intangible, Cost Intangible and Cost Tangible as predictors of Tolerance.

First set		**Second set**	
Construct	**Tolerance**	**Construct**	**Tolerance**
Positive meaningful event	0.896	Benefit Intangible	0.487
Negative meaningful event	0.998	Cost Intangible	0.408
Exposure	0.897	Cost Tangible	0.591
		Negative meaningful event	0.750
		Positive meaningful event	0.739
		Exposure	0.742

3.5.3 Path coefficient sizes and significance

Path coefficients explain how strong the effect of one variable is on another variable. The weight of different path coefficients allows their relative statistical importance to be ranked (Wong 2013). Bootstrap confidence intervals were calculated and significance of path coeeficients evaluated by seeing if zero falls within the 95% confedence intervals (Hair 2014).

Which variables affect tolerance?

The structural model suggests that *Cost Intangible* (-0.38) and *Benefit Intangible* (0.4)

had equal effects on *Tolerance* while *Cost Tangible* (-0.06) had an insignificant effect. *Exposure* (-0.04), *Positive Meaningful Event* (0.08) and *Negative Meaningful Event* (-0.02) did not significantly affect *Tolerance* (Table 5.4, Fig. 5.2).

Which variables affect costs and benefits?

Exposure (-0.38) had the strongest effect on *Cost Tangible* followed by *Negative Meaningful Event* (0.26). *Positive Meaningful Event* (-0.13) had the weakest effect but was still significant (Table 5.4, Fig. 5.2).

Negative Meaningful Event (0.35), *Positive Meaningful Event* (-0.31) and *Exposure* (-0.28) all had moderate significant effects on *Cost Intangible* (Table 5.4, Fig. 5.2).

Positive Meaningful *Event* (0.48) had the strongest effect on *Benefit Intangible* while *Negative Meaningful Event* (-0.26) had a moderate effect while *Exposure* (0.11) had a weak but significant effect (Fig. 5.2).

Which variables influence experience?

Exposure (0.32) had a moderate significant effect on *Negative Meaningful Event* but an insignificant effect on *Positive Meaningful Event* (-0.02) (Table 5.4, Fig. 5.2).

3.5.4 Coefficient of determination- R_2

R_2 values represent the amount of explained variance of the endogenous constructs in the structural model. Values of 0.25, 0.50 and 0.75 are considered weak, moderate and substantial, respectively (Hair et al. 2014). R_2 was 0.598 for the *Tolerance* endogenous latent variable, meaning that the latent variables *Cost Tangible, Cost Intangible* and *Benefit Intangible* explained 59.8% of the variance in *Tolerance*. Thirty four percent of variation in *Cost Intangible*, 32% of *Benefit Intangible* and 29% of *Cost Tangible* were explained by *Exposure, Positive Meaningful Event* and *Negative Meaningful Event*. Ten percent of variation in *Negative Meaningful Event* was explained by *Exposure* but no variation in *Exposure* explained *Positive Meaningful Event* (Fig 5.2).

Table 5.4 Path coefficients of latent variables, 95% confidence levels and significance of path coefficients. EXPO=exposure, NME= negative meaningful event, PME=positive meaningful event, CT=cost tangible, CI=cost intangible, BI=benefit intangible, TOL=tolerance.

	Path Coefficients	95% confidence intervals	Significance
BI → T	0.4	0.3, 0.49	Significant
CI → T	-0.38	-0.49, -0.27	Significant
CT → T	-0.06	-0.14, 0.02	Not Significant
EXPO→T	-0.04	-0.12, 0.04	Not Significant
PME→T	0.08	-0.01, 0.16	Not Significant
NME→ T	-0.02	-0.1, 0.05	Not Significant
NME → BI	-0.26	-0.35, -0.18	Significant
NME →CI	0.35	0.25, 0.44	Significant
NME →CT	0.26	0.16, 0.37	Significant
PME →BI	0.48	0.41, 0.55	Significant
PME →CI	-0.31	-0.39, -0.22	Significant
PME →CT	-0.13	-0.19, -0.04	Significant
EXPO →BI	0.11	0.02, 0.21	Significant
EXPO →CI	0.28	-0.36, -0.2	Significant
EXPO →CT	-0.38	-0.46, -0.31	Significant
EXPO→ NME	-0.32	-0.4, -0.23	Significant
EXPO →PME	-0.02	-0.13, 0.09	Not Significant

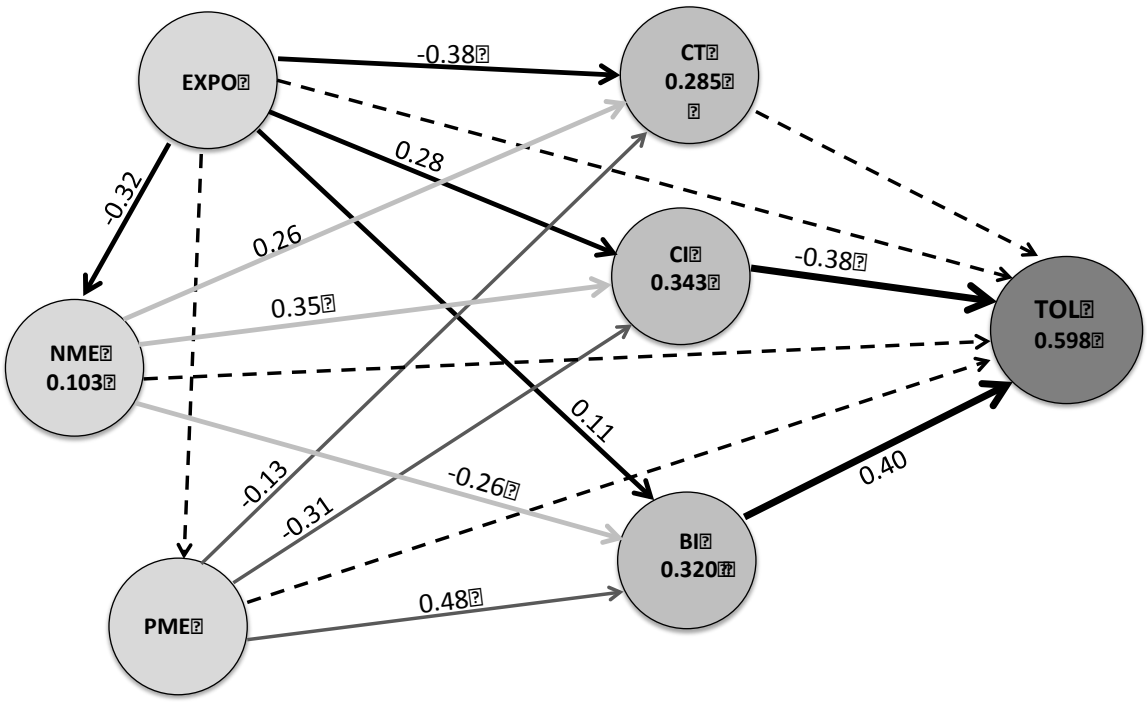

Figure 5.2 Final Structural Equation Model. Circles indicate latent variables as follows: EXPO=exposure, NME= negative meaningful event, PME=positive meaningful event, CT=cost tangible, CI=cost intangible, BI=benefit intangible, TOL=tolerance. Values inside circles are the coefficient of determination (R^2). Lines joining circles are the paths linking latent variables and values adjacent to lines are significant path coefficients. Broken lines are non-significant path coefficients.

4. Discussion

A belief that wildlife management in the 21st Century should aim to manage interactions between wildlife and people to achieve goals valued by those affected or interested in wildlife is increasing (Riley et al. 2002; Booth 2011). This requires conservation initiatives to consider the views and attitudes of stakeholders whose co-operation and support is required to achieve conservation goals (Decker et al. 2011). In this context, understanding the attitudes and tolerance of stakeholders towards different management policies, strategies and methods is essential for designing management plans (Heberlein 2012). Management then becomes a process of mediating a balance between stakeholder tolerance and wildlife persistence.

Sustainably managing wildlife populations requires information on carrying capacities, biological costs and benefits of foraging in natural versus urban landscapes, fecundity, sex ratios, and the influences of social structure and issues of overshooting (the time lag between exceeding natural carrying capacity and population decline). On the Cape Peninsula research on population demography and carrying capacity has been undertaken to some extent (Kansky & Gaynor 2000; Hoffman 2011) and has been incorporated into baboon management plans (Brownlie 2000) however research on the human dimensions of human-baboon conflict has been minimal (Kansky & Gaynor 2000, R.K unpublished data) and not incorporated into baboon management. This case study fills this gap with WTM as a useful tool to improve understanding of the proximate drivers of tolerance.

4.1 Extent of the problem and tolerance of residents?

Although most residents have some problems with baboons, the majority experience small to medium problems while only a quarter have serious problems. However, the types of costs that most contribute to *tolerance* were the *intangible costs*, those with no monetary value. Translating the types of problems listed by residents into basic human needs that are not being met (Rosenberg 2003; Madden & McQuinn 2014) might explain why *intangible costs* were more important than *tangible costs*. Since human well-being depends on ones ability to fulfill all basic needs, when these are not met negative emotions and dissatisfaction result (Max Neef et al. 1989; Rosenberg

2003). The basic need for safety is not met when residents and their dependents feel afraid when baboons enter their home. The needs for order and to experience competence and efficacy are not met when baboons cause mess and when residents are not able to prevent damage or get them out the home. And the basic human needs for ease and peace and autonomy are not met when baboon presence is a nuisance and stressful. When the extent of monetary loss impacts on the basic need for physical well-being i.e. to provide food, shelter and safety, we might expect *tangible costs* to be a significant driver of *tolerance*. This was not the case in this study where monetary losses were in the region of 0.5-1% of yearly income meaning that the extent of monetary losses were not likely to have a significant impact on residents livelihoods. Therefore *intangible co*sts had a larger number of unmet needs compared to tangible costs and this may explain the higher impact of *intangible co*sts over *tangible costs* in driving tolerance.

Despite these problems, residents on the Cape Peninsula are relatively positive and tolerant of baboons. Three quarters evaluated their overall experience of baboons as positive or neutral, half have had some positive experience with baboons, overall positive emotions are greater than negative emotions in both number and intensity, most don't find it difficult living with baboons and most see baboons as beneficial to some extent. Not surprisingly, most can tolerate them to some extent in their neighborhood or on their property, most want the baboon population to remain the same or increase in their area and Cape Town and most think a baboon should only be killed after it has injured a human. This bodes well for the future of the baboon population on the Cape Peninsula and perhaps in hindsight, is the reason for the persistence of this population despite increased urban development. This may also seem positive for the re-wildling cities movement (www.rewildingeurope.com, www.wild.org). However, one should not conclude that all urban populations would be tolerant to wildlife because people have different tolerances for different species and different types of damage (Chap. 2) and therefore each species and context would require evaluation on a case-by-case basis (Heberlein 2012).

Despite this positivity, residents do think baboons are potentially dangerous to humans and many are afraid of them particularly when they enter their house. Not surprisingly 75% will not tolerate them inside their home. Since most residents also

report they do not have sufficient information on how to respond when baboons enter their house (see Appendix IX), an important management intervention would be to assist residents to improve their knowledge and ability to prevent baboons entering their home and to cope when baboons do gain entry. This would be particularly important since *negative meaningful events* may be more likely to occur when a person is confronted by a baboon inside their home.

Despite this fear and the general finding that most residents think there are contexts when culling baboons would be necessary, the contexts are quite specific and these occur very rarely on the Cape Peninsula, e.g. when a person has been injured or killed. No humans have been killed and instances of injury are very rare usually occurring when baboons have been cornered inside a house or when people have tried to retrieve items taken by baboons. Despite this tolerance 36 baboons have been killed by the authorities during 2012-2013 (www.hwsolutions.org). This suggests that there is a mismatch between residents' tolerance and baboon management by authorities.

4.2 Support for the Wildlife Tolerance Model

The results from the SEM supported the *outer model* structure of the WTM: 60% of *tolerance* was explained by perceptions of *costs* and *benefits* whilst *exposure* and *meaningful events* explained approximately 30% of perceptions of *costs* and *benefits*. The insignificant path coefficients between *exposure* and *meaningful events* to *tolerance* supports the hypothesis that *costs* and *benefits* mediate the relationships between *exposure*/ *meaningful events* and *tolerance*. However since *exposure* and *meaningful events* moderately explained perceptions of *costs* and *benefits* (30%), a substantial amount of unexplained variance in costs and benefits remains and therefore other factors driving perceptions of *costs* and *benefits* will need to be identified. These could be the extent to which residents implement mitigation measures as well as the *inner model* variables identified in the WTM (see Chap. 6).

HWC mitigation strategies typically assume increasing damage to be an important causal factor in decreasing tolerance (Hulme & Murphee 1999; Distefano 2003; Dickman 2010). This study found that *tangible costs* are not significant in determining *tolerance*. One possible explanation is that our study area is in relatively

wealthy suburbs and losses to respondents were generally low (0.6% of average annual income) and therefore do not substantially affect their livelihood.

An interesting finding was the equal contribution of *intangible costs* and *intangible benefits* as drivers of *tolerance*. The fact that *tangible costs* did not contribute to explaining *tolerance* compared to *intangible costs* and *intangible benefits* highlights the need to separate *costs* and *benefits* into tangible and intangible so management interventions can target the specific factors driving tolerance for a particular context. This then allows for the development of an optimal mix of mechanisms (instruments, incentives and institutions (Young et al. 2005) that best enhance stakeholder tolerance whilst better ensuring wildlife persistence. Since most mitigation interventions focus on reducing tangible costs (for example compensation schemes) and emphasize the need for tangible benefits (tourism, trophy hunting), this study highlights that in some circumstances focus on intangible costs and benefits would be more effective (Jacobs et al. 2011; Barua et al. 2013; Vaske et al. 2013). Future case studies in different contexts will be important to build knowledge of the contexts and species where these may differ.

Meaningful events, both positive and negative, are better predictors of *intangible benefits* than *exposure*. Further, *exposure* does not significantly drive *positive meaningful events*, but *positive meaningful events* most strongly drives *intangible benefits*. So, in a management context, how can *positive meaningful events* be enhanced so as to increase the perception of *benefits*? It may be possible to increase *positive meaningful events* in non-residential areas such as in nature reserves or on the side of the roads. Management of baboons in these areas to enhance a positive baboon experience and prevent negative interactions would be critical. Development of aggression towards people resulting from habituation of baboons to feeding by tourists on the roadside as well as in picnic areas or other areas of tourist concentrations with food readily available such as restaurants has been a regular occurrence. Between 2005-2010 a local non-government organization called Baboon Matters conducted walking tours with baboons and offered reduced rates to residents. These may have contributed to positive experiences.

Conversely, perceptions of *exposure*, *negative meaningful events* and *positive meaningful events* equally drive *intangible costs* meaning the more a person is exposed to baboons the greater the perceptions of *intangible costs*. In addition, the greater the number of *negative meaningful events* and the lower the number of *positive meaningful events*, the higher the perceptions of *intangible costs*, including negative emotions, feelings of fear, danger, nuisance and/or stress. *Exposure* however poorly explained *meaningful events* meaning that irrespective of *exposure* residents are having *positive* and *negative meaningful events* with baboons and therefore reducing *exposure* will not reduce the number of *negative meaningful events* or increase the number of *positive meaningful events*. Therefore reducing residents' *exposure* to baboons as well as the number of *negative meaningful events* will need to be considered as two separate management interventions. Reducing the number of *negative meaningful events* should be possible by providing detailed information and training on how to behave when baboons enter homes (see Kansky 2002). Reducing *exposure* should be possible by encouraging residents to make their properties less attractive to baboons (see Kansky 2002) together with reducing the amount of time baboons spend in residential areas through the Baboon Monitor Program (Kansky & Gaynor 2000; www.hwsolutions.org). Structural incentives (Heberlein 2012) may also be necessary such as by laws to encourage the use of baboon proof dustbins, compost bins and vegetable gardens and removal of exotic fruit trees. Ratepayers associations may also encourage property management through innovative competitions.

Overall, this case study found support for the *outer model* variables in the WTM as drivers of *tolerance*. The model distinguished between tangible (monetary) and intangible (non monetary) costs and benefits and found that while *intangible costs* and *benefits* equally contributed to driving *tolerance*, *tangible costs* had no significant effect on *tolerance*. *Exposure* and *meaningful events* explained 30% of variance in *costs* and *benefits* but *exposure* drives *costs* more than *benefits*. This means that while conservation managers could reduce perceptions of *costs* and increase perceptions of *benefits* (and therefore increase *tolerance*) by reducing *exposure* to baboons to some extent, there remains a large amount of unexplained variance in *costs* and *benefits* and therefore other factors driving perceptions of *costs* and *benefits* will need to be identified. These could be the extent to which residents implement mitigation

measures as well as the *inner model* variables identified in the WTM (see Chap. 6). *Exposure* explained only 10% of variance in *negative meaningful events* but did not explain any variance in *positive meaningful events*. Since both *meaningful events* and *exposure* moderately explain perceptions of *costs* and *benefits*, separate management interventions are required to influence these. Additional case studies are now needed using the WTM in order to determine the extent to which these proximate, *outer model* variabes are important for different species, stakeholders and cultures. Accumulation of this knowledge will allow evaluation of the extent to which these factors are relevant across landscapes and can then inform policies and strategies at these scales. These are urgently required given the rapid rate of biodiversity loss and global change.

Chapter 6

Tolerance for Baboons in Cape Town, South Africa – A Test of the Wildlife Tolerance Inner Model

Abstract

The Wildlife Tolerance Model (WTM) was developed to guide research aimed at identifying primary drivers of tolerance to living with damage causing wildlife. The *outer model* of the WTM proposes that the net outcome of the extent to which a person is exposed to a species as well as the types of meaningful events (positive or negative) determine perceptions of the costs and benefits of living with a species. These in turn determine tolerance. A second *inner model* predicts eleven variables that impact on tolerance through costs and benefits. Previous research found support for the *outer model* using urban baboon-human conflict on the Cape Peninsula of South Africa as a case study. Here we use the same case study to test the *inner model*. Baboons are commonly involved in human-wildlife conflicts in Africa but few studies have examined the attitudes and tolerance of people towards them. We surveyed 403 residents living in five urban areas adjacent to the Table Mountain National Park. We performed a cluster analysis with five *inner model* variables (Schwartz Values, Wildlife Value Orientations, Interest in animals, empathy and anthropomorphism). Two subgroups emerged that differed significantly in all five variables. We then tested for differences in *outer model* variables. Group1 (GP1) was significantly more tolerant than Group 2 (GP2) and differences in tolerance persisted after controlling for other *outer model* variables suggesting *inner model* variables were more important in explaining differences between the two groups. We then performed a Structural Equation Model for each subgroup with *outer model* variables but no significant differences were found meaning for each group *outer model* variables are equally important in explaining tolerance. This means that GP2 will need a three times decrease of exposure to reach the tolerance levels of GP1 despite GP1 having exposure levels 1.3 less than GP2.

1. Introduction

Predicting the drivers of tolerant attitudes and behavior towards damage causing wildlife is important because intolerance is a major direct and indirect driver of the decline of many medium and large mammalian species (IUCN 2008; Woodroffe et al. 2005; Loveridge et al. 2010; Dickman 2012; Estrada et al. 2012). Human-Wildlife Conflict (HWC) can be defined as a type of biodiversity conflict (Bennett et al. 2001) consisting of two components: (i) impacts that deal with direct interactions between humans and wildlife species (Young et al. 2010); and (ii) conflicts between humans over how to manage the impacts between humans and wildlife.

HWC can have substantial impacts on stakeholders (Loveridge et al. 2010) that in turn can reduce support for the conservation of biodiversity in general (De Boer et al. 1998; Maikhuri et al. 2001; Allendorf et al. 2006; Wang et al. 2006; Gubbi et al. 2009). Predicting the most important drivers of tolerance was the aim of the Wildlife Tolerance Model (WTM) (Chap. 4).

The WTM was developed from meta - analytic reviews as well as concepts and theories from a wide variety of disciplines (Chaps. 2, 3, 4). The need for a comprehensive theoretical model arose due to the lack of a widely accepted and applied framework to guide HWC research and management such as the frameworks that exist for managing communal natural resources (Ostrom 2009) and pro-environmental behaviour (Klockner 2013). The lack of a widely applied model hinders progress because currently research takes place as individual case studies with a variety of variables being applied in surveys that are not easily comparable across sites (Chap. 3). This prevents evaluation of potential key drivers of tolerance that can be applied over broader spatial scales. Landscape approaches to conservation of biodiversity and ecosystems are increasingly being recognized as most cost effective (Millennium Ecosystem Assessment 2005; Sayer et al. 2013) and therefore failure to identify strategies and policies that can be implemented at these scales reduces efficiency in conservation management.

The WTM is described in detail in Chap. 4 and Fig. 4.1. The model consists of two components: an *outer model* (OM) with six variables and an *inner model* (IM) with 11

variables. For the OM, the net outcome of the extent to which a person experiences a species determines their perceptions of the costs relative to benefits of living with a species. These in turn determine tolerance. The IM predicts eleven variables that impact on tolerance through costs and benefits. In chapter four we tested and found support for the OM of the WTM using a case study of urban primates in the city of Cape Town, South Africa. Here we use the same case study to evaluate the extent to which the IM variables: *Schwartz values, Wildlife Value Orientations, Interest in wildlife, Empathy* and *Anthropomorphism* impact on the OM variables. A second aim is to determine if these IM variables impact on support for different management actions by conservation authorities as well as mitigation measures applied by residents.

1.1 Inner model variables

1.1.1 Schwartz Values

Differences in values are thought to be important drivers of biodiversity conflicts and HWC specifically (Vaske et al. 1995; Rosenberg 2005; Heberlein 2012; Hazzah et al. 2014; Madden & McQuinn 2014) but have not been applied in quantitative surveys (Chap. 3). Values are formed early in life, remain relatively stable throughout adult life and therefore are slow or unlikely to change once formed (Bardi et al. 2009; Heberlein 2012). This has important conservation management implications because interventions designed to change attitudes or behavior are unlikely to be effective, particularly when the attitudes, behavior or a persons identity is strongly linked to their values (Heberlein 2012). In such cases structural measures (for e.g. incentives and institutions) that do not contradict values are most effective (Heberlein 2012; Hazzah et al. 2014).

Schwartz's value theory is a set of basic universal value priorities that organize human motivations (Schwartz et al. 2012, Fig. 4.2, Table 4.2). These basic values exist in over 70 different cultures (Schwartz 2011) and have been linked to a wide range of behaviours (Bardi et al. 2008; Maio 2010; Roccas & Sagiv 2010). The theory has rarely been tested in the context of human-wildlife relations (but see Kaltenborn & Bjerke 2002; Hrubes et al. 2001).

1.1.2 Wildlife Value Orientations

Expanding on the notion that individuals and groups may have different value priorities, a Wildlife Value Orientations (WVO) construct was developed (Fulton et al. 1996; Manfredo 2008) to reflect the social ideology of a cultural group in relation to wildlife. Two dimensions are recognized: utilitarian and mutualistic. Utilitarian's believe wildlife are primarily for human benefit and prioritize human well-being over wildlife treatment. Mutualists believe wildlife capable of living in relationships of trust and caring with humans and are less likely to support actions resulting in death or harm to wildlife (Teel et al. 2005; Teel & Manfredo 2009; Appendix VI). WVO predict support for recreational trapping (Manfredo et al. 1997), intention to support reintroduction of wolves (Hermann & Menzel 2013) and destruction of damage causing wildlife (Zinn et al. 1998).

1.1.3 Interest in animals

The more a person is interested in animals in general and specifically wildlife, and the more experiential the interest in wildlife, the more benefits will be perceived to living with damage causing wildlife. This is predicted from meta-analytic reviews (Chap. 2 & 3) as well as a potential link between interest in animals, values, anthropomorphism and empathy (Chap 4). High empathy is linked with increased human pro-social behavior (Konrath et al. 2011) as well as to treatment of animals (Paul 2000; Daly & Morton 2006; Fillipi et al. 2010; Signal and Taylor 2007). People with *self transcendence* values i.e. those committed to equality, justice and protection for all people, preservation of the natural environment and acceptance and understanding of those who are different from oneself as well as caring and dependability towards in-group members (Schwartz et al. 2012, Table 4.2, fig 4.2), are predicted to extend their empathy beyond their self- interest and include other species in their in-group. In-groups or entities that are liked, are attributed more mind and therefore anthropomorphized more (Chap. 4).

A specific aim of this study was therefore to test the hypothesis that individuals prioritizing *self transcendence* value dimensions, *mutualistic* WVO, high trait empathy to other people and baboons and high anthropomorphism, will perceive more benefits to living with baboons and therefore score higher on tolerance than

individuals prioritizing *'self enhancement'* values who will also score lower on empathy, anthropomorphism, be less interested in animals and wildlife and score higher on utilitarian WVO. A second hypothesis was that those who prioritize *self transcendence* values will also show greater support for more humane management interventions that do not involve lethal or pain aversion techniques.

2. Methods

Study area, sampling and survey instrument are as in Chap. 5. Additional variables examined in the current paper are described in Appendix VII. We used two constructs to measure anthropomorphic tendency- *Belief in Animal Mind* (BAM) (Hills 1985) and one compiled by Nicholas Epley and Adam Waytz specifically for the current study. The *human empathy* scale was the Davis Interpersonal Reactivity Index (IRI) (Davis 1980, 1983a, 1983c). The 28 items comprise four 7-item subscales representing different components of interpersonal sensitivity: 1. Fantasy scale measures an inclination to identify with fictitious characters 2. Perspective taking measures ability to adopt another persons view 3. Empathic concern assesses ability to feel compassion for others who engaged in negative experiences, 4. Personal distress indicates extent to which individuals witness others negative experiences resulting in their own anxiety and discomfort. This scale was modified for the baboon empathy scale and resulted in 11 of the 19 items being used (Appendix VII). The new 19 - item *Schwartz Value* survey (PVR2) was used for the value construct (Schwartz et al. 2012, Appendix VII). The *Wildlife Value Orientation* (WVO) construct was from Teel and Manfredo 2009) (Appenix VII). The remaining constructs and variables were developed specifically for this study and were guided by theory emanating from the quantitative reviews and the WTM (Appendix VII).

2.1 Data analysis

In order to determine the role of the IM variables we conducted a cluster analysis using five of these variables: *Schwartz values, Wildlife Value Orientations, Interest in Animals and Wildlife, Empathy for people, Empathy for baboons* (Appendix VII). To test construct reliability and validity of these we performed Confirmatory Factor Analysis (CFA) using SmartPLS software (Ringle et al. 2014) as recommended by

Brown (2006) for developing and refining measurement instruments.

For the cluster analysis we used Statistica 11 (StatSoft 2012) to perform hierarchical clustering using Euclidian distance as the distance measure, and Ward's method for linkage. The number of clusters was selected using visual inspection of the dendogram and was cross-validated using K-means clustering. We replaced missing values for the cluster analysis in order to include as many respondents as possible. Respondents with more than half missing values for a construct were not considered for replacement. Missing data imputation was using K-Nearest Neighbors. The emerging groups were compared for the IM variables as well as additional variables listed in Appendix VII using Chi^2, one -way analysis of variance (ANOVA) and Man Whitney U tests. Although all data were not normally distributed, we found no differences in results between the ANOVA's and Man Whitney U tests. We therefore report only F statistics from the ANOVA's. We used Analysis of co variance (ANCOVA) to compare the constructs in the Structural Equation Model (SEM) from Chap. 5 to determine if differences in tolerance were apparent and if these could be attributed to the constructs preceding tolerance in the SEM (see Chap. 5). For these constructs we standardized the construct scales by subtracting the mean and dividing by the standard deviation (*z* score).

For the *Institutions* variable we compared the average scores for the five questions: Trust in the organization, General Performance, Skills and knowledge to manage baboons, Communication with residents and Education of residents (VII). For the *Schwartz Values* mean scores were computed for the three items for each of the 19 values and used for the CFA. For the cluster analysis and ANOVA corrections for individual differences in use of the response scale were computed by first computing each individual's mean score across all 57 value items (MRAT) and secondly, centering scores of each of the 19 values for an individual around that individual's MRAT (i.e., subtract MRAT from each of the 19 value scores) (S. Schwartz pers. com.). A pro-environmental index (Pro_env_index) was computed by adding the scores of five variables such that the higher the score the less pro-environmental the person. The variables were: wether a person eats meat or not (meat_Y/N), the frequency of meat eating (meat_freq), the proportion of organic food a person buys (organic), wether a person recycles house waste (recycle y/n) and the proportion of

money a person would be willing to pay to buy predator friendly farmed meat above the price of normally farmed meat (%meat_pred_friendly) (Appendix VII).

3. Results

3.1 Construct validity and reliability

Results for the CFA are reported in Appendix X. The results were satisfactory for the exploratory nature of the study. Modifications were made for the *baboon empathy* scale where the PD sub-scale was removed as it did not translate well from the *human empathy* scale. The EC sub scale was not sufficiently distinct from the PT scale and was therefore combined with the PT subscale to form one *baboon empathy* construct. For the *WVO use* subscale only items 1,2 & 3 were used as items 4 & 5 had low indicator reliability. The *human empathy* scale had a low convergent validity (0.4-0.5) for the four sub-scales, possibly due to respondent fatigue, as it was the last section in the survey.

3.2 Differences between cluster groups

3.2.1 Cluster variables

Two cluster groups were identified (Fig 6.1). Group one (GP1) consisted of 38% of the respondents while group two (GP2) consisted of the remaining 62%. Significant differences were found between the two cluster groups for the five IM variables tested (Table 6.1) and therefore the emerging cluster groupings were validated. Respondents that formed part of GP1 were significantly more interested in animals, wildlife in general and baboons in particular than GP2 (Table 6.1). GP1 also had more mutualistic WVO's and scored higher on the two anthropomorphism constructs as well as the two empathy constructs (people and baboon) (Table 6.1). *Self transcendence* value priorities showed the largest difference between the two groups with GP1 showing higher values. *Openness to change* values was significantly higher for GP1 while no significant differences were apparent for *self enhancement* values. GP1 also showed higher scores for *tradition* values compared to GP2 (Table 6.1).

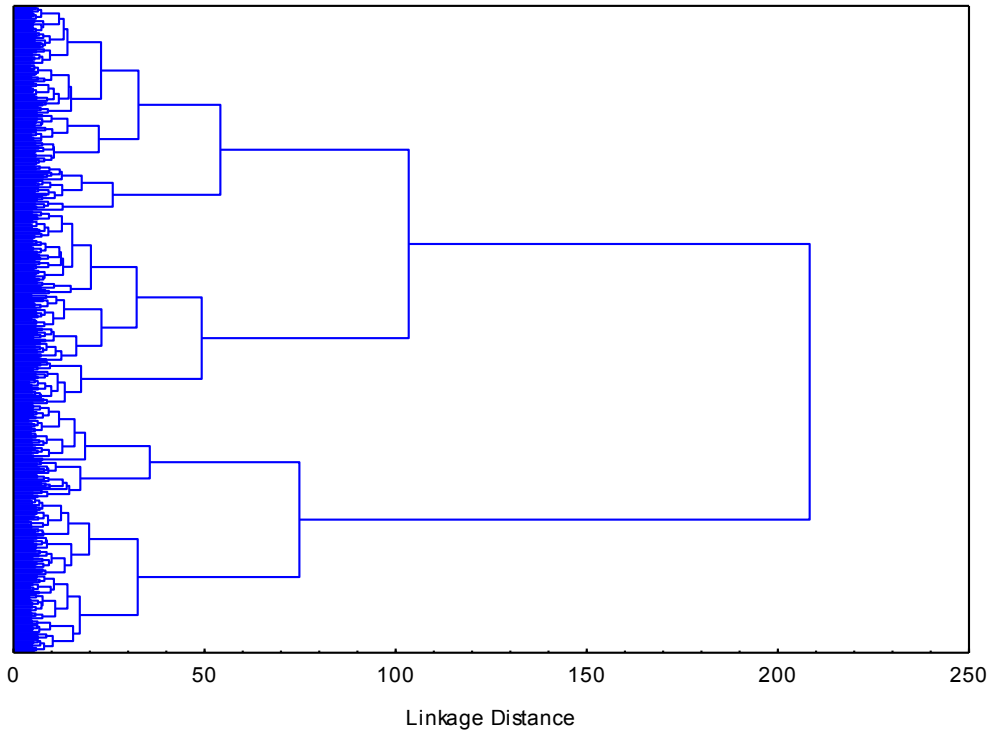

Figure 6.1 Cluster analysis dendrogram showing two cluster groups based on the input of five *inner model* variables from the Wildlife Tolerance Model: Schwartz values, WVO, Interest in animals and Wildlife, Empathy towards people, empathy for baboons (Appendix VII).

Table 6.1 Comparison between cluster group 1 (GP1) and group 2 (GP2) for the four concepts that formed part of the cluster analysis (Interest in animals and wildlife, Wildlife Value Orientations (WVO), Schwartz Value's). See Appendix B for variable names and questions used. Significant differences are highlighted. Dark shading indicates F values above 100.

	Mean GP1 (n=154)	**Std dev**	**Mean GP2 (n=248)**	**Std dev**	**Mean All**	**Std dev**	**F**	**P value**
Interest in animals and wildlife								
Bab_interest	**4.50**	0.79	3.35	1.13	3.79	1.16	118.38	<0.001
Int_Wild_gen_PAS_avg	**6.65**	0.52	5.76	0.98	6.10	0.93	106.32	<0.001
Int_Wild_BAB_Avg	**6.02**	1.22	4.60	1.48	5.15	1.55	96.63	<0.001
Int_Wild_gen_ACT_avg	**6.12**	0.93	5.0	1.32	5.42	1.30	86.62	<0.001
Like_dislike	**6.19**	1.37	4.81	1.50	5.34	1.60	84.90	<0.001
Animals_like	**6.87**	0.53	5.94	1.2	6.30	1.09	77.79	<0.001
Int_Wild_area_avg	**6.52**	0.82	5.65	1.22	6.0	1.16	60.68	<0.001
People_animal (reversed)	3.43	1.46	**4.37**	1.53	4.0	1.57	36.16	<0.001
Domestic_wild	**4.61**	1.15	3.99	1.35	4.22	1.31	22.19	<0.001
Bab_mang	**4.40**	0.88	3.69	1.06	3.96	1.08	44.92	<0.001
Bab_Respect	**6.39**	0.99	5.27	1.35	5.70	1.34	77.60	<0.001
Bab_Look	**5.46**	1.43	4.32	1.61	4.76	1.64	51.59	<0.001
Bab_Behave	**5.47**	1.36	4.21	1.47	4.70	1.55	73.25	<0.001
Anthropomorphism								
Belief Animal Mind_avg	**5.79**	1.11	5.30	1.15	5.5	1.14	17.75	<0.001
Anthro_index_avg	**4.15**	0.97	3.84	0.85	3.96	0.9	10.47	<0.001
Wildlife Value Orientations								
Utilitarian								
WVO-hunt	3.33	1.49	**4.28**	1.40	3.91	1.50	41.23	<0.001
WVO-use (123)	2.09	1.19	**3.13**	1.34	2.73	1.40	61.94	<0.001
Mutualistic								
WVO-social affiliation	**6.29**	1.06	4.92	1.38	5.45	1.43	108.49	<0.001
WVO-care	**5.94**	1.02	4.33	1.31	4.94	1.44	168.3	<0.001
Empathy								
Baboon - EC	**5.22**	0.77	4.16	0.84	4.57	0.96	158.72	<0.001
Baboon - PT	**4.79**	1.19	3.25	1.25	3.84	1.44	144.10	<0.001
People - FS	**3.68**	0.95	3.36	0.84	3.49	0.89	11.93	<0.001
People - EC	**5.07**	0.53	4.54	0.57	4.75	0.61	85.96	<0.001
People - PD	2.72	0.96	**2.91**	0.81	2.84	0.88	4.45	0.036
People - PT	**4.53**	0.78	4.05	0.68	4.24	0.76	40.14	<0.001
Schwartz values								
Self Transcendence								
Universalism - Nature	**5.26**	0.68	4.40	0.81	4.73	0.87	118.9	<0.001
Universalism - Concern	**5.31**	0.74	4.70	0.77	4.94	0.81	60.10	<0.001
Universal - Tolerance	**5.16**	0.76	4.6	0.72	4.82	0.78	54.45	<0.001
Benevolence - Care	**5.46**	0.56	4.93	0.76	5.14	0.73	53.59	<0.001
Benevolence - Dependability	**5.38**	0.63	4.90	0.74	5.08	0.73	44.15	<0.001

Openness to change								
Self-direction - Thought	**5.35**	0.57	4.86	0.80	5.05	0.76	43.16	<0.001
Self-direction - Action	**5.06**	0.70	4.64	0.83	4.81	0.81	26.89	<0.001
Stimulation	**4.11**	1.0	3.69	1.02	3.89	1.03	25.56	<0.001
Hedonism	**4.44**	1.03	4.06	0.97	4.21	1.0	14.03	<0.001
Self Enhancement								
Achievement	3.96	0.92	3.83	0.87	3.88	0.89	2.05	0.153
Power - Dominance	2.68	1.06	2.65	0.93	2.66	0.98	0.08	0.77
Power - Resources	3.02	0.86	3.07	0.83	3.05	0.84	0.35	0.55
Face	**3.98**	1.20	3.72	1.12	3.82	1.15	4.82	0.03
Tradition								
Security - Personal	**4.75**	0.86	4.44	0.82	4.56	0.85	12.63	<0.001
Security - Social	**4.68**	1.08	4.31	0.97	4.45	1.03	12.24	<0.001
Tradition	**3.46**	1.41	3.12	1.16	3.25	1.27	6.74	0.01
Conformity - Rules	**4.30**	1.21	3.91	1.21	4.07	1.22	9.66	0.002
Conformity - Interpersonal	**4.16**	1.09	3.83	0.98	3.96	1.04	9.74	0.002
Humility	**4.54**	0.94	4.09	0.85	4.27	0.91	24.02	<0.001

3.2.2 Socio-demographic and other variables

The two cluster groups did not differ significantly in most of the socio-demographic and general category variables such as number of children, number of pets, age, education level, years lived in village, value of property and yearly income (Table 6.2). However, GP1 consisted of significantly more females than males (Chi^2 (df=1)=9.54, p=0.002, GP1=45% female, 30% male GP2: 55% female, 70% male) and although respondents in this group did not have more pets, they did have significantly closer relationships with them; i.e. they loved them and felt they were part of their family significantly more than GP2 (Table 6.2, Appendix VII). GP1 also partake in significantly more pro-environmental behaviors than GP2 (Table 6.2, Appendix VII).

No significant differences were found in the proportion of individuals from each group between villages (Chi^2 (df=4)=2.85, p=0.58, GP1: CP=42%, KM=44%,

SC=35%, TK=37%, WG=35%; GP2: CP=58%, KM=56%, SC=65%, TK=63%, WG=65%).

Table 6.2 Comparison between cluster group 1 (GP1) and group 2 (GP2) for socio-demographic and other variables. See Appendix VII for variable names and questions used. F values are for Analysis of Variance results. Significant differences are highlighted.

Variable	Mean GP1 (n=154)	Std dev	Mean GP2 (n=248)	Std dev	Mean All	Std dev	F	P-value
General								
Child_tot	0.69	1.02	0.85	1.03	0.79	1.03	2.06	0.15
Pets_tot	2.38	3.22	1.97	2.39	2.13	2.74	2.07	0.15
Age_category	3.7	1.23	3.61	1.34	3.64	1.30	0.37	0.54
Yrs_village	10.62	7.62	11.04	9.60	10.88	8.88	0.20	0.65
Income_yearly	3.25	1.26	3.22	1.18	3.24	1.21	0.03	0.86
Value_ property	7.38	1.30	7.25	1.44	7.30	1.39	0.68	0.41
Education	4.11	1.02	4.18	1.11	4.15	1.08	0.318	0.57
Economic stress	4.33	1.59	4.53	1.51	4.45	1.54	1.52	0.22
Pets_love	4.88	0.47	4.53	0.85	4.67	0.74	17.76	<0.001
Pets_part_family	4.82	0.52	4.54	0.83	4.66	0.73	11.36	<0.001
Pro-env_index	10.16	1.63	10.84	1.57	10.59	1.63	13.85	<0.001
Organic	32.9	20.3	28.6	20.9	30.3	20.7	3.89	0.05
Tot_neg_tot_pos_emotion	-26.5	28.94	5.10	31.9	-7.03	34.39	99.67	<0.001
Prob_bab	2.60	1.81	3.87	1.93	3.39	1.98	43.03	<0.001
Overall experience	3.87	1.03	2.88	1.03	3.25	1.14	87.61	<0.001
Knowledge								
Knowledge_gen	2.36	1.03	2.11	0.96	2.21	1	5.77	0.017
Knowledge_house	3.13	1.09	2.97	1	3.04	1.02	1.93	0.17
Perception population size								
Bab_abund_area	3.95	0.94	4.06	0.89	4.02	0.91	1.31	0.25
Bab_abund_CP	3.52	0.99	3.79	0.86	3.69	0.92	7.95	0.005
Bab_abund_africa	3.57	0.96	3.69	0.91	3.64	0.93	1.63	0.202
Personal norm								
Responsibility_AVG	5.28	1.42	4.32	1.75	4.69	1.69	30.33	<0.001
Mitigation measures								
Mean effectiveness	4.14	0.67	3.70	0.78	3.86	0.77	31.75	<0.001
Mean difficulty (revers)	3.57	0.85	3.21	0.73	3.35	0.80	19.48	<0.001
Spent mitigation	2233.2	5982.3	3791.0	14759	3200.9	12212.4	1.38	0.24

3.2.3 Familiarity and support for institutions

Respondents were generally unfamiliar with all organizations involved with baboon management but GP1 respondents were slightly more familiar than GP2 (Table 6.3). Both groups showed a similar order of familiarity with all respondents being most familiar with Baboon Matters Trust followed by South African National Parks, City of Cape Town, Nature Conservation Corporation, Ratepayers Association, Cape Nature, Baboon Technical Committee, Baboon Liaison Group, Baboon Research Unit (Table 6.3). Significant differences between the two groups presented for three of the nine institutions involved with baboons on the Cape Peninsula. GP2 showed more support for the City of Cape Town authorities and the Baboon Technical committee while GP1 showed more support for Baboon Matters Trust (Table 6.3).

Table 6.3 Comparison between cluster group 1 (GP1) and group 2 (GP2) for institutional familiarity (number and percentage of respondents who were familiar with the organization) and institutional support as measured by the average score for trust in the organization, general performance, skills and knowledge to manage baboons, communication and education of residents (Appendix VII). F values are for Analysis of Variance results. Significant differences are highlighted.

Institutions	GP1				GP2				All		F	P value
	Freq.	%	Mean score	Std dev	Freq.	%	Mean score	Std dev	Mean	Std dev		
Baboon Matters Trust	86	55,8	**3.64**	1.16	121	48,8	2.75	1.04	3.12	1.18	33.56	<0.001
South African National Parks	80	51,9	2.15	1.00	111	44,8	2.41	1.48	2.30	1.30	1.90	0.17
City of Cape Town	71	46,1	1.86	0.95	101	40,7	**2.3**	0.82	2.09	0.87	8.94	0.003
Nature Conservation Corporation	69	44,8	2.34	0.92	82	33,1	2.58	1.11	2.47	1.03	2.18	0.14
Ratepayers Association	58	37,7	2.93	1.25	80	32,3	2.99	1.08	2.97	1.15	0.09	0.76
Cape Nature	52	33,8	2.11	0.96	72	29,0	2.32	0.82	2.23	0.89	1.65	0.20
Baboon Technical Committee	42	27,3	1.86	1.0	55	22,2	**2.43**	0.89	2.19	0.98	8.80	0.004
Baboon Liaison Group	39	25,3	2.27	1.05	54	21,8	2.51	0.94	2.41	1	1.34	0.25
Baboon Research Unit	38	24,7	2.41	1.08	50	20,2	2.82	1.01	2.64	1.05	3.20	0.08

3.2.4 Support for management interventions by authorities

Significant differences between the two groups presented for 10 (63%) of 16 management interventions that authorities could implement to prevent and reduce baboon impacts on residents (Table 6.4, Appendix VII). GP2 presented higher preference for lethal control of baboons, (e.g. destroying individual baboons that cause repeated problems) and prefered methods that involved pain aversion (e.g. use of paintball guns). GP1 presented higher preference for baboon monitors with no weapons, treating injured baboons and education of residents (Table 6.4). Despite these differences support for lethal control and pain aversion methods was overall low for both groups (1.8-3 on a scale of 1-5 where 1=no support and 5=complete support) (Table 6.4).

3.2.5 Mitigation measures applied by residents

Significant differences between the two groups presented for 7 (30%) of the 23 mitigation measures applied by residents to prevent or reduce baboon impacts (Table 6.5, Appendix VII). The most significant difference was in the manner by which baboons were chased: a higher proportion of residents from GP2 chased baboons aggressively (53% vs 33%), with a hosepipe (58% vs 41%) or with a paint ball gun (12% vs 4%). A significantly higher proportion of GP1 residents do not chase baboons at all (34% vs 20%) (Table 6.5). Regarding property management, a significantly larger proportion of GP2 keep windows and doors closed even when the baboons are not around (52% vs 35%), keep food out of site (51% vs 41%) and have baboon proof doors (44% vs 32%) (Table 6.5).

3.2.6 Wildlife Tolerance Model constructs

Significant differences between the two groups presented for all constructs in the WTM (Table 6.6, Appendix VII). Non - standardized descriptive statistics and comparisons for construct items are presented in Table 6.7. GP1 were exposed to baboons significantly less, had more positive and less negative experiences, had less costs and more benefits and were significantly more tolerant than GP2. (Tables 6.6 & 6.7).

3.2.7 Controlling for Wildlife Tolerance Model antecedent constructs to tolerance

We performed analysis of co-variance (ANCOVA) on the WTM model constructs to determine if differences remained in tolerance between the two groups after controlling for the antecedent constructs of tolerance in the WTM. Differences in *tolerance* did not disappear after controlling for *exposure (EXPO), positive meaningful events* (PME), *negative meaningful events* (NME), *cost intangible* (COST INTANGIBLE) and *benefit intangible* (BI) meaning that these co-variates do not account for the differences in tolerance between the two groups (Table 6.8). Subsequently differences in BI and COST INTANGIBLE did also not disappear after controlling for Exposure, Positive Meaningful Event, Negative Meaningful Event. However differences in Cost Tangible did disappear after controlling for Exposure, Positive Meaningful Event and Negative Meaningful Event meaning these variables account for the differences in Cost Tangible between the two groups and supporting the finding from chap 5 of the low importance of Cost Tangible in driving Tolerance (Table 6.8).

3.2.8 Structural Equation Model (SEM) comparison between two groups

Since significant differences were found in WTM constructs between the two subgroups, we conducted SEM- multi-group analysis to compare parameters between the two groups to determine if IM variables moderate relationships in the path model (Hair et al. 2012). We found no significant differences between path coefficients for the SEM's for GP1 and GP2 (Appendix X1).

Table 6.4 Comparison between cluster group 1 (GP1) and group 2 (GP2) of the mean score for support of residents for different management options that can be implemented by the authorities managing baboons on the Cape Peninsula. F values are for Analysis of Variance results. Scale is from 1 to 6 where 1 =do not support at all and 6=complete support (Appendix VII). Significant differences are highlighted.

Management Options	Mean GP1 (n=150)	Std dev	Mean GP2 (n=243)	Std dev	Mean All	Std dev	F	P value
6. Destroy male baboons that cause repeated problems ONLY **if there are other males in the troop**	2.38	1.56	**3.61**	1.58	3.13	1.68	55.67	<0.001
8. Destroy some female baboons that cause repeated problems	2.13	1.50	**3.22**	1.64	2.80	1.68	43.67	<0.001
7. Destroy male baboons that cause repeated problems **irrespective of how many other males there are**	2.01	1.54	**3.06**	1.68	2.65	1.70	37.43	<0.001
2. Baboon monitors/chasers to keep baboons away from residential areas-with paint ball guns	2.66	1.67	**3.54**	1.52	3.21	1.64	28.51	<0.001
4. Shoot at and kill some baboons with live ammunition every now and again	1.58	1.27	**2.47**	1.67	2.12	1.9	31.12	<0.001
13. Destroy **dispersing males** when there are no other troops for them to join	2.11	1.64	**3.16**	1.77	2.74	1.79	33.84	<0.001
9. Destroy whole troops that cause repeated problems	1.51	1.26	**2.15**	1.50	1.90	1.44	19.09	0.005
1. Baboon monitors/chasers to keep baboons away from residential areas-with no weapons	**4.14**	1.29	3.70	1.35	3.87	1.35	9.86	0.002
15. Education of residents, general public and tourists	**4.80**	0.67	4.64	0.71	4.70	0.69	4.57	0.03
14. Provide water points in the mountains for baboons to drink in dry months	**4.30**	1.07	4.04	1.22	4.14	1.17	4.79	0.03
3. Baboon monitors/chasers to keep baboons away from residential areas-with loud noises such as bear bangers	3.1	1.61	3.32	1.55	3.23	1.57	1.89	0.17
5. Treat injured baboons	4.61	1.00	4.43	0.92	4.50	0.95	3.25	0.07
12. Translocate **dispersing males** to troops with a shortage of males	4.06	1.31	4.21	1.23	4.15	1.26	1.29	0.25
11. Feeding stations in mountains to keep baboons away from residential areas	4.06	1.31	4.21	1.23	4.15	1.26	1.29	0.26
10. Electric fences around residential areas	2.62	1.65	2.91	1.68	2.80	1.67	2.73	0.10
16. Law enforcement for feeding baboons	4.81	0.89	4.70	0.92	4.74	0.91	1.33	0.25

Table 6.5 Comparison between cluster group 1 (GP1) and group 2 (GP2) for the different mitigations measures that can be used by residents to manage impacts from baboons on their property. For GP1 sample size was 104 and for GP2, 225. Percentages (%) and frequencies (Freq.) are the proportion and number of respondents who implement the mitigation measure. Significant differences are highlighted.

Mitigation Measures used by residents on property	**GP 1 (n=104)**		**GP 2 (n=225)**		**All**	**Chi^2**	**P value**
	%	**Freq.**	**%**	**Freq.**	**%**		
Chase baboons off my property aggressively by shouting or running at them but without using any additional aids	32.7	34	**53.3**	120	47.2	12.38	<0.001
Keep windows and doors closed even when the baboons are not around	34.6	36	**52.4**	118	49.2	9.2	0.002
Chase baboons off my property with water/hosepipe	41.4	43	**58.2**	131	52.3	8.15	0.004
I usually don't chase them	**33.7**	35	20.0	45	23.6	6.96	0.008
Chase baboons off my property with a paint ball gun	3.9	4	**12.4**	28	10.3	6.95	0.008
Keep food out of sight	41.35	43	**55.1**	124	50.8	5.41	0.02
Baboon proof doors (with gates or bars)	32.7	34	**44.0**	99	40.3	3.83	0.050
Baboon proof pantry	3.9	4	9.3	21	7.7	3.42	0.065
Baboon proof vegetable garden (e.g. cage, netting, e-fence)	7.7	8	14.7	33	13.8	3.42	0.064
Chase baboons off my property with a catapult	15.4	16	23.1	52	21.5	2.7	0.10
Chase baboons off my property with a pellet gun	2.9	3	7.1	16	5.4	2.63	0.10
Keep windows and doors closed only when I know the baboons are around	68.3	71	59.1	133	59.5	2.57	0.11
I call the baboon hotline to help me	11.5	12	18.2	41	16.2	2.47	0.11
I use my dogs to help me chase them	11.5	12	17.3	39	16.2	1.91	0.16
Baboon proof fruit trees (e.g. cage, netting, e-fence)	11.5	12	7.1	16	8.7	1.71	0.19
Keep food locked away at all times	16.4	17	22.2	50	20.5	1.56	0.21
I call someone to help me chase them-a family member or neighbour	18.3	19	23.6	53	21.3	1.19	0.28
Dogs warn me when baboons are around	71.2	74	76.0	171	73.6	0.87	0.35
Baboon proof rubbish bin	74.0	77	78.7	177	77.4	0.85	0.36
Chase baboons off my property calmly without shouting or using any additional aids	50	52	45.3	102	45.6	0.62	0.43
Baboon - proof windows (bars or special locks etc.)	57.7	60	59.1	133	56.9	0.06	0.80
Baboon proof compost bin	23.1	24	22.2	50	23.1	0.03	0.86
No food in garden (e.g. pet food, bird seed, fruit trees)	40.4	42	41.3	93	41.3	0.03	0.87

Table 6.6 Comparison between cluster group 1 (GP1) and group 2 (GP2) for constructs in the Structural Equation Model of the Wildlife Tolerance Model. F values are for Analysis of Variance results. NME= negative meaningful event, PME= positive meaningful event. Values have been standardized using z scores (see methods).

	GP1		GP2		F	P value
	Mean (n=136)	Stdev	Mean (n=209)	Stdev		
Exposure	0.25	1.0	-0.16	0.97	14.21	<0.001
PME	0.29	1.05	-0.19	0.93	19.32	<0.001
NME	-0.21	0.84	0.14	1.07	10.42	0.0014
Cost Tangible	-0.23	0.88	0.15	1.05	11.80	<0.001
Cost Intangible	-0.43	0.85	0.28	1.0	46.32	<0.001
Benefit Intangible	0.55	0.93	-0.36	0.88	84.87	<0.001
Tolerance	0.55	1.01	-0.36	0.82	84.53	<0.001

Table 6.7 Comparison between cluster group 1 (GP1) and group 2 (GP2) for the non-standardized items that formed the constructs in the Structural Equation Model (SEM) of the Wildlife Tolerance Model (WTM) (Chap 4). NME= negative meaningful event, PME= positive meaningful event, CT=cost tangible, CI=cost intangible, BI=benefit intangible. F values are for Analysis of Variance results. Significant differences are highlighted.

	Mean GP1	Std dev	Mean GP2	Std dev	Mean All	Std dev	F	P value
Exposure								
Visit_neigh_sum	2.91	1.58	2.51	1.48	2.67	1.53	6.55	0.01
Visit_neigh_win	3.59	1.78	3.38	1.48	3.46	1.61	1.65	0.20
Visit_property_sum	4.0	1.82	3.09	1.68	3.44	1.79	25.35	<0.001
Visit_property_win	4.53	1.86	3.97	1.66	4.18	1.76	9.56	<0.001
Enter_house_sum	1.47	2.3	2.25	3.40	1.95	3.05	5.96	0.02
Positive Meaningful Event	3.12	2.9	1.78	2.62	2.29	2.81	22.38	<0.001
Negative Meanigful Event	1.01	1.64	1.75	2.11	1.47	1.98	13.38	<0.001
Cost Tangible								
Tot_yes_no_mit_meas	6.88	3.57	8.17	3.92	7.67	3.84	10.86	0.001
Damage_sum	483.74	1600	1014	2776	812.7	2409	4.25	0.04
Damage_win	226.1	1099.4	396.2	1547	330.7	1411.2	1.27	0.26
Extent_damage	1.89	0.81	2.14	0.79	2.05	0.80	9.07	0.003
Cost Intangible								
Avg_neg_emotion	0.50	0.76	1.04	1.11	0.83	1.03	28.31	<0.001
Stress_babs	2.13	1.69	3.47	2.03	2.96	2.02	46.55	<0.001
Nuisan_babs	2.45	1.84	3.75	2.05	3.26	2.07	41.31	<0.001
Danger_humans	2.29	1.1	2.82	1.12	2.62	1.14	21.60	<0.001
Afraid_you	1.72	0.94	2.31	1.26	2.09	1.18	24.98	<0.001
Afraid_you_house	2.52	1.27	3.09	1.35	2.87	1.35	16.78	<0.001
Afraid_other_house	2.97	1.34	3.57	1.31	3.35	1.35	18.13	<0.001
Cost_bab_avg	2.65	1.46	3.92	1.66	3.43	1.70	59.10	<0.001
Benefit Intangible								
Avg_pos_emotion	3.16	1.48	1.57	1.31	2.18	1.58	126.53	<0.001
Enjoy	5.58	1.68	3.85	1.92	4.51	2.01	82.53	<0.001
Benefit_you	3.83	1.28	2.70	1.37	3.14	1.45	65.33	<0.001
Benefit_community	3.54	1.34	2.60	1.33	2.96	1.41	45.18	<0.001
Benefit_mankind	4.08	1.19	3.21	1.31	3.55	1.33	42.76	<0.001
Benefit_nature	4.41	1.05	3.97	1.13	4.14	1.12	13.48	<0.001
Tolerance								
Tol_neigh	156.78	156.78	54.34	103.26	93.87	135.9	58.00	<0.001
Tol_prop	107.43	143.33	31.01	70.88	59.28	109.96	47.20	<0.001
Pop_area	3.25	1.09	2.77	1.35	2.95	1.28	13.84	<0.001
Pop_CT	3.49	1.03	3.11	1.39	3.26	1.28	8.04	0.005
Pop_africa	4.03	1.00	3.83	1.24	3.91	1.16	2.82	0.09
Tol_Kill_Indx_first_uns_COM	5.32	1.78	4.11	1.77	4.58	1.87	42.77	<0.001
Tol_Kill_Indx_first_uns_RAR	5.81	1.59	4.70	1.78	5.13	1.79	39.11	<0.001

Table 6.8. Comparison between GP1 and GP2 for the constructs in the Structural Equation Model (SEM) of the Wildlife Tolerance Model (WTM) (Chap 4) when controlling for antecedent constructs using analysis of co-variance. EXPO=exposure, NME= negative meaningful event, PME=positive meaningful event, CT=cost tangible, CI=cost intangible, BI=benefit intangible, TOL=tolerance. F values are for Analysis of Variance results. Significant differences are highlighted.

	Constructs controlled	**Mean GP1 n=136**	**Std dev**	**Mean GP2 n=209**	**Std dev**	**F**	**P value**
CT	EXPO, PME, NME	-0.226	0.87	0.147	1.05	0.58	0.44
CI	EXPO, PME, NME	-0.427	0.84	0.27	0.99	15.32	<0.001
BI	EXPO, PME, NME	0.552	0.93	-0.359	0.88	45.32	<0.001
TOL	EXPO, PME, NME	0.247	1.00	-0.161	0.97	45.95	<0.001
TOL	EXPO, PME, NME, CT, CI, BI	0.551	1.00	-0.358	0.817	13.35	<0.001

4. Discussion

Support was found for the hypothesis that individuals prioritizing *self transcendence* value priorities, *mutualistic* WVO, high trait *empathy* (people and baboons), *anthropomorphism* and salience of *interest in animals* in general and wildlife in particular, perceive more benefits, less costs and are therefore more tolerant to living with baboons than individuals with lower scores on these dimensions. The differences in tolerance persisted after controlling for OM variables suggesting that individual psychological factors more strongly explain differences in tolerance to baboons in these two groups. Further, the results highlight the need to control for OM variables when comparing tolerance between groups. When OM variables are not controlled, they may hide identification of the most important drivers of tolerance. For example, if differences in tolerance between the two groups disappeared after controlling for

exposure and *meaningful events*, we would conclude that these two OM variables account for the differences in tolerance and therefore reducing *exposure* and *meaningful events* for GP2 to levels of GP1 would equalize tolerance between the two groups.

Residents in the five suburbs surveyed could be divided into two subgroups of unequal size, a smaller group (GP1) consisting of 38% of respondents and a larger group (GP2) consisting of 62% of respondents. GP1 have higher salience for animals, wildlife and baboons meaning that animals may be more closely linked to their identity than GP2 individuals. We hypothesize that this interest results in high empathy towards baboons and therefore high interest and concern for the wellbeing of individual baboons resulting in high anthropomorphism and mutualistic WVO. This interest and extension of care to an out-group (animals, baboons) may derive from *self transcendence* value priorities. When identities are strongly linked to values, beliefs and attitudes towards an object, the attitudes are said to have high centrality and horizontal structure if they are associated with a large number of beliefs, strong affect towards the object and tied to many values (Heberlein 2012). If this is the case with GP1 they may be less able or willing to change their beliefs around baboons and baboon management. On the other hand, if GP2 members identify themselves as "non animal persons" they too may not be amenable to changing their beliefs around baboons and baboon management. Research exploring the link between identity of stakeholder groups and the extent of the centrality and horizontal structure of their attitudes will be an interesting future research direction as it would inform choice of intervention approaches (Heberlein 2012; Madden & McQuinn 2014). At any rate, the association of these IM variables with tolerance and the antecedent variables in the WTM mean that attitudes and tolerance are unlikely to shift using persuasive techniques such as education (Heberlein 2012).

One aspect that was beyond the scope of the study was the attitudes and tolerance of conservation managers. It is predicted that the conservation authorities managing baboons on the Cape Peninsula have utilitarian WVO as seen from the application of lethal and pain aversion baboon management interventions in the last two years (www.hwsolutions.org). Therefore they would be more similar to GP2 respondents than GP1. They may even have stronger utilitarian values than GP2 based on the

overall low support for lethal and aversive management interventions even by GP2. These differences are predicted to create conflict in baboon management on the Cape Peninsula. The high frequency and number of articles regularly printed in the local press about baboon management issues and the number of petitions and demonstrations are testimony to this conflict. Further, respondents from both groups showed low familiarity and opinions of the organizations involved in baboon management on the Cape Peninsula. The highest familiarity and support was for Baboon Matters, an independent non-government organization publically opposed to lethal and aversive methods (www.baboonmatters.org.za). Urban residents elsewhere are reported as having high mutualistic WVO (Teel & Manfredo 2005; Sijtsma et al. 2011) and wildlife managers may also show more support for lethal control than the general public (Koval & Mertig 2004) although wildlife managers are not always a cohesive group (Sanborn & Schmidt 1995; Muth et al. 2006). GP1 respondents may be more aligned with animal rights activists and environmentalist who are also more likely to be female (Herzog 2007; Xiao & McCright 2013) and score higher on trait empathy towards people, animals and the environment (Angantyr et al. 2011; Apostol et al. 2013).

4.1 Management implications

Species management has been the traditional focus of wildlife management professionals (Messemer 2009) however the incorporation of human dimensions into management decisions is being increasingly acknowledged as important (Manfredo 2008; Decker et al. 2012). This means wildlife management must be a tradeoff between stakeholder and wildlife needs and will require balancing sustainable wildlife populations, consideration for animal welfare and tolerance of stakeholders and between stakeholders, for the costs and benefits of living with wildlife. To date species management has been the primary focus of baboon management on the Cape Peninsula with little focus on the human dimensions. How could stakeholder tolerance be combined with species management?

The SEM results comparing GP1 and GP2 indicate that the drivers of tolerance as outlined in the OM of the WTM are similar for both groups, i.e. *exposure* and *meaningful events* drive perceptions of costs and benefits and ultimately tolerance

(Appendix XI). Therefore reducing exposure should increase tolerance for both groups. However the ANCOVA results comparing the WTM OM variables between GP1 and GP2 indicated that GP1 was more tolerant than GP2 even after controlling for *exposure*, *meaningful events*, costs and benefits. Therefore for any decrease in exposure, GP1 should increase in tolerance to a greater extent relative to GP2. What this ratio is would need to be tested experimentally. If this were a linear relationship, since GP1 was willing to have baboons in their neighborhood and property approximately 3 times more often that GP2 (Table 6.7), we could speculate that GP2 would require a 3 times reduction in exposure to reach the same tolerance levels of GP1. Since it would not be possible to target a reduction in exposure for a particular group, it may be possible to target other proximate variables, such as *intangible costs* or benefits specifically targeting GP2 individuals (see Chap. 5).

Our analyses were not sufficiently sensitive to differentiate between the relative contributions of each IM variable to explaining the differences between the two groups. This would require experimental studies that would also examine interactions between IM variables. When these are identified, it may be possible to target some IM variables with specific interventions. Changing *values* is unlikely, particularly for older residents since these develop early in life and tend to be stable throughout adult life (Bardi et al. 2009; Heberlein 2012). However for younger residents this may be possible through ongoing education programs initiated at a young age (Heberlein 2012). For adults creating incentives for behavior change through incentives that complement values important to individuals or a community, rather than trying to change their values would a more productive approach (Heberlein 2012; Hazzah et al. 2014).

Little is known of the drivers of individual interest in animals or wildlife or the stability of this interest over time. The biophillia hypothesis (Wilson 1984) proposes that all humans possess an innate tendency to seek connections with nature and other forms of life. Other evidence suggests variation in interest in animals is based on a genetic pre disposition (Lykken et al. 1993). Social and individual parameters such as pet ownership, gender, personality, social connection, social competence and early exposure during childhood may also be important factors (Daly & Morton 2009; Wedel & Kotrschal 2011; Apostol et al. 2013) but more research is required in this

field, particularly in relation to wildlife.

Whilst debate exists within the literature as to whether *empathy* is a learned ability (i.e., distinct from personality factors), a relatively stable personality trait (e.g., Daly and Morton 2003) or a combination of these (i.e., a personality trait mutable by experience, e.g., Preston and de Waal 2002), programs to increase empathy towards animals and people are being implemented in schools as part of humane education programs (Ascione 1992; Ascione & Weber 1996; Hergovitch et al. 2002). These aim to instill ethical behavior by teaching human rights, animal protection, environmental stewardship, and cultural issues as interconnected and integral dimensions of a just, healthy society (e.g. www.humaneducation.org; www.rootsofempathy.org). We surmise it would be necessary to design programs more specifically for the HWC context. When combined with early childhood programs this may increase interest in wildlife as well.

Anthropomorphism is both a transient mental state, varying across situations (Waytz et al. 2010b; Eyssel et al. 2011) but individual differences are also stable over time (Waytz et al. 2010b). Anthropomorphism also varies across cultures (Asquith 1986; Waxman & Medin 2007). Since perceived similarity increases anthropomorphism, it may be possible to implement programs to emphasize similarities between people and animals when the need to increase tolerance for a species is required and emphasize dissimilarities for situations requiring population reductions. Increasing empathy and mind perception between different stakeholder groups for each other could usefully reduce conflict and enable stakeholders to work together to formulate management plans and strategies that are acceptable to all groups. This could be achieved through mediation and social learning processes (e.g. Conflict transformation: Madden & McQuinn 2014; Theory U: www.presencing.com/theory; Non Violent Communication: www.cnvc.org).

4.2 Managing exposure

The WTM indicates that managing exposure of residents to baboons is important. However managing exposure of wildlife to people may be equally important as human modified landscapes can act as population sinks (Beckman & Lackey 2008;

van de Meer et al. 2014) and was the case for certain troops on the Cape Peninsula prior to implementation of non lethal management interventions (Kansky & Gaynor 2000). On the Cape Peninsula injury and mortality results from direct impact of residents on baboons as well as indirectly through human modification of the landscape (electrocution on electricity pylons, road accidents and dogs). This means that "too much" tolerance may have negative impacts for baboons. A question is then how much exposure is optimal for both baboons and people. For this reason an adaptive management approach is required (Enck et al. 2006; Grantham et al. 2010; Westgate et al. 2013; Fabricius & Cundill 2014) where interventions are monitored and evaluated for their impact on both baboons and people over time. Optimal solutions are likely to change over time depending on the changing context. Baboon movements and responses change as human activities, structures and minds change thus creating a complex and unstable social-ecological system (Game et al. 2014). Involving stakeholders in the adaptive management process would be important in order to improve transparency and trust in the institutions involved and could be an integral component of a social learning process.

4.3 Mitigation measures

Optimal foraging theory (OFT) predicts that foraging patterns can be understood as tradeoffs between strategies to maximize energy intake while minimizing energy expenditure (MacArthur & Pianka 1966; Baruch-Mordo et al. 2013). Animals foraging in human dominated landscapes are no exception and may be attracted to foraging in urban areas due to a scarcity of natural forage (Baruch-Mordo et al. 2014) but also because energetic intake is more profitable. For example the amount of calories obtained from a loaf of bread may be equivalent to half a days foraging for a baboon in natural vegetation (Kansky & Gaynor 2000). Therefore each case study will need to be evaluated individually because the suit of management interventions applied must be informed by relative costs and benefits of foraging in landscapes (Baruch-Mordo et al. 2013). For example if the natural carrying capacity of an area is insufficient for the species concerned, preventing impacts on humans may be exceptionally difficult and would require high levels of tolerance from stakeholders who would need to be willing to "subsidize" these wildlife species. Baboons on the Cape Peninsula are under their natural carrying capacity as a population (Kansky &

Gaynor 2000; Hoffman 2011). Therefore in order to encourage baboons to forage outside the urban area a management objective is to increase the costs of foraging in residential areas through the Baboon Monitoring Program that employs men to follow baboons daily and chase them away from residential areas before they enter the suburbs (Kansky & Gaynor 2000; www.hwssolutions.org). An additional strategy to reduce the rewards of foraging in residential areas is to make residential properties energetically un-rewarding by preventing access to food (Kansky 2002), but this relies on residents' willingness to implement these strategies. GP1 may not feel the need to implement mitigation measures because of their high tolerance although they are more likely to feel personally responsible to prevent damage than respondents from GP2. GP2 found implementing mitigation measures more difficult and less effective than GP1. Since most residents in our sample are relatively well off financially, and therefore finances are not likely to be a limiting factor in implementing mitigation measures, structural incentives (Heberlein 2012) may be required to induce behavior change. This could take the form of municipal by-laws or rates rebates to maintain baboon proof rubbish and compost bins or build baboon proof pantries inside the home. Innovative solutions to baboon proof properties and subsidies to implement these may also be effective (e.g. subsidized predator fencing: Karlsson & Sjöström 2011).

4.4 Limitations of study

This study has some limitations that should be noted. Firstly, while the constructs reliability and validity were sufficient for the exploratory nature of this study, some of these measures were low, despite their wide use cross culturally (People empathy, Belief in Animal Mind). The reason for this may have been due to the long length of the survey. Some constructs from the WTM OM that showed sufficient validity and reliability in Chapter 4 performed less well with the smaller sample sizes when split into the subgroups. Secondly, the large number of group comparisons increased the probability of Type I statistical errors. Although most of the differences were highly significant, at levels of less than 0.001 and showed consistency according to theory, these results should be see as trends and interpreted within the exploratory nature of this study. Future studies using the WTM should therefore aim to be narrower in

scope with a reduced survey length. This will allow testing of more specific hypotheses of the WTM.

Chapter 7

Summary and Conclusions

1. Summary

The primary aim of this project was to develop a theoretical model of important drivers of tolerance by stakeholders living in proximity to damage causing medium and large mammalian wildlife. This was deemed necessary because although in recent years there has been an increase in the study of tolerance and models that predict important drivers, these have not been a result of quantitative syntheses of past research. Further, there is a lack of a widely accepted and used model of tolerance to damage causing mammalian wildlife such as those that exist in other environmental disciplines, for example management of common pool resources (Ostrom 2009) and pro environmental behavior (Klockner 2013). This prevents identification of key drivers of tolerance and the extent they can be applied at broader spatial scales. Landscape approaches are increasingly being recognized as most cost effective in conservation policy due to the rapid rate of biodiversity decline and global environmental change.

The science of conservation biology is often criticized for a lack of a theory driven approach to conservation (With 1997; Fazey et al. 2005). The crisis nature of conservation is often the reason as synthesis and theory development and testing can be time consuming. HWC is a particularly crisis management discipline as stakeholders often demand immediate action and when this does not happen conflict results.

Use of theory may however be more cost effective in the long term as the failure to synthesize and evaluate past research and generate new theory can lead to activities and policies that have little or no impact (Driscoll &Lindenmayer 2012). This is because researchers may fail to identify relevant factors or recognize complexity. This was a key finding from the meta-analyses in chapters two and three. These analyses showed that contrary to conventional wisdom in HWC mitigation strategies, the tangible damage that stakeholders undergo is not always the primary driver of

attitudes. Further, experiencing damage was complex as it interacted with different stakeholder groups and species groups in complex patterns. For example, the tolerance to damage index from Chapter two showed that human tolerance of ungulates and primates was proportional to the probability of experiencing damage while elephants elicited tolerance levels higher than anticipated and carnivores elicited tolerance levels lower than anticipated. In relation to stakeholder group, communal farmers had a lower probability of being positive toward carnivores irrespective of probability of experiencing damage, while commercial farmers and urban residents were more likely to be positive toward carnivores irrespective of damage. Urban residents were more likely to be positive toward ungulates, elephants, and primates when the probability of damage was low, but not when it was high. Commercial and communal farmers had a higher probability of being positive toward ungulates, primates, and elephants irrespective of probability of experiencing damage.

The second review in Chapter three aimed to determine if common patterns of variables explaining tolerance are present across a wide range of species, stakeholders and contexts. Results showed that the majority of publications measured variables with a low likelihood of explaining drivers of attitudes or did not quantify variables of generally high utility. For example, only four categories (25%) were applied in over 50% of publications, and two thirds were mostly not significant in explaining attitudes. Again, *tangible costs* and *tangible benefits* thought to be the main drivers of attitudes to damage causing wildlife in general, were respectively, two and three times more non-significant than significant in explaining attitudes. *Intangible costs* were the most important category to explain attitudes but was under represented in publications. *Intangible benefits* were mostly not important in explaining attitudes. *Costs* were more significant than *benefits* suggesting negative perceptions more strongly determine attitudes. Socio-demographic variables commonly used in published studies such as gender, education and wealth, poorly explained attitudes.

These quantitative meta-analyses further highlighted the complexity of HWC, a fact that is increasingly being emphasized in qualitative reviews and models of tolerance that have emerged during the four years duration of this project. But how can this complexity be incorporated into tangible products to manage HWC? Recognition of

this complexity coupled with the need for quantitative surveys as an essential management tool for conservation managers was the aim of the Wildlife Tolerance Model (WTM) proposed in Chapter four. Quantitative randomized surveys are essential to objectively determine the extent of HWC and the tolerance of communities living in close proximity to damage causing wildlife. This is necessary because inequalities may exist within or between communities or stakeholder groups that can result in powerful individuals or those with extreme views more likely to be heard. This increases the probability that species are managed based on non-representative views. Obtaining objective evaluations of the conflict is particularly important where institutions or specialized interest groups are unrepresentative of stakeholders. A second aim of the WTM was to look more broadly across disciplines and search for additional constructs and theories that would be relevant for addressing the complexity inherent in HWC. These were found in Social Ecological Systems (SES) theory, pro-environmental behavior, social psychology, human-animal relation studies and economic psychology. A further aim of the WTM was for surveys to be comparable across species and sites to enable accumulation of relevant knowledge allowing adaptive management of intervention strategies to manage HWC's across landscapes.

The WTM proposes that the net outcome of the extent to which a person is exposed to a species as well as the types of meaningful events (positive or negative) determine perceptions of the costs relative to benefits of living with a species. This in turn determines tolerance. This is the *outer model* of the WTM. A second component predicts 11 *inner model* variables that may further drive perceptions of costs and benefits.

In order to test the WTM urban baboon-human conflict on the Cape Peninsula of South Africa was used as a case study. Baboons are one of the most common primate species involved in human-wildlife conflicts in Africa but few studies have examined the attitudes and tolerance of people towards them. The *outer model* was first tested using Partial Least Squares Structural Equation Modeling (PLS-SEM) and results reported in Chapter four. *Inner model* variables were tested using cluster analysis and results reported in Chapter five. Four hundred and three residents living in five urban areas adjacent to the Table Mountain National Park and the Cape Peninsula Protected

Natural Environment were surveyed. Support for the *outer model* was found. Overall 60% of tolerance was explained by perceptions of costs and benefits. While both *intangible costs* and *intangible benefits* equally contributed to driving tolerance, tangible costs had no significant effect on tolerance. *Exposure* and *Meaningful events* explained 30% of variance in costs and benefits but *exposure* drove costs more than benefits. *Exposure* explained 10% of variance in *negative meaningful events* but did not explain any variance in *positive meaningful events*. To examine the role of *inner model* variables of the WTM a cluster analysis was performed with five *inner model* variables in order to define sub groups, if any in our sample (Schwartz Values, Wildlife Value Orientations, Interest in animals, empathy and anthropomorphism). Two subgroups emerged that differed significantly in all five *inner model* variables. We then tested for differences in the two groups for the *outer model* variables of the WTM as well as other variables such as support for different management measures that conservation authorities may implement to reduce impacts of baboons and mitigation measures that residents may use. Group1 (GP1) was significantly more tolerant than Group 2 (GP2) and this difference persisted after controlling for *outer model* variables except for *tangible costs*, which could be explained by differences in *exposure* and *meaningful events*. Therefore in this case study, *inner model* variables were more important in explaining differences between the two groups than the *outer model* variables. A PLS-SEM was then performed for each group with *outer model* variables but no significant differences were found between the two groups meaning for each group *outer model* variables are equally important in explaining tolerance. It was concluded that for the less tolerant GP2 *outer model* variables would need to be increased to a greater extent to reach the tolerance levels of GP1, i.e. it was not a matter of just ensuring that GP2 had *exposure* levels similar to those of GP1 –which were 1.3 times less than GP2, because GP2's tolerance was three times lower than GP1. Therefore it was predicted that GP2 would require a three times decrease of *exposure* to reach the tolerance levels of GP1.

This case study further highlighted the complexity of HWC. A question that emerged was why was GP1 less exposed to baboons. Was this only a perception or were they objectively less exposed. Results showed that there was no difference in the presence of GP1 or GP2 members in the villages so the differential exposure of baboons in

these suburbs could not have been a factor. Another interesting question is if GP1 were actually less exposed to baboons, would they still be as tolerant if they were more exposed to baboons? Further research is therefore needed to determine if these patterns are repeated in other contexts.

Some disadvantages and limitations emerged from the approach used to test the WTM with the baboon case study. An attempt was made to incorporate as many variables as possible from the WTM so as to evaluate the role of as many as possible. This proved effective as the importance of both components of the model, the *outer model* and the *inner model* variables was demonstrated. It was therefore possible to see the "bigger picture" view of the utility of the model. The disadvantage of this method was that the survey was lengthy, meaning that the quality of the data may have been impacted due to respondent fatigue. Secondly, it meant exposing the data to errors inherent in multiple testing resulting in increased probabilities of type I errors and reduced reliability and viability of some constructs. Future research can now focus on examining the more intricate aspects of the model and testing more specific hypotheses, particularly on the interrelationships between the *inner model* variables and between specific *inner model* variables and their impact on *outer model* variables. Some of these hypotheses are outlined in Appendix VI.

2. Conclusions

To broaden and deepen support for conservation in society it will be important to understand what aspects of biodiversity people value and to reflect these values in conservation policies and actions (Enck et al. 2006; Booth et al. 2011). As the number and rate of global mammal decline increases (Di Marco et al. 2014), understanding human- animal relationships is an urgent research priority. Focus on studies of people living in close proximity to wildlife is required because these are the people that will ensure their future. There is an urgent need to integrate knowledge from a variety of disciplines to address the complex nature of social-ecological systems in conservation (Game et al. 2014). The WTM is a useful starting point to address this complexity systematically. There is also a need to understand human tolerance to wildlife in the absence of conflict because these stakeholder groups are predominantly the drivers of

policies and who allocate and control funding. It is then necessary to understand how tolerance by this group transfers to people living in direct contact with wildlife in order to align strategies and policies for mammal conservation. The WTM could provide the theoretical framework for such comparisons as it controls for the extent of experience with wildlife. Additional case studies are now needed in order to assess the versatility of this model for different species and cultures.

In conclusion,

- Understanding and addressing taxonomic bias is important for designing strategies and policies that can be applied at landscape scales. It is also important to understand differences in taxonomic bias between different stakeholder groups, particularly between those that design policies but do not live with wildlife and stakeholders that live with wildlife but have little impact on policy.
- Separation of tangible and intangible costs and benefits is useful as this allows differentiation between explicit and implicit impacts of wildlife that invariably require different types of mitigation interventions. Explicit costs and benefits require technological solutions while implicit costs and benefits require structural incentives.
- Identification of appropriate stakeholder groups is critical in order to target interventions at the appropriate level. Some stakeholder groups are more obvious such as urban residents, commercial farmers or community farmers. However stakeholder groups can also be "hidden" in the heterogeneity of what appears to be a unified sample such as we found in our case study.
- Although time consuming and costly, synthesis of research and theory development is critical to develop long-term efficiency in conservation management. Current funding directions in conservation largely focus on practical on the ground implementation but this project highlights the potential utility of a more theoretical approach.
- Since HWC is an emerging research field (Cronin et al. 2014) the WTM could be a useful theoretical framework on which to base future research. When applied across species and landscapes knowledge will accumulate that will

allow identification of patterns of tolerance that will inform policies and strategies to manage HWC across lndscapes.

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APPENDIX I

Search terms used in meta-analyses for chapters 2 and 3.

We searched Web of Science for the terms: human-wildlife conflict* OR human wildlife conflict* OR wildlife conflict* OR felid-human conflict* OR felid human conflict* OR carnivore-human conflict* OR carnivore human conflict* OR elephant-human conflict* OR elephant human conflict* OR primate-human conflict* OR primate human conflict* OR ungulate-human conflict* OR ungulate human conflict* OR livestock predation OR livestock depredation OR crop raiding OR crop damage* OR agricultural damage*. We refined the results using the terms: tolerance* OR perception* OR attitude*. Literature on irrelevant topics were filtered out. We identified species in these publications and used this species list to conduct more specific searches. These were: baboon*, bear*, cougar*, coyote*, deer*, elephant*, elk*, lynx*, monkey*,mountain lion*, panthera*, puma*, tiger*, vulpes* and wolf*. The resulting publications were further refined using the terms: tolerance* OR perception* OR attitude*. Since very few primate references emerged we further searched two of the main primate journals: International Journal of Primatology and American Journal of Primatology using the search items: attitude* OR perception* OR tolerance* AND crop damage OR raiding.

APPENDIX II

Summary of classification tree methodology (CART)

In the case of classification trees the dependent (response) variable y is a discrete variable consisting of two or more classes (e.g., yes/no, present/not present, low/medium/high). For continuous response variables, a similar technique called regression trees can could be used.

The concept of Entropy

The concept of entropy (chaos) is used as a basis for constructing classification trees. To explain entropy in the framework of classification trees, consider a response variable with two classes, 'yes' and 'no'. If a data set comprises 50% yes and 50% no responses, then the entropy of that data set is a maximum because the data will have only a 50% chance of correctly predicting the response variable. Entropy increases as the proportion of one response variable tends towards zero percent, and it reaches a minimum when a data set consists of 100% of one class. In this case the data will have a 100% chance of correctly predicting the class of the response variable.

Entropy can be calculated from a dataset using various methods of which the Gini measure is probably the most common in classification trees.

The aim of a classification tree is to divide the data set into subsets such that the subsets have an entropy lower than the whole data set. Thus it strives to group classes together into subsets as best as possible based on the independent or predictor variables. This is achieved as follows:

Case 1: One continuous independent variable(x)

The method selects a point x_p between the minimum and maximum of x that splits the data into two sets (or nodes in a tree). All the cases for which $x \leq x_p$ goes to the left node and all the cases where $x > x_p$ goes to the right node.

The point where the split is made is the point that decreases the entropy from the parent node to the child nodes the most.

The procedure above is then repeated for each of the two nodes. Thus a binary split is made on each node using the criteria mentioned above.

Stopping rules are used to decide when the splitting process should stop. For example a minimum number of cases per node can be specified, and if that minimum number is reached, the node will split no further.

Case 2: One categorical independent variable

In the case of a categorical independent variable, all combinations of binary splits of the levels of the variable are considered and the combination that most successfully decreases the entropy are used as splitting criteria. For example if a variable has three levels namely *a*,*b* and *c* then the following combinations of splits will be considered:

Left node	Right node
a	*b*,*c*
a,*b*	*c*
a,*c*	*b*

Case 3: More than one independent variable (combination of continuous and discrete)

The procedure described above is applied to each variable independently. Then the variables are compared with one another and the one that provides the best split over all the variables is used as the splitting variable.

Variable importance

A variable importance factor in terms of its effect on the response variable can be derived once the tree has been built. This variable importance is calculated based on the number of times the variable was used as splitting variable and how well it separated the classes of the response variable. During the tree building process, the CART procedure keeps track of which variables were used for splitting nodes, and from this information an importance score is allocated to each predictor variable. These scores are all relative to the variable that was found to be involved in

most of the splits. This most important variable is allocated a score of 1. All the other variables then get scores (<1) relative to the most important one.

Cost sequence plots

Cost sequence plots represent a graph of the miss-classification cost of each tree generated in the tree building process. The two lines on the graph represent re-substitution cost (based on the same data used for generating the tree), and cross-validation cost. The cross-validation cost graph is used as guideline for determining the optimal tree to be reported.

Literature Cited

Breiman, L, J.H. Friedman, R.A. Olshen and C.J.Stone. 1993. Classification and regression trees, Chapman & Hall, New York.

APPENDIX III

Publications included in the meta-analysis of Chapter 2

The 54 publications identified and included in the meta-analysis of human attitudes to damage-causing wildlife, including IUCN Red list category and status, country, location and types of stakeholders where survey was undertaken, as reported in each publication. Wildlife assessed included carnivores, elephants, primates and ungulates. IUCN Red List Categories: LC=least concern, V=vulnerable, NT=near threatened, E=endangered, CR=critically endangered. IUCN Red list Population Status: S=stable, D=decreasing, I=increasing, UNK=unknown.

Species (Common name)	**Species (Latin name)**	**IUCN Red List Category**	**IUCN Red List Status**	**Country**	**Context**	**Publication**
Carnivores						
Brown bear, Grizzly bear,	*Ursus arctos*	LC	S	China	Sichuan Province	Liu et al. 2011
Asiatic black bear, Himalayan black bear	*Ursus thibetanus*	V	D	Norway	All provinces including areas with and without carnivores (but since 41% of those not in carnivore areas believed they had carnivores in their area we included this study)	Røskaft et al. 2007
				Turkey	Atvin province, residents in human-bear conflict hotspot	Ambarl and Bilgin 2008
American black bear	*Ursus americanus*	LC		USA	Wyoming, farmers in Cachea and Rich counties	McIvore and Conover 1994
				USA	Colorado, Urban residents in Roaring Fork Valley	Don Carlos et al. 2009

Caracal	*Caracal caracal*	LC	UNK	Namibia	North central Namibia	Schumann et al. 2008
Cheetah	*Acinonyx jubatus*	V	D	Kenya	Amboseli group ranches	Goldman et al. 2010
				Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al. 2006
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al. 2005
				Namibia	Waterburg area	Marker et at 2003
				Kenya	Central Kenya	Romanach et al. 2007
				Namibia	North central Namibia	Schumann et al. 2008
				Botswana	Ganzi District	Selebatso et al. 2008
Coyote	*Canis latrans*	LC	I	USA	Wyoming, farmers in Cachea and Rich counties	McIvore and Conover 1994
Hyena spotted Brown hyena Striped hyena	*Crocuta crocuta*, *Hyaena brunnea*, *Hyaena hyaena*	LC, NT, NT	D, D, D	Kenya	Amboseli group ranches	Goldman et al. 2010
				Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al. 2006
				Namibia	North central	Schumann et al. 2008
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al. 2005
				Kenya	Central	Romanach et al. 2007
Jackal black backed	*Canis mesomelas*	LC	S	Kenya	Amboseli group ranches	Goldman et al. 2010
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al. 2005
				Kenya	Central	Romanach et al. 2007

				Namibia	North central	Schumann et al. 2008
Jaguar	*Panthera onca*	NT	D	Brazil	Parana state, villages around Iguacu National Park	Conforti & Azevedo 2003
				Brazil	Mato Grosso state, Northern Pantanal districts of Cáceres, Poconé and Barão de Melgaço	Zimmerman et al. 2005
Leopard	*Panthera pardus*	NT	D	Kenya	Amboseli group ranches	Goldman et al. 2010
				Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al. 2006
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al. 2005
				Kenya	Central	Romanach et al. 2007
				Namibia	North central	Schumann et al. 2008
				Namibia	Waterburg Nationa Park, commercial ranches surrounding park	Stein et al. 2010
				Ethiopia	Northern Ethiopia -2 areas one with leopard and one without	Yirga et al. 2011
Leopard snow	*Panthera uncia*	EN	D	Pakistan	Machiara National Park, villages surrounding park	Dar et al. 2009
				India	Trans Himalaya region , villages in Spiti valley	Bagchi and Mishra 2006
				India	Ladak, Hemis National Park, villages surrounding park	Jackson et al. 2003
				Nepal	Manang district, Upper Marsyangdi valley of Annapurna Conservation Area	Oli et al. 1994
Lion	*Panthera leo leo*	V	D	Kenya	Amboseli group ranches	Goldman et al. 2010
				Kenya	Mbirikiri Group ranch between Tsavo National Park and Amboseli National Park	Hazzah et al. 2009

				Bostwana	Makgadagadi pans National Park, villages and cattle posts surrounding park	Hemson et al. 2009
				Tanzania	Serengeti National Park, villages surrounding park	Kaltenborn et al. 2006
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al. 2005
				Kenya	Central	Romanach et al. 2007
				Namibia	North central	Schumann et al. 2008
Lynx Canadian	*Lynx canadensi*	LC	S	Poland	Four regions	Bath et al. 2008
Bobcat	*Lynx rufus*	LC	S	USA	Central New Mexico - 3 areas where lynx are present	Harrison 1998
Eurasian lynx	*Lynx lynx*	LC	S	India	Ladak , Hemis National Park, villages surrounding park	Jackson et al. 2003
Iberian lynx	*Lynx pardinus*	CR	D	Norway	All provinces including areas with carnivores and without (but since 41% of those not in carnivore areas believed they had carnivores in their area we included this study)	Røskaft et al. 2007
Mountain lion, Puma, Cougar	*Puma concolor*	LC	D	Brazil	Parana state, villages around Iguacu National Park	Conforti and Azevedo 2003
				USA	Wyoming,farmers in Cachea and Rich counties	McIvore and Conover 1994
				USA	Montana residents in 3 regions western, central and southwest, differing in cougar density and	Riley and Decker 2000

					level of conflict	
				Canada	Alberta, rural residents in Foothill municipal district,	Thornton and Quinn 2009
Tiger	*Panthera tigris*	EN	D	india	Ghats, Kalakad–Mundanthurai Tiger Reserve, 12 villages around park	Arjunan et al. 2006
Wild dog	*Lycaon pictus*	EN	D	Zimbabwe	Nyaminyami District, Matusodona National Park, Omay Communal Land surrounding park	Davies & du Toit 2004
				South Africa	Kwazulu/Natal province, Huhluwe -iMfoloze National Park, community members and private landowners surrounding park	Gusset et al. 2008
				Zimbabwe	3 conservancies	Lindsey et al. 2005
				Kenya	Central	Romanach et al. 2007
Wolf Grey	*Canis lupus*	LC	S	USA	Wisconsin	Agarwala et al. 2010
				USA	Minnesota, rural residents	Chavez et al. 2005
				India	Ladak, Hemis National Park, villages surrounding park	Jackson et al. 2003
				Sweden	Residents living in wolf territory	Karisson & Sjostrom 2011
				USA	Wisconsin	Naughton-Treves et al. 2003
				Norway	All over Norway including areas with carnivores and without (but since 41% of those not in carnivore areas believed they had carnivores in their area we included this study)	Røskaft et al. 2007
				Canada	Manitoba Rural, Riding Mountain National Park, residents within 50km of park	Stronena et al. 2007
Wolverine	*Gulo gulo*	LC	D	Norway	All over Norway including areas with carnivores and without (but since 41% of those not in carnivore areas believed they had	Røskaft et al. 2007

					carnivores in their area we included this study)	
Elephant						
Asian elephant	*Elephas maximus*	EN	D	Sri lanka	Urban and rural citizens	Bandara & Tisdell 2003
				India	Assam, Sonitpur and Kaziranga- Karbi Anglong Elephant Reserves, residents in 8 villages surrounding park	Barua et al. 2010
African elephant	*Loxodonta Africana*	V	I	Kenya	Laikipia district	Gadd 2005
				Kenya	Amboseli group ranches	Goldman et al. 2010
				Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al. 2006
				Tanzania	Kilimanjaro National Park, Masaai vilages- Kitendi and Irkaswa surrounding park	Kitati et al. 2010
				Bangladesh	Residents from villages around 4 Protected areas	Sarker & Roskaft 2010
Primates						
Yellow baboon Olive baboon	*Papio cynocephalus, Papio Anubis*	LC LC	S S	Kenya	Amboseli group ranches	Goldman et al. 2010
Langur western purple faced	*Trachypithecus vetulus*	EN	D	Sri lanka	Colombo city, farmers in 6 villages near city	Nijman and Nekaris 2010
Macaque, long tailed/ crab eating	*Macaca fascicularis*	LC	D	Singapore	Central Catchment Nature reserve, Visitors and residents surrounding reserve	Chihmunsha et al. 2009
Bornean orangutan	*Pongo pygmaeus*	E, CR	D, D	Indonesia	Batang Serangan village, farmers	Cambell-Smith et al. 2010

Sumatran orangutan	*Pongo abelii*					
Ungulates						
Antelope				USA	Montana, farmers from 7 counties	Lacey et al. 1993
Blackbuck	*Antilope cervicapra*	NT	S	India	Solapur province	Agarwala et al. 2010
Buffalo	*Syncerus caffer*	LC	D	Kenya	Amboseli group ranches	Goldman et al. 2010
				Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al. 2006
Mule deer	*Odocoileus hemionus*	LC	S	USA	Wyoming, Cachea and Rich counties farmers	McIvore and Conover 1994
White tailed deer	*Odocoileus virginianus*	LC	S	USA	Montana, farmers	Irby et al. 1997
				USA	Montana, farmers from 7 counties	Lacey et al. 1993
				USA	South Carolina, Hilton Head Island, SeaPines Plantation	Bowker et al. 2003
				USA	Connecticut, Greenwhich residents (urban and peri-urban)	Kilpatrick et al. 2007
				USA	Connecticut, Groton	Kilpatrick and Walter 1997
				USA	Montana, farmers from 7 counties	Lacey et al. 1993
				USA	New York, Tompkins county	Stout et al. 1993
				USA	Montana, farmers	Irby et al. 1997
				USA	Virginia, farmers and homeowners	West and. Parkhurst 2002
Eland	*Tragelaphus oryx*	LC	S	Kenya	Amboseli group ranches	Goldman et al. 2010
Elk /moose	*Alces americanus*	LC	S	USA	Arizona, ranchers	Heydlauff et al. 2006
				USA	Montana, farmers	Irby et al. 1997
				USA	Montana, farmers from 7 counties	Lacey et al. 1993
				USA	Wyoming, Cachea and Rich counties, farmers	McIvore and Conover 1994
				USA	Montana, farmers from 7 counties	Lacey et al. 1993
				USA	Alaska, Anchorage, residents	Whittaker et al. 2001

Gazelle, Grant's	*Nanger granti*	LC	D	Kenya	Amboseli group ranches	Goldman et al. 2010
Giraffe	*Giraffa camelopardalis*	LC	D	Kenya	Amboseli group ranches	Goldman et al. 2010
Oryx				Kenya	Amboseli group ranches	Goldman et al. 2010
Sheep bighorn	*Ovis Canadensis*	LC	S	USA	Montana, farmers from 7 counties	Lacey et al. 1993
Sheep blue /bharal	*Pseudois nayaur*	LC	UNK	India	Ladak, Hemis National Park, villages surrounding park	Jackson et al. 2003
				Nepal	Manang district, Upper Marsyangdi valley, Annapurna Conservation Area	Oli et al. 1994
Sheep pronghorns	*Antilocapra Americana*	LC	S	USA	Montana farmers	Irby et al. 1997
Wildebeest common or blue	*Connochaetes taurinus*	LC	S	Kenya	Amboseli group ranches	Goldman et al. 2010
Zebra	*Equus quagga*	LC	S	Kenya	Amboseli group ranches	Goldman et al. 2010

APPENDIX IV

Publications included in the meta-analysis of Chapter 3

The 45 publications identified and included in the meta-analysis of human attitudes to damage-causing wildlife, including IUCN Red list category and status, country, location and types of stakeholders where survey was undertaken, as reported in each publication. Wildlife assessed included carnivores, elephants, primates and ungulates. IUCN Red List Categories: LC = least concern, V = vulnerable, NT = near threatened, E = endangered, CR = critically endangered. IUCN Red list Population Status: S = stable, D = decreasing, I = increasing, UNK = unknown.

Species (Common name)	Species (Latin name)	IUCN Red List Category	IUCN Red List Status	Country	Context	Publication
Carnivores						
Brown Bear or Grizzly Bear	*Ursus arctos*	LC	S	Slovenia	Rural, urban and hunters in North and South Slovenia	Kaczensky et al., 2004
				China	Sichuan Province	Liu et al., 2011
Asiatic Black Bear, Himalayan Black Bear	*Ursus thibetanus*	V	D	Norway	All provinces including areas with and without carnivores (but since 41% of those not in carnivore areas believed they had carnivores in their area we included this study)	Røskaft et al., 2007
				Turkey	Atvin province, residents in human-bear conflict hotspot	Ambarl and Bilgin, 2008
American Black Bear	*Ursus americanus*	LC		USA	Georgia, residents in bear areas	Agee and Miller, 2009
				USA	Colorado, Urban residents in Roaring Fork Valley	Don Carlos et al., 2009
				USA	Adrionik National Park, New York, residents adjacent to park	Kretzer et al., 2009

				USA	New York State residents	Siemer et al., 2009
Caracal	*Caracal caracal*	LC	UNK	Namibia	North central Namibia	Schumann et al., 2008
Cheetah	*Acinonyx jubatus*	V	D	Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al., 2006
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al., 2005
				Namibia	Waterburg area	Marker et al., 2003
				Kenya	Central Kenya	Romanach et al., 2007
				Namibia	North central Namibia	Schumann et al., 2008
				Botswana	Ganzi District	Selebatso et al., 2008
Hyaena Spotted Hyaena Brown Hyaena Striped	*Crocuta crocuta*, *Hyaena brunnea*, *Hyaena hyaena*	LC, NT, NT	D, D, D	Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al., 2006
				Namibia	North central	Schumann et al., 2008
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al., 2005
				Kenya	Central	Romanach et al., 2007
Jackal Black Backed	*Canis mesomelas*	LC	S	South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al., 2005
				Kenya	Central	Romanach et al., 2007
				Namibia	North central	Schumann et al., 2008
Jaguar	*Panthera onca*	NT	D	Brazil	Parana state, villages around Iguacu National Park	Conforti and Azevedo, 2003
				Brazil	Mato Grosso state, Northern Pantanal districts of Cáceres, Poconé and Barão de Melgaço	Zimmerman et al., 2005

Leopard	*Panthera pardus*	NT	D	Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al., 2006
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al., 2005
				Kenya	Central	Romanach et al., 2007
				Namibia	North central	Schumann et al., 2008
				Namibia	Waterburg National Park, commercial ranches surrounding park	Stein et al., 2010
Leopard Snow	*Panthera uncia*	EN	D	Pakistan	Machiara National Park, villages surrounding park	Dar et al., 2009
Lion	*Panthera leo*	V	D	Kenya	Mbirikiri Group ranch between Tsavo National Park and Amboseli National Park	Hazzah et al., 2009
				Bostwana	Makgadagadi pans National Park, villages and cattle posts surrounding park	Hemson et al., 2009
				Tanzania	Serengeti National Park, villages surrounding park	Kaltenborn et al., 2006
				South Africa and Zimbabwe	Private ranches (6 sites)	Lindsey et al., 2005
				Kenya	Central	Romanach et al., 2007
				Namibia	North central	Schumann et al., 2008
Lynx Canadian	*Lynx canadensis*	LC	S	Poland	Four regions	Bath et al., 2008
Lynx Iberian	*Lynx pardinus*	CR	D	Norway	All provinces including areas with carnivores and without (but since 41% of those not in carnivore areas believed they had carnivores in their area we included this study)	Røskaft et al., 2007

Mountain Lion or Puma or Cougar	*Puma concolor*	LC	D	Brazil	Parana state, villages around Iguacu National Park	Conforti and Azevedo, 2003
				USA	Kentucky and North Dakota residents	Davenport et al., 2010
				USA	Montana residents in 3 regions western, central and southwest, differing in cougar density and level of conflict	Riley and Decker, 2000
Tiger	*Panthera tigris*	EN	D	india	Ghats, Kalakad–Mundanthurai Tiger Reserve, 12 villages around park	Arjunan et al., 2006
Wild Dog	*Lycaon pictus*	EN	D	South Africa	Kwazulu/Natal province, Huhluwe - iMfoloze National Park, community members and private landowners surrounding park	Gusset et al., 2008
				Zimbabwe	Three conservancies	Lindsey et al., 2005
				Kenya	Central	Romanach et al., 2007
Wolf Grey	*Canis lupus*	LC	S	USA	Wisconsin	Agarwala et al., 2010
				USA	Minnesota, rural residents	Chavez et al., 2005
				Sweden	Residents living in wolf territory, wolf areas and the rest of country	Karlssona and Sjostrom, 2006
				Sweden	Residents living in wolf territory	Karisson ,and Sjostrom, 2011
				USA	Wisconsin	Naughton-Treves et al., 2003
				Norway	All over Norway including areas with carnivores and without (but since 41% of those not in carnivore areas believed they had carnivores in their area we included this study)	Røskaft et al., 2007
				Canada	Manitoba Rural, Riding Mountain National Park, residents within 50km of park	Stronena et al., 2007

Wolverine	*Gulo gulo*	LC	D	Norway	All over Norway including areas with carnivores and without (but since 41% of those not in carnivore areas believed they had carnivores in their area we included this study)	Røskaft et al., 2007
Carnivores unspecified				Tanzania	Serengeti National Park, North West area	Holmern et al., 2007
				South Africa	Bushbuckridge neighbouring Manyaleti Game reserve	Lagendijk and Gusset, 2008
Elephant						
Elephant Asian	*Elephas maximus*	EN	D	Sri lanka	Urban and rural citizens	Bandara and Tisdell, 2003
				India	Assam, Sonitpur and Kaziranga- Karbi Anglong Elephant Reserves, residents in 8 villages surrounding park	Barua et al., 2010
Elephant African	*Loxodonta africana*	V	I	Tanzania	Serengeti National Park, residents from villages surrounding park	Kaltenborn et al., 2006
				Bangladesh	Residents from villages around 4 Protected areas	Sarker and Roskaft, 2010
Primates						
Langur Western Purple-faced	*Trachypithecus vetulus*	EN	D	Sri lanka	Colombo city, farmers in 6 villages near city	Nijman and Nekaris, 2010
				Sri lanka	Twenty-two regions in Sri lanka with langur populations	Parker et al., 2008
Macaque Crab-eating or Long-tailed	*Macaca fascicularis*	LC	D	Singapore	Central Catchment Nature reserve, Visitors and residents surrounding reserve	Chihmunsha et al., 2009
Ungulates						
Blackbuck	*Antilope cervicapra*	NT	S	India	Solapur province	Agarwala et al., 2010
Buffalo African	*Syncerus caffer*	LC	D			
				Tanzania	Serengeti National Park, residents from	Kaltenborn et al., 2006

					villages surrounding park	
Mule deer White tailed deer	*Odocoileus hemionus* *Odocoileus virginianus*	LC LC	S S	USA	South Carolina, Hilton Head Island, Sea Pines Plantation	Bowker et al., 2003
				USA	Montana, farmers from 7 counties	Lacey et al., 1993
				USA	Amherst suburb of Buffalo, NY	Locker et al., 1999
				USA	Montana, farmers from 7 counties	Lacey et al., 1993
				USA	New York, Tompkins county	Stout et al., 1993
				USA	Virginia, farmers and homeowners	West and Parkhurst, 2002
Moose or Elk	*Alces americanus*	LC	S	USA	Montana, farmers from 7 counties	Lacey et al., 1993
Sheep Bighorn	*Ovis Canadensis*	LC	S	USA	Montana, farmers from 7 counties	Lacey et al., 1993
Ungulates unspecified				USA	Wyoming	Van Tassel et al., 2000

APPENDIX V

List of main and sub-categories and publications that used them for the meta-analysis in Chapter 3

	Main category		Sub-categories (where present)	Publications
1	Attitude			Davenport et al., 2010; Don Carlos AW et al., 2009; Hazzah et al., 2009; Kaczensky et al., 2004; Riley and Decker 2000; Stout et al., 1993
2	Benefit	2.1	Tangible	Arjunan et al., 2006; Hazzah et al., 2009; Karisson and Sjostrom 2011; Naughton-treves et al., 2003; Romanach et al., 2007; Stout et al., 1993; Stronena et al., 2007
		2.2	Intangible:	Agee and Miller 2009; Bandara and Tisdell 2003; Hazzah et al., 2009; Kaczensky et al., 2004; Lacey et al., 1993; Siemer et al., 2009 Stout et al., 1993
3	Context			Don Carlos et al., 2009; Kaltenborn et al., 2006
4	Cost	4.1	Tangible:	Agarwala et al., 2010; Ambarl and Bilgin 2008; Bandara and Tisdell 2003; Barua et al., 2010; Bowker et al., 2003; Chihmunsha et al., 2009; Conforti and Azevedo 2003; Dar et al., 2009; Gusset et al., 2008; Hazzah et al., 2009; Hemson et al., 2009; Holmern et al., 2008; Kaczensky et al., 2004; Karisson and Sjostrom 2011; Kretzer et al., 2009; Lacey et al., 1993; Lagendijk and Gusset 2008; Liu et al., 2011; Locker et al., 1999; Naughton-treves et al., 2003;

				Riley and Decker 2000; Romanach et al., 2007; Siemer et al., 2009; Stein et al., 2010; Stout et al., 1993; Stronena et al., 2007; Van Tassell 2000; West and Parkhurst 2002; Zimmerman et al., 2005
		4.2	Intangible	Agee and Miller 2009; Bath et al., 2008; Kaczensky et al., 2004; Kretzer et al., 2009; Locker et al., 1999; Riley and Decker 2000; Røskaft et al., 2007; Siemer et al., 2009; Stout et al., 1993; Stronena et al., 2007
5	Experience species	5.1	Distance to the conflict	Agarwala et al., 2010; Arjunan et al., 2006; Bath et al., 2008; Chavez et al., 2005; Holmern et al., 2008; Kaczensky et al., 2004; Karlssona and Sjostrom 2011; Nijman and; Nekaris 2010; Sarker and Roskaft 2010; Selebatso et al., 2008; Stronena et al., 2007
		5.2	Length live in area	Arjunan et al., 2006; Bowker et al., 2003; Karisson and Sjostrom 2011; Kretzer et al., 2009; Riley and Decker 2000; Sarker and Roskaft 2010; Siemer et al., 2009; Stein et al., 2010
		5.3	Personal experience	Agee and Miller 2009; Barua et al., 2010; Bath et al., 2008; Davenport et al., 2010; Gusset et al., 2008; Karisson and Sjostrom 2011; Karlssona and Sjostrom 2006; Kretzer et al., 2009; Lagendijk and Gusset 2008; Parker et al., 2008; Røskaft et al., 2007; Siemer et al., 2009; Van Tassell 2000
6	Institutions			Hazzah et al., 2009; Davenport et al., 2010
7	Knowledge			Bandara and Tisdell 2003; Barua et al., 2010; Bath et al., 2008; Kaczensky et al., 2004; Lagendijk and Gusset 2008; Liu et al., 2011
8	Landscape characteristics			Bath et al., 2008; Kaczensky et al., 2004; Karlssona, and Sjostrom 2006; Kretzer et al., 2009; Røskaft et al., 2007; Stout et al., 1993

9	Land-use	9.1	Cohort	Agee and Miller 2009; Chavez et al., 2005; Chihmunsha et al., 2009; Dar et al., 2009; Davenport et al., 2010; Hemson et al., 2009; Holmern et al., 2009; Kaczensky et al., 2004; Karisson and Sjostrom 2011; Karlssona and Sjostrom 2006; Lagendijk and Gusset 2008; Liu et al., 2011; Marker et al., 2003; Naughton-treves et al., 2003; Riley and Decker 2000; Røskaft et al., 2007; Sarker and Roskaft 2010; Selebatso et al., 2008; Siemer et al., 2009
		9.2	Activity	Kretzer et al., 2009; Lindsey et al., 2005; Romanach et al., 2007; Schumann et al., 2008; Zimmerman et al., 2005
		9.3	Dependency	Agarwala et al., 2010; Arjunan et al., 2006 Dar et al., 2009; Hazzah et al., 2009; Holmern et al., 2012; Karlssona and Sjostrom 2006; Van Tassell 2000
10	Legal	10.1	Conservancy	Schumann et al., 2008; Lindsey et al., 2005
		10.2	Tenure	Romanach et al., 2007; Sarker and Roskaft 2010; Selebatso et al., 2008
11	Mitigation measures			Bowker et al., 2003; Holmern et al., 2007; Kretzer et al., 2009; Stein et al., 2010
12	Property characteristics			Dar et al., 2009; Marker et al., 2003; Selebatso et al., 2008; Zimmerman et al., 2005
13	Salience			Bandara and Tisdell 2003; Barua et al., 2010; Kaczensky et al., 2004; Karisson and Sjostrom 2011; Karlssona and Sjostrom 2006; Kretzer et al., 2009; Røskaft et al., 2007; Siemer et al., 2009; Stout et al., 1993; Van Tassell 2000
14	Socio-demographic	14.1	Age	Agee and Miller 2009; Arjunan et al., 2006; Bandara and Tisdell 2003; Bath et al., 2008; Bowker et al., 2003; Dar et al., 2009; Gusset et al., 2008; Hazzah et

		al., 2009; Holmern et al., 2016; Kaczensky et al., 2004; Kaltenborn et al., 2006; Karisson and Sjostrom 2011; Karlssona and Sjostrom, 2006; Kretzer et al., 2009; Lagendijk and Gusset 2012; Lindsey et al., 2005; Liu et al., 2011; Naughton-treves et al., 2003; Nijman and Nekaris 2010; Riley and Decker 2000; Roman˜ach, et al., 2007; Røskaft et al., 2007; Sarker and Roskaft 2010; Selebatso et al., 2008; Siemer et al., 2009; Stein et al., 2010; Stout et al., 1993; Stronena et al., 2007; Van Tassell 2000; Zimmerman et al., 2005
14.2	Gender	Agee and Miller 2009; Arjunan et al., 2006; Bandara and Tisdell 2003; Bath et al., 2008; Bowker et al., 2003; Conforti and Azevedo 2003; Dar et al., 2009; Davenport et al., 2010; Gusset et al., 2008; Holmern et al., 2010; Kaczensky et al., 2004; Kaltenborn et al., 2006; Karisson and Sjostrom 2011; Karlssona, and Sjostrom 2006; Kretzer et al., 2009; Lagendijk and Gusset 2011; Liu et al., 2011; Naughton-treves et al., 2003; Riley and Decker 2000; Romanach et al., 2007; Røskaft et al., 2007; Sarker and Roskaft 2010; Siemer et al., 2009; Stout et al., 1993
14.3	Education	Agarwala et al., 2010; Bandara and Tisdell 2003; Bowker et al., 2003; Dar et al., 2009; Davenport et al., 2010; Holmern et al., 2007; Kaczensky et al., 2004; Kaltenborn et al., 2006; Karisson and Sjostrom 2011; Karlssona, and Sjostrom 2006; Lagendijk and Gusset 2008; Liu et al., 2011; Naughton-treves et al., 2003; Riley and Decker 2000; Romanach et al., 2007; Røskaft et al., 2007; Sarker and Roskaft 2010; Selebatso et al., 2008; Siemer et al., 2009; Stein et al., 2010; Stronena et al., 2007; Van Tassell 2000
14.4	Tribe	Hazzah et al., 2009; Lindsey et al., 2005; Liu et al., 2011 Romanach et al., 2007; Selebatso et al., 2008; Stein et al., 2010
14.5	Other	Hazzah et al., 2009; Kretzer et al., 2009; Naughton-treves et al., 2003; Riley

		and Decker 2000; Sarker and Roskaft 2010
15	Species characteristics	Bath et al., 2008; Davenport et al., 2010; Hazzah et al., 2009; Kaczensky et al., 2004; Kretzer et al., 2009; Lindsey et al., 2005; Marker et al., 2003; Parker et al., 2008; Riley and Decker 2000; Røskaft et al., 2007; Stronena et al., 2007; West and Parkhurst 2002
16	Wealth	Arjunan et al., 2006; Bandara and Tisdell 2003; Bowker et al., 2003; Conforti and Azevedo 2003; Dar et al., 2009; Hazzah et al., 2009; Karisson and Sjostrom 2011; Karlssona, and Sjostrom 2006; Kretzer et al., 2009; Lacey et al., 1993; Marker et al., 2003; Naughton-treves et al., 2003; Stronena et al., 2007; Van Tassell 2000; Zimmerman et al., 2005

APPENDIX VI

Additional explanations and hypotheses of Wildlife Tolerance Model constructs.

1. Outer Model variables

Tolerance

A person who does not perceive risks or costs despite being exposed to wildlife would be considered tolerant because despite not undergoing an obvious hardship, they are able to absorb the extra actual or potential costs of living with wildlife. Applying this to community level, those able to exist sustainably with wildlife without conflict would be considered tolerant because the existence of wildlife in their area involves being exposed to potential risks and costs that communities without the presence of wildlife would not be exposed to.

Tolerance indicators

The table below lists the question types that were used in attitude surveys of stakeholders living with damage causing mammalian wildlife from Kansky et al. (2014). The number of surveys where each question type when applied and the number of respondents surveys are also shown (R.K unpublished data). Here we evaluate and discuss their use as measures of tolerance in our WTM.

Question Type	**No. Surveys Applied**	**% Number of people surveyed**	**Description**
General Positive Attitudes	29	66%	Describes an affect or cognition of a species, such as the extent to which a species is liked or should be conserved.
Future population	12	13%	Support for an increase, decrease, or stable future population of a species
Kill/Remove	9	10%	Whether a person had or would kill or remove a species from their property
Want Species	6	6%	Desirability of a species on a persons' property or desirability of living near a species
Support lethal control	*5*	*2%*	*S*upport for removal or lethal control of a species as a management option, in the context of under-abundant species

Damage	3	0.1%	Degree to which an individual will tolerate damage from a species
Tolerance			
Welfare	2	3%	Support for reduction of over-abundant species with non-lethal control

Applying our definition of *tolerance* to the seven question types, we argue that six of these can be useful measures of tolerant behavior as follows: *Future population*: the ability to tolerate an increase in population size of a species since a larger population size increases the risk of an encounter and therefore potential costs. *Kill/Remove*: the ability to tolerate not killing a species despite the hardship it causes since the presence of wildlife always involves potential costs compared to areas with no wildlife. *Want Sp*: the ability to tolerate a species on your property despite the hardship it causes since the presence of wildlife always involves potential costs compared to areas with no wildlife. *Support lethal control* and *Welfare*: similar to *Kill/Remove*. *Tolerance*: degree to which an individual will tolerate damage from a species. *General Positive Attitudes:* a general positive attitude towards a species would not be a good indication of tolerant behavior. Although in many cases positive attitudes can lead to positive behavior, it is not the only antecedent of a behavior (Taylor et al. 2005; Fishbein & Ajen 2010). In addition, a person may have a negative attitude but not behave negatively or they may have a positive attitude but behave negatively. For example, in Kansky et al. (2014) we reported that in general, commercial farmers tend to hold more positive attitudes to damage causing wildlife than communal farmers, however, one could not assume that these farmers engaged in more sustainable management practices, as commercial farmers may have relatively more resources to manage and extirpate wildlife. Therefore we suggest a multi-item scale tolerance indicator. Such an indicator should cover the many dimensions of tolerance in the context of HWC and would be an improvement on most surveys that typically use one or two of these measures (Podsakoff et al. 2003).

Below we provide more detail on the selection of tolerance indicators in the WTM.

1. Spatial - tolerance to spatial proximity at four distances. The assumption is that the closer a species occurs to things that are of value to humans, the greater the potential costs (tangible and intangible). The question one could ask is “How many days per year would you be willing to cope/tolerate/accept species x inside your house/ on your property/ in your neighborhood/ in your village/town /in your district. The spatial scales are relative and not actual distances because these would not be comparable between different landscapes. This measure would be useful for policy and conservation managers, as it would provide targets for management interventions. The variation within and between stakeholder groups would provide a measure of conflict, the greater the variance the higher expected human-human conflict.

2. Damage -tolerance to undergoing monetary costs due to a species

3. Killing – tolerance to killing under seven different contexts for two conditions: i. When a species is perceived to be common ii. When a species is perceived to be rare. The seven contexts are: 1.….it is seen in the bush far away from any village or houses or livestock or agricultural crops. 2….it is seen in the vicinity of where livestock are grazing or vegetable gardens or agricultural crops are growing, or on the urban fringe where they could enter peoples houses. 3…..it has injured or killed a domestic animal or has raided some houses or agricultural crops for the first time. 4…….it causes repeated problems for you and your community but has never harmed a person. 5…..it has threatened a child or adult human. 6…..it has injured a child or adult human. 7….it has killed a child or adult human

Context is important (Fishbein &Ajzen 2010; Heberlein 2012) yet in meta-analyses of attitude towards damage causing wildlife only 2 out of 45 publications provided context in attitude surveys (Chap. 3). For example for pro-environmental behavior, the availability of recycling facilities, the quality of public transport, the market supply of goods, or pricing regimes can strongly affect people's engagement in pro-environmental behaviour (Steg & Vlek 2009).

4. Population size -the population size of a species that a person is prepared to tolerate (or support for a change in population size). Here the assumption is that larger populations have the potential to incur more costs than smaller populations.

5. Prevention -the ability and willingness to undergo the extra costs (tangible and intangible) to apply prevention or mitigation measures that are effective, sustainable, legal and comply with welfare norms.

Costs and benefits

The costs and benefits of living with particular wildlife species will be different for each site or household (see discussion Chap. 2; Chap. 3) and therefore detailed identification of these would be important in order to implement effective mitigation interventions. To obtain these, qualitative interviews and/or focus groups are needed to inform survey design. Below we list some potential costs and benefits likely to be experienced by people living with wildlife. The Millennium assessment dimensions of ecosystem services and human well-being (MA 2005) Harrington et al. (2010), Dickman et al. (2011), Barua (2012) and Non Violent Communication needs (www. CNVC.org) may provide additional insights.

Costs:

Social costs -conflict between stakeholders (community-community, community – authorities), loss of life, emotional stress (stress of coping, fear, danger, worry, concern for animal welfare).

Environmental costs - loss of wildlife, animal welfare, disruption of wildlife behavior and social structure, loss of ecosystem services due to extirpation of wildlife

Security costs- personal safety, secure resource access, security from disasters

Basic material for good life-adequate livelihoods, sufficient nutritious food, shelter, access to goods

Damage costs-to property, livelihood, extra time, labor and finances to manage problem, lost opportunity costs such as children missing school in order to guard crops and in the case of loss of a breadwinner due to mortality. Health costs due to injury.
Mitigation costs-time, money, labor
Freedom of choice and action - opportunity to be able to achieve what an individual values doing and being.
Benefits:
Provisioning services- Production of goods e.g. foods, fibers, medicines, meat, skins, trophies, tourism, guano
Regulating services- Ecosystem services - e.g. pollination, seed dispersal, habitat heterogeneity, trophic cascades, bush clearing, elephant paths
Life-fulfilling processes - aesthetic, spiritual, symbolic, educational, recreational, and scientific values, cultural: sense of place, ancestral home, giver of sustenance, legacy, escape, solace and restoration, spiritual source.

Non Use value - Existence value -Value derived simply from the satisfaction of knowing that some feature of the environment continues to exist, whether or not this might also benefit others.

Bequest value -Value associated with the knowledge that a resource will be passed onto descendants to maintain the opportunity for them to enjoy it in the future.
Philanthropic value-Value associated with the satisfaction from ensuring resources are available to contemporaries (the current generation) (Harington et al. 2010)

Empathy

Women generally score higher on empathy scales than men (Baron-Cohen et al. 1985; Erlanger & Tsytsarev 2012). Therefore we hypothesize that women will perceive less costs and more benefits of living with damage causing wildlife and therefore be more tolerant.

Anthropomorphism

What triggers the perceived similarity when some objects and entities are clearly very different in appearance to humans? Specific situations relevant to the HWC context are: (i) being liked or feeling liked - people with positive attributes such as personality or behavior are attributed more mind and intentionality than those with negative attributes and behavior (Kozak et al. 2006). (ii) familiarity and attachment (Eddy et al. 1993) (iii) unpredictability and intentionality- entities behaving unpredictably or intentionally evoke a need to understand the intention behind the act and a need to control the unpredictability may result (Epley et al. 2008b) (iii) stress – when a non-human representation is unavailable to a person under cognitive load (stress) and there is a strong need to rapidly explain the behavior ascription of a human-like mind may

result (Rosset 2008; Waytz et al. 2010).

At the other end of the humanization/anthropomorphism spectrum is dehumanization- the denial of mental ability to an entity. Triggers of dehumanization can be (i) When people are wronged or victimized, they might search for a perpetrator to blame, even when this is an animal (Oldridge 2004), or God (Gray & Wegner 2009) (ii) When people do not share similar beliefs or values for example where others are perceived to have different political beliefs are judged to be less capable of 'logical analysis' and holding an 'objective perspective' (Kennedy & Pronin 2008) (iii) When there is a need to rationalize aggression, discrimination or a harmful action (Gray et al. 2012), for example participants instructed to eat beef later ascribed less mind to cows than those who were instructed to eat cashews (Loughnan et al. 2010).

Taxonomic bias

Attractiveness

Animal attractiveness influences the size of parrot zoo populations (Frynta et al. 2010) as well as mammalian zoo populations (Frynta et al. 2013), conservation decision-making among the general public (Gunnthorsdottir 2001; Knight 2008), flagship species (Smith et al. 2010) as well as conservation policy-makers (Metrick and Weitzman 1996; Knegtering et al. 2002,). Among people living with wildlife attractiveness influences preference for species removal (de Pinho et al. 2014).

Size

Size has been found to be a significant predictor of the value of a species for trophy hunters (Johnson et al. 2010). Larger species attract more interest from the public (Ward et al. 1998) receive more conservation investment (Sitas et al. 2009) are disproportionately represented in captive breeding programs (Balmford et al. 1996), reintroduction projects (Seddon et al. 2005), as flagship species (Clucas et al. 2008; Smith et al. 2012) and are also over represented within felid human-conflict literature (Inskip & Zimmerman 2009).

Similarity to humans

The similarity principle states that in general, people give more consideration to others who are perceived as similar to themselves than to those who are perceived as dissimilar (Plous 1993). This comes from studies demonstrating that humans are more likely to help others of the same race (Saucier et al. 2005), similar appearance (Graf & Riddell 1972), political views (Karabenick et al. 1973), and nationality (Feldman 1968). Species similar to humans regarding size, weight, lifespan, reproductive strategy, parental investment and social organization are preferred (Batt 2009) and people prefer to 'save' species that they consider to be most similar to human anatomy, intellect and emotion (Plous 1991, 1993). Phylogenetic closeness to humans also determines publication bias in ecology (Bonnet et al. 2002) and wildlife

research (Cronin et al. 2014) and conservation investments (Martin-Lopez 2011; Martín-Forés et al. 2013).

Danger

Carnivores elicit less positive attitudes compared to other mammalian groups after controlling for experiencing damage (Chap. 2) and the general public are less inclined to support conservation of species that are dangerous or harmful (Knight 2008; Martín-López et al. 2009; Fischer et al. 2011).

Rarity

The value of rarity by humans is well established as can be seen by the trade in rare objects since time immemorial. In conservation, rare species are also valued for their genetic uniqueness. To see rare animals in zoos visitors are more willing to invest time in searching and contemplating rare species, ready to expend more physical effort to get to them, tolerate more unpleasant conditions, pay more and, risk more to obtain (steal) a rare species (Angulo et al. 2009). Among birdwatchers more effort is invested in finding rare bird species (Booth et al. 2011). Rare species also tend to be favored for religious and magical uses (Alves et al. 2012) and prices to hunt trophy bovids (Prescott et al. 2012) and felids (Palazey et al. 2011) increase when a species status changes on the IUCN red list. The general public are also more willing to pay for conservation of endangered species (Tisdell et al. 2007).

Symbolism

The anthropological literature abounds with examples of the symbolic nature of animals. For example lion are associated with bad luck for the Kalahari San (Lewis Williams 2011), in Tanzania some ethnic groups bewitch and 'train' spotted hyaenas *Crocuta crocuta* to kill other peoples' livestock (Dickman 2008), in Sierra Leone chimpanzee attacks on villagers are orchestrated by humans who shape-shift into chimpanzees and kill local youths for their body parts (Richards 2000) and in Madagascar the aye-aye *Daubentonia madagascarensis*, a small nocturnal primate, is a harbinger of doom (Glaw et al. 2008). Culture can be defined as a set of attitudes, values, beliefs, and behaviors shared by a group of people, and communicated from one generation to the next (Barnouw 1985). Where groups of stakeholders differ in these dimensions in relation to taxonomic groups or species, and where these differences translate to differences in the perception of costs and benefits, identification of these different groups of stakeholders would be important for targeting management interventions. The tribe and the cohort which a person belonged were important in defining attitudes towards damage causing wildlife (Chap. 3).

Wildlife Value orientations

The Wildlife Values in the West study revealed that Utilitarians and Pluralists possess certain similar sociodemographic and lifestyle characteristics, which differ from those of Mutualists and Distanced individuals (Teel et al., 2005). Utilitarians and Pluralists are more likely than the other two value orientation types to be male, tend to be slightly older on average and to have lived in the state for a longer period of time.

Table 1. Summary of characteristics of individuals who present Utilitarian, Mutualistic, Pluralistic and Distances Wildlife Value Orientations (From Teel et al 2005)

Utilitarian	- wildlife primarily for human benefit - prioritize human well-being over wildlife - treatment of wildlife in utilitarian terms - activities that result in death (e.g. hunting, lethal removal) or harm to wildlife acceptable
Mutualist	- wildlife capable of living in relationships of trust and caring with humans, as if part of an extended family, and as deserving of rights - less likely to support actions resulting in death or harm to wildlife - more likely to engage in welfare-enhancing behaviors for individual wildlife (e.g., feeding), - view wildlife in human terms
Pluralist	-hold both a mutualism and a utilitarian value orientation. - influence of the two value orientations is situationally-contingent, i.e the role of a specific orientation can vary depending upon the given situation. For certain issues, Pluralists are likely to respond in a manner similar to that of Utilitarians, whereas for other issues they may behave more like Mutualists.
Distanced	-do not hold either a mutualism or a utilitarian orientation. -tend to be less interested in wildlife and wildlife-related issues. - more likely than the other value orientation types to express fear, or a concern for safety, while in the outdoors due to the possibility of negative encounters with wildlife (e.g., risk of being attacked or contracting a disease).

Personal Norms

Personal norms are activated when (1) a person is aware of the need for help, (2) a person is aware of the consequences a certain behaviour would have for the person in need (awareness of consequences), (3) a person accepts responsibility for his or her actions (ascription of responsibility), and (4) a person perceives him or herself as capable of performing the helping action (perceived behavioral control) (Schwartz & Howard 1998).

Feelings of guilt are also closely related with social norms. They deliver the standards of behaviour a social reference group view as appropriate in a specific context—that is what the group views as right or wrong. If an individual internalizes these standards they provide the content of her/his personal moral norms (Bamberg & Mo¨ser 2007). A perceived mismatch between one's own behaviour and social norms may lead to feelings of guilt (Baumeister 1998) which would in turn motivate an individual to perform the behavior in question. For this reason social norms are predicted to be antecedents to personal norms (Klockner 2013).

Further it is predicted that there are interactions between personal norms, empathy, interest in wildlife, values and WVO's.

Ho: Individuals or groups high in trait empathy, interest in wildlife, universalism values, mutualism WVO's will be driven by personal norms and therefore perceive more benefits than costs to living with wildlife.

We hypothesize that implementing mitigation measures to reduce wildlife damage can be seen as a pro-social behavior and therefore personal norms would be important in determining if people implement mitigation measures to prevent wildlife damage.

Ho: When a person is aware of the need to implement mitigation measures because of the consequences of not implementing them, and a person accepts responsibility for implementing them and a person perceives themselves as capable of implementing the mitigation measures, then they will implement mitigation measures.

The concept of personal norms has been usefully operationalized by Vining and Ebreo (1992) using the following items: ''I feel a strong personal obligation to . . . (one of the two behaviors), ''I am willing to put extra effort into . . . (one of the two behaviors) on a regular basis,'' and ''I would feel guilty if I didn't . . . (one of the two behaviors)''.

Self-efficacy/behavioral control

Working knowledge - the information a person has at their disposal when evaluating or processing information about an object or issue (Wood et al. 1995) is expected to be an important antecedent of Percieved Behavioural Control (Chap. 3). For example knowledge of prevention methods to reduce damage may inform implementation of

mitigation measures or support for the types of management interventions applied by conservation authorities.

Habit

Habits consist of three components; past behavior or performance, response automaticity, and contextual cues. Habit strength is the degree of automaticity a behaviour has in a given stable situation (Verplanken & Aarts 1999). Klockner (2013) suggests that the Response Frequency Measure (Verplanken et al. 1994) and the highly correlated Self-Report Habit Index (Verplanken and Orbell 2003) are the most common and accepted operationalizations of Habit.

The Self-Report Habit Index consists of questions such as:

Behavior X is something . . ….I do frequently, I do automatically, I do without having to consciously remember, that makes me feel weird if I do not do it, I do without thinking, that would require effort not to do it, that belongs to my (daily, weekly, monthly) routine, I start doing before I realize I'm doing it, I would find hard not to do, I have no need to think about doing, that's typically "me", I have been doing for a long time (Verplanken & Orbell 2003).

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APPENDIX VII

Questions and variables used in the questionnaires for testing the Wildlife Tolerance Model

A. Outer Model Variables

Latent variable		Indicators	Questions in Survey	Scale
Exposure	1.	Enter_house_sum	How often did baboons ENTER your HOUSE LAST SUMMER (Dec 2011 to May 2012)?	Number of times
	2.	Enter_house_win *	How often did baboons ENTER your HOUSE THIS WINTER (June to Sep 2012)?	Number of times
	3.	Visit_neigh_sum	How often did baboons VISIT your NEIGHBOURHOOD LAST SUMMER (Dec 2011 to May 2012)?	1=5-7 days a week 2=2-4 times a week 3=1 times week-2 times a month 4=2 times a month –once a month 5=once a month - once every 2 months 6=once every 2 months-once every 3 months 7=never
	4.	Visit_neigh_win	How often did baboons VISIT your NEIGHBOURHOOD THIS WINTER (June to Sep 2012)?	As above
	5.	Visit_prop_sum	How often did baboons VISIT your PROPERTY LAST	As above

			SUMMER (Dec 2011 to May 2012)?	
	6.	Visit_prop_win	How often did baboons VISIT your PROPERTY THIS WINTER (June to Sep 2012)?	As above
Positive meaningful event	1.	Experience_pos	Have you had any particularly POSITIVE EXPERIENCES with baboons? If yes HOW MANY such incidences have you experienced?.....	Number of experiences
Negative meaningful event	1.	Experience_neg	Have you had any particularly NEGATIVE, TRAUMATIC OR SCARY EXPERIENCES with baboons? If yes HOW MANY such incidences have you experienced?..... Please describe what happened.	Number of experiences
Cost tangible	1.	Tot_yes_no_mit_meas	Which of the following MEASURES HAVE YOU TRIED to prevent and reduce baboon damage? Please mark all those you have tried by ticking the ☐ in the first column	Number of mitigation measures used out of a list of 23
	2.	Damage_sum	How much DAMAGE in Rands did your HOUSEHOLD EXPERIENCE due to baboons LAST SUMMER (Dec 2011 to May 2012)?	Rands
	3.	Damage_win	How much DAMAGE in Rands did your HOUSEHOLD EXPERIENCE due to baboons THIS WINTER (June to Sep 2012)?	Rands
	4.	Extent_damage	What is your estimation of the EXTENT of DAMAGE that you will likely have from baboons this coming SUMMER (Dec 2012-May 2013)?	1=no damage 2=slight damage 3=medium damage 4=high damage

				5=very high damage
	5.	Spent_mitigation*	How much money have you spent in TOTAL on MITIGATION MEASURES to PREVENT BABOON DAMAGE ON YOUR PROPERTY?	Rands
Cost intangible	1.	Avg_neg_emotion	Please describe what EMOTIONS you feel due to LIVING WITH BABOONS in your area: Please tick as many feelings as necessary and indicate the intensity of the feeling on a scale of 0 to 5 where Frightened, Unsettled, Panicked, Miserable, Wary, Nervous, Worried, Annoyed, Stressed out, Overwhelmed, Disgruntled, Frazzled, Fragile, Resentful, Worn out, Agitated, Animosity, Frustrated, Disgusted, Irritate, Hostile, Furious, Disturbed	0=I do not feel this at all 1=very weakly 2=weakly 3=average intensity 4=strongly 5= very strongly
	2.	Cost_bab_avg	COSTBAB1.Living with baboons in my area is difficult because I feel like a prisoner in my own home COSTBAB2.Living with baboons in my area is difficult because I worry about the safety of my children COSTBAB3.Living with baboons in my area is difficult because I worry about the safety of my pets COSTBAB4.Living with baboons in my area is difficult because I need to be vigilant at all times COSTBAB5.Living with baboons in my area is difficult because it takes up a lot of my time to deal with them	1=strongly disagree 2=moderately disagree, 3=slightly disagree 4=neither 5=slightly agree 6=moderately agree 7=strongly agree
	3.	Afraid_you	How AFRAID are YOU PERSONALLY of baboons when they occur in areas where humans live and baboons are not fenced in?	1= I am NOT afraid at all 2= I am Somewhat afraid 3= I am Moderately afraid 4= I am Quite afraid 5= I am Very afraid

	4.	Afraid_you_house	How AFRAID are YOU PERSONALLY of baboons when THEY ENTER YOUR HOUSE?	1= I am NOT afraid at all 2= I am Somewhat afraid 3= I am Moderately afraid 4= I am Quite afraid 5= I am Very afraid
	5.	Afraid_other_house	How AFRAID are OTHER MEMBERS OF YOUR HOUSEHOLD of baboons when they ENTER YOUR HOUSE?	1= They are NOT afraid at all 2= They are Somewhat afraid 3= They are Moderately afraid 4= They are Quite afraid 5= They are Very afraid
	6.	Danger_humans	How DANGEROUS do you think baboons are for HUMANS when they occur in areas where humans live and baboons are not fenced in?	1= NOT Dangerous at all 2= Somewhat dangerous 3= Moderately Dangerous 4= Quite Dangerous 5= Very Dangerous
	7.	Stress_babs	How emotionally STRESSFULL is it for you LIVING WITH BABOONS in your area? Please tick the appropriate number indicating the extent of the stress	1 = not stressful at all and 7 = extremely stressful
	8.	Nuisans_babs	How much of a NUISANCE is it for you living with baboons in your area? Please tick the appropriate number indicating the extent of the nuisance	1 =not a nuisance at all and 7 = extreme nuisance
Benefit intangible	1.	Avg_pos_emotion	Please describe what EMOTIONS you feel due to LIVING WITH BABOONS in your area: Please tick as many feelings as necessary and indicate the intensity of the feeling on a scale of 0 to 5 where	0=I do not feel this at all 1=very weakly 2=weakly 3=average intensity

			Compassionate, Sympathetic, Fascinated, Safe, Grateful, Joyful, Amused, Happy, Calm, Comfortable, Trusting, Relaxed	4=strongly 5= very strongly
	2.	Benefit_you	Please list how BENEFICIAL OR NOT you think baboons are for YOU. If you think there are any benefits, please list them.	1= NOT beneficial at all and 5= Very beneficial
	3.	Benefit_community	Please list how BENEFICIAL OR NOT you think baboons are for your COMMUNITY. If you think there are any benefits, please list them.	1= NOT beneficial at all and 5= Very beneficial
	4.	Benefit_mankind	Please list how BENEFICIAL OR NOT you think baboons are for MANKIND. If you think there are any benefits, please list them.	1= NOT beneficial at all and 5= Very beneficial
	5.	Benefit_nature	Please list how BENEFICIAL OR NOT you think baboons are for NATURE. If you think there are any benefits, please list them.	1= NOT beneficial at all and 5= Very beneficial
	6.	Enjoy	How much do you ENJOY living with baboons in your area? Please tick the appropriate number indicating the extent of enjoyment where	1=not enjoyable at all and 7= very enjoyable
Tolerance	1.	Tol_kill_first_uns_com	Many wild animals are known to cause damage to humans and their property. Some are herbivores capable of eating agricultural crops and gardens or raiding urban households. Others are carnivores capable of killing domestic livestock as well as scaring, injuring or killing humans. Under what conditions do you think it would be justified to kill a wild animal? Please ignore for now if it is illegal or not, who would do the killing, how it would be killed or what would be done with its body.	Yes/no/unsure

		Read the scenarios listed in the table below and tick the appropriate boxes. A. If BABOONS ARE ABUNDANT do you think a baboon should be killed if…… ….it is seen in the bush far away from any village or houses or livestock or agricultural crops. ….it is seen in the vicinity of where livestock are grazing or vegetable gardens or agricultural crops are growing, or on the urban fringe where they could enter peoples houses. …..it has injured or killed a domestic animal or has raided some houses or agricultural crops for the first time …….it causes repeated problems for you and your community but has never harmed a person …..it has threatened a child or adult human …..it has injured a child or adult human ….it has killed a child or adult human	
2.	Tol_kill_first_uns_rar	Same as above but …..B. IF BABOONS ARE RARE do you think a baboon should be killed if…….	Yes/no/unsure
3.	Pop_area	Would you like the population of baboons IN YOUR AREA to decrease, stay the same or increase?	1 =Decrease a lot 2= Decrease a little 3= Stay same 4= Increase a little 5= Increase a lot 6=no opinion
4.	Pop_ct	Would you like the population of baboons in CAPE TOWN to decrease, stay the same or increase?	As above
5.	Pop_africa	Would you like the population of baboons in AFRICA to decrease, stay the same or increase?	As above

6.	Tol_neigh	What would be the maximum NUMBER OF DAYS PER YEAR you would be able to TOLERATE OR COPE with baboons visiting your NEIGHBOURHOOD ?	Number of days
7.	Tol_house*	What would be the MAXIMUM NUMBER OF TIMES that you would be able to TOLERATE OR COPE, OF baboons ENTERING your HOUSE IN ONE YEAR?	
8.	Tol_prop	What would be the maximum NUMBER OF DAYS PER YEAR you would be able to TOLERATE OR COPE with baboons visiting your property?	
9.	Spend_authorities*	How much MONEY do you think should be SPENT by the AUTHORITIES, using taxpayer's money, to manage baboons on the Cape Peninsula?	1=R0 2=R1-R500,000 3=R500,000-1million 4=1 million-3 million 5=3-5 million 6=5-10 million 7=What ever it takes 9=I am not interested

* Variables that were removed from the final model

B. Inner model variables and additional other variables used in questionairs from Chapter 6.

Variable name	Description	Question in survey	Scale/Index
Interest in animals and wildlife			
People_animal	1.	Would you describe yourself as more of a **"PEOPLE" or "ANIMAL"** person?	**1 = leaning towards preference for animals and 7 =preference for people.**

Animals_like		1.	To what extent do you **like animals** in general, domestic or wild?	**1=I don't like animals at all and 7= I like animals very much?**
Domestic_wild		1.	Comparing domestic to wild animals, indicate the extent to which you prefer domestic or wild animals.	1=strong preference for domestic animals and 7= strong preference for wild animals?
Int_Wild_gen_PAS_avg	Extent of passive interest in all types of wildlife	1.	I consider myself a person who is interested in most wild animals	1=strongly disagree 2=moderately disagree, 3=slightly disagree 4=neither 5=slightly agree 6=moderately agree 7=strongly agree
		2.	I like to read up and watch films about most wild animals	
		3.	I am interested in learning about how different animal species behave and interact with each other	
		4.	The idea of liking wild animals seems a strange idea to me	
Int_Wild_gen_ACT_avg	Extent of experiential interest in all types of wildlife	1.	If I was walking in the outdoors, I would like to look closely at most wild animals	1=strongly disagree 2=moderately disagree, 3=slightly disagree 4=neither 5=slightly agree 6=moderately agree 7=strongly agree
		2.	I like most types of wild animals but I have little desire to walk many miles into the bush to see them	
		3.	I try to stay away from most wild animals	
		4.	I sometime walk in nature so I can see wild animals	
		5.	I like wild animals but I prefer to see them on television or in a zoo rather than running free near me	
Int_Wild_AREA_avg	Extent of interest in living with all types of wildlife in the specific area where the person lives	1.	Seeing most wildlife species in my area makes me happy	1=strongly disagree 2=moderately disagree, 3=slightly disagree 4=neither 5=slightly agree 6=moderately agree 7=strongly agree
		2.	I find wildlife in my area a nuisance	
		3.	I enjoy having wildlife in my area	
		4.	I would be sad if there were no wild animals in my area	
		5.	I find it stressful living in an area with wild animals	
		6.	I get annoyed when I see wildlife in my area	
Int_wild_BAB_avg	Extent of interest in having baboons living in the area where the person lives	1.	I often complain to other people about living with baboons	1=strongly disagree, 2=moderately disagree, 3=slightly disagree 4=neither, 5=slightly agree 6=moderately agree 7=strongly agree
		2.	It is becoming easier for me to live with baboons	
		3.	I would be happy if there were no baboons in my area	
		4.	I would be sad if there were no baboons living in my area	
		5.	I would be sad if there were no baboons on the Cape Peninsula	
Bab_interest	General interest in baboons	1.	How interested are you in BABOONS?:	**1=not interested at all and 5=very interested**
Bab_mang	General interest in baboon management	1.	How interested are you in **BABOON MANAGEMENT in Cape Town**?:	**1=not interested at all and 5=very interested**

Like_dislike		1.	Please indicate the extent to which you **LIKE or DISLIKE** Baboons	1= Dislike very much, 2= Dislike, 3= Moderately Dislike, 4= Neutral, 5= Moderately Like, 6= Like, 7= Like very much, 8= No opinion
Respect		1.	Please indicate the extent to which you **RESPECT or DISRESPECT** baboons.	1= Disrespect very much, 2= Disrespect, 3= Moderately Disrespect, 4= Neutral, 5= Moderately Respect, 6= Respect, 7= Respect very much, 8= No opinion
Look		1.	Please list how **ATTRACTIVE/UNATTRACTIVE** you think baboons **LOOK**. .	1= Very unattractive, 2= Unattractive , 3= Moderately unattractive, 4= Neutral, 5= Moderately attractive, 6= Attractive, 7= Very attractive, 8= No opinion
Behave		1.	Please list how **ATTRACTIVE/UNATTRACTIVE** you think baboons **BEHAVE.**	1= Very unattractive, 2= Unattractive , 3= Moderately unattractive, 4= Neutral, 5= Moderately attractive, 6= Attractive, 7= Very attractive, 8= No opinion
Wildlife value orientation				
Utilitarian_ use (only 1,2,3 were used in final analysis-see APPENDIX X)	Extent of belief that wildlife are primarily for human use	1.	Humans should manage wildlife populations so that humans benefit The needs of humans should take priority over wildlife protection.	1=strongly disagree, 2=moderately disagree, 3=slightly disagree 4=neither, 5=slightly agree 6=moderately agree 7=strongly agree
		2.	Wildlife are on earth primarily for people to use.	
		3.	Fishing allows people to enjoy the outdoors in a positive manner	
		4.	Fish are valuable only if people get to use them in some way	
		5.		
Utilitarian_hunt	Extent of support for hunting wildlife	1.	We should strive for a world where there is an abundance of wildlife for hunting and fishing	1=strongly disagree, 2=moderately disagree, 3=slightly disagree 4=neither, 5=slightly agree 6=moderately agree 7=strongly agree
		2.	Hunting does not respect the lives of animals.	
		3.	Hunting is cruel and inhuman to the wild animals	
		4.	People who want to hunt should be provided the opportunity to do so	
		5.	Fishing is cruel and inhumane to the fish	
Mutualistic_ social affiliation	Extent of social affiliation with wildlife	1.	Wildlife should have rights similar to the rights of humans.	1=strongly disagree, 2=moderately disagree, 3=slightly disagree 4=neither, 5=slightly agree 6=moderately agree 7=strongly agree
		2.	I view all living things as part of one big family.	
		3.	We should strive for a world where humans and wildlife can live side by side without fear.	

Mutualistic_care	Extent of care for wildlife	1. 2. 3. 4.	I feel a strong emotional bond with wild animals. I care about wildlife as much as I do other people. I value the sense of companionship I receive from wild animals. Wildlife are like my family and I want to protect them	1=strongly disagree, 2=moderately disagree, 3=slightly disagree 4=neither, 5=slightly agree 6=moderately agree 7=strongly agree
Schwartz Values				
Self Transcendence				
Universalism - Nature		1. 2. 3.	It is important to him to care for nature. It is important to him to take part in activities to defend nature. It is important to him to protect the natural environment from destruction or pollution.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
Universal - Tolerance		1. 2. 3.	It is important to him to be tolerant toward all kinds of people and groups. It is important to him to listen to and understand people who are different from him. It is important to him to accept people even when he disagrees with them.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
Universalism - Concern		1. 2. 3.	It is important to him to protect the weak and vulnerable people in society. It is important to him that every person in the world have equal opportunities in life. It is important to him that everyone be treated justly, even people he doesn't know.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
Benevolence - Care		1. 2. 3.	It is important to him to take care of people he is close to. It is very important to him to help the people dear to him It is important to him to concern himself with every need of his dear ones.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
Benevolence - Dependability		1. 2. 3.	It is important to him that people he knows have full confidence in him. It is important to him to be a dependable and trustworthy friend. It is important to him that all his friends and family can rely on him completely.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
Openness to change				
Self-direction - Thought		1. 2.	It is important to him to develop his own understanding of things. It is important to him to have his own original ideas.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like

	3.	It is important to him to expand his knowledge.	me
Self-direction - Action	1.	It is important to him to make his own decisions about his life.	1=not like me at all, 2=not like me, 3=a little like me,
	2.	It is important to him to plan his activities independently.	4=somewhat like me, 5=like me, 6=very much like
	3.	It is important to him to be free to choose himself what he does.	me
Stimulation	1.	It is important to him always to look for different things to do.	1=not like me at all, 2=not like me, 3=a little like me,
	2.	It is important to him to take risks that make life exciting.	4=somewhat like me, 5=like me, 6=very much like
	3.	It is important to him to have all sorts of new experiences.	me
Hedonism	1.	It is important to him to have a good time.	1=not like me at all, 2=not like me, 3=a little like me,
	2.	It is important to him to enjoy life's pleasures.	4=somewhat like me, 5=like me, 6=very much like
	3.	It is important to him to take advantage of every opportunity to have fun.	me
Self Enhancement			
Achievement	1.	It is important to him to have ambitions in life.	1=not like me at all, 2=not like me, 3=a little like me,
	2.	It is important to him to be very successful.	4=somewhat like me, 5=like me, 6=very much like
	3.	It is important to him that people recognize what he achieves.	me
Power - Dominance	1.	It is important to him that people do what he says they should.	1=not like me at all, 2=not like me, 3=a little like me,
	2.	It is important to him to have the power to make people do what he wants.	4=somewhat like me, 5=like me, 6=very much like me
	3.	It is important to him to be the one who tells others what to do..	
Power - Resources	1.	It is important to him to have the money to protect his interests.	1=not like me at all, 2=not like me, 3=a little like me,
	2.	It is important to him to be wealthy.	4=somewhat like me, 5=like me, 6=very much like
	3.	It is important to him to own expensive things that show his wealth	me
Face	1.	It is important to him that no one should ever shame him.	1=not like me at all, 2=not like me, 3=a little like me,
	2.	It is important to him to protect his public image.	4=somewhat like me, 5=like me, 6=very much like
	3.	It is important to him never to be humiliated.	me
Tradition			
Security - Personal	1.	It is very important to him to avoid disease and protect his health.	1=not like me at all, 2=not like me, 3=a little like me,
	2.	It is important to him to be personally safe and secure.	4=somewhat like me, 5=like me, 6=very much like
	3.	It is important to him never to do anything dangerous.	me
Security - Social	1.	It is important to him that there is stability and order in the wider society.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like
	2.	It is important to him to have a strong state that can defend its	me

		citizens.	
	3.	It is important to him that his country protects itself against all threats.	
Tradition	1.	It is important to him to maintain traditional values and ways of thinking.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
	2.	It is important to him to follow his family's customs or the customs of a religion.	
	3.	It is important to him to honor the traditional practices of his culture.	
Conformity - Rules	1.	It is important to him never to violate rules or regulations.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
	2.	It is important to him to follow rules even when no-one is	
	3.	watching.	
	4.	It is important to him to obey all the laws.	
Conformity - Interpersonal	1.	It is important to him to avoid upsetting other people.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
	2.	It is important to him never to annoy anyone.	
	3.	It is important to him never to make other people angry.	
Humility	1.	It is important to him never to be boastful or self-important.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
	2.	It is important to him to be humble.	
	3.	It is important to him never to seek public attention or praise.	
Anthropomorphism/mind attribution			
Anthro_index_avg		The human brain is capable of many things. Your brain is capable of thinking, planning for the future, remembering the past, experiencing emotions such as happiness, and basic feelings such as pain. We want to know how similar you think baboons are to you or other humans, in terms of what its brain can do. Please choose the extent to which you think baboons are similar or different to you/other humans by circling the appropriate number for each statement. **Compared to you, how much is a BABOON able to …**	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
	1.	make plans for the future,	
	2.	remember the past,	
	3.	think and reason,	
	4.	feel pain,	

		5.	feel happiness,	
		6.	feel hatred	
Belief Animal Mind_avg		1.	Most animals are unaware of what is happening to them	1=strongly disagree 2=moderately disagree, 3=slightly disagree 4=neither 5=slightly agree 6=moderately agree 7=strongly agree
		2.	Most animals are capable of experiencing a range of feelings and emotions (e.g. pain, fear, contentment, maternal affection	
		3.	Most animals are able to think to some extent to solve problems and make decisions about what to do	
		4.	Most animals are more like computer programs, i.e. mechanically responding to instinctive urges without awareness of what they are doing	
Empathy people				
Fantasy	Measures people's tendencies to identify imaginatively with fictional characters in books or movies	1.	I daydream and fantasize, with some regularity, about things that might happen to me.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
		2.	I really get involved with the feelings of the characters in a novel.	
		3.	I am usually objective when I watch a movie or play, and I don't often get completely caught up in it	
		4.	Becoming extremely involved in a good book or movie is somewhat rare for me.	
		5.	After seeing a play or movie, I have felt as though I were one of the characters.	
			FS6- When I watch a good movie, I can very easily put myself in the place of a leading character.	
			FS7-When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.	
Empathic Concern	Measures people's other-oriented feelings of sympathy for the misfortunes of others. Measures emotional component of empathy	1.	I often have tender, concerned feelings for people less fortunate than me.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
		2.	When I see someone being taken advantage of, I feel kind of protective towards them.	
		3.	Other people's misfortunes do not usually disturb me a great deal.	
		4.	When I see someone being treated unfairly, I sometimes don't feel very much pity for them.	
		5.	Sometimes I don't feel very sorry for other people when they are having problems.	

		6.	I am often quite touched by things that I see happen.	
		7.	I would describe myself as a pretty soft-hearted person.	
Personal Distress	Measures self-oriented feelings of distress during others' misfortunes	1.	Being in a tense emotional situation scares me.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
		2.	I am usually pretty effective in dealing with emergencies.	
		3.	In emergency situations, I feel apprehensive and ill-at-ease.	
		4.	I sometimes feel helpless when I am in the middle of a very emotional situation.	
		5.	When I see someone get hurt, I tend to remain calm.	
		6.	I tend to lose control during emergencies.	
		7.	When I see someone who badly needs help in an emergency, I go to pieces.	
Perspective taking	Measures people's tendencies to imagine other people's points of view. Measures cognitive or intellectual component of empathy	1.	I sometimes find it difficult to see things from the "other guy's" point of view.	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
		2.	I try to look at everybody's side of a disagreement before I make a decision.	
		3.	I sometimes try to understand my friends better by imagining how things look from their perspective	
		4.	If I'm sure I'm right about something, I don't waste much time listening to other people's arguments	
		5.	I believe that there are two sides to every question and try to look at them both.	
		6.	When I'm upset at someone, I usually try to "put myself in his shoes" for a while.	
		7.	Before criticizing somebody, I try to imagine how I would feel if I were in their place.	
Empathy baboons				
Empathic Concern		1.	I often have tender, concerned feelings for baboons in general	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
		2.	When I see baboons being hurt I feel kind of protective towards	
		3.	them	
		4.	When I see baboons in distress it doesn't disturb me a great deal	
		5.	When I see baboons being treated badly I sometimes don't feel much pity for them	

	6.	Sometimes I don't feel very sorry for baboons when they are having problems	
		When it comes to baboons, I would describe myself as a pretty soft-hearted person	
Personal Distress	1.	When I see baboons hurt I tend to remain calm	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
	2.	When I see baboons who badly need help in an emergency, I go to pieces	
Perspective taking	1.	When I am upset about something baboons have done, I usually try to "put myself in its shoes" for a while	1=not like me at all, 2=not like me, 3=a little like me, 4=somewhat like me, 5=like me, 6=very much like me
	2.	When baboons are being problematic or a nuisance to me I often try to see things from their perspective as well	
	3.	I sometimes try to understand baboons better by imagining how things look from their perspective	
Perception Baboon population size			
Bab_abund_area	1.	How **ABUNDANT or RARE** do you personally think baboons are **IN YOUR AREA?**	1= Very rare, 2= Quite rare, 3= Neither rare nor common, 4= Quite common, 5= Very common
Bab_abund_africa	1.	How **ABUNDANT or RARE** do you personally think baboons are **IN AFRICA**?	1= Very rare, 2= Quite rare, 3= Neither rare nor common, 4= Quite common, 5= Very common
Bab_abund_CP	1.	How **ABUNDANT or RARE** do you personally think baboons are on the **CAPE PENINSULA?**	1= Very rare, 2= Quite rare, 3= Neither rare nor common, 4= Quite common, 5= Very common
Knowledge			
Knowledge_gen	1.	How **KNOWLEGEABLE** are you about **BABOON BEHAVIOUR AND HABITS** compared to an expert who has studied each species for 5 years or more?	1= I have very little knowledge , 2= I have a small amount of knowledge , 3= I have average knowledge, 4= I have quite a lot of knowledge , 5= I am very knowledgeable
Knowledge_house	1.	How **KNOWLEGEABLE** are you about **HOW TO BEHAVE when baboons ENTER YOUR HOUSE?**	1= I have very little knowledge , 2= I have a small amount of knowledge , 3= I have average knowledge, 4= I have quite a lot of knowledge , 5= I am very knowledgeable
Economic stress			

Econ_stress_avg	The extent to which a persons feels finantial pressure	1. 2. 3.	I feel comfortable with my current economic situation I worry about my ability to earn enough money for myself and my family in the future I am confident my future financial situation will be satisfactory	1=strongly disagree, 2=moderately disagree, 3=slightly disagree 4=neither, 5=slightly agree, 6=moderately agree, 7=strongly agree
Personal norm				
Respons_avg		1. 2. 3.	The authorities in Cape Town are responsible for ensuring that baboons do not damage my property I believe residents should take full responsibility to manage their property to prevent baboon damage I believe it is my responsibility to prevent baboon damage on my property	
Pets				
Pets_tot		1.	Total number pets in household	
Pets_dog		1.	Total number dogs	
Cats		1.	Total number cats	
Pets_grow_up		1.	Did you grow up with pets?	
Pets_love		1.	Please list the extent to which you **LOVE YOUR PET**/s.	**1=love a small amount and 5 =love very much**
Pets_part_family		1.	Please list the extent to which you feel your **PET/s PART OF YOUR FAMILY**	**1=not part of my family at all and 5=very much part of my family.**
Pro-environmental behaviour				
Meat_YN		1.	Do you eat meat	yes/no
Meat_freq		1.	If yes, how often?	1=Once every 3 months, 2= Once a month 3=Once a week, 4=A few times a week.
Organic	Interest in buying organically farmed food	1.	How much of the food you buy and eat is organic food?	1=0% , 2=about 20% ,3=about 40% ,4=about 60% ,5=about 80% ,6=about 100%
Recycle_y/n		1.	Do you recycle your household waste?	Yes/no
Interest_meat_pred_friend	Interest in predator friendly meat	1.	If you are a **MEAT EATER**, how would you feel about having a choice to buy **PREDATOR FRIENDLY MEAT?** Predator friendly meat is meat that has been derived from farming practices	1=I would not be interested at all 2=I might be interested 3=I would be interested.

			that use methods to minimize losses from predators using ethical and holistic management practices.	
WTP_pred_friendly	Willingness to pay extra for predator friendly meat	1.	If you were interested, how much **PERCENT** would you be willing to **ADD** to the price of regular meat?	%
Pro_Env_index	Pro-environmental index	1.	We computed a pro-environmental index by adding the scores of the variables; meat_Y/N, meat_freq, organic, recycle, %meat_pred_friendly.	The higher the score the less pro-environmental the person
Socio demographic				
Res_full_part		1.	Number of years you have lived in village full time or part time resident	Number of years
Yrs_village		1.	Number of years lived in village	Number of years
Size_vil_grow		1.	Where did you grow up?	1=farm, 2=rural village, 3=small town, 4=large town, 5=city
Age_category		1.	Age	1=20's, 2=30's, 3=40's, 4=50's, 5=60's, 6=>70
Educ_level		1.	Highest level of education	
Gender		1.	Gender	Male/female
Hunter_past_yn		1.	Have you ever been a hunter	Yes/No
Adult_houshld		1.	Number of adults in household	Number
Child_tot		1.	Number of children in household	Number
Tot_house_hold		1.	Total number of people in household	Number
Income_yearly		1.	What yearly income class is your household?	1=less than R60,000 2=60,000-120,000 3=120,000-240,000 4=240,000-480,000 5=>480,000
Value_property		1.	Please tick the estimated value of the property on which you reside	1=Less than R50 000 2=50 000- 100 000 3=102 000-200 000 4=201 000 -300 000 5=301 000-400 000 6=401 000-800 000

			7=801 000-1.6 million 8=1.6 million-3.2 million 9=more than 3.2 million
General			
1.	Overall_experience	How would you evaluate YOUR OVERALL EXPERIENCE of baboons?	1= very negative 2=negative 3=neutral 4=positive 5= very positive.
2.	Prob_bab	How much of a PROBLEM are BABOONS for your HOUSEHOLD? Please tick the appropriate number indicating the extent of the problem. Please describe the problems you have with baboons.	1 = not a problem at all and 7= a crisis?
3.	Tot_neg_tot_pos_emotion	The sum of the intensity of negative emotions minus the sum of the intensity of positive emotions for each respondent. Since there were more negative emotions in the list (23) compared to positive emotions (12), a negative value indicates relatively more positive emotions while a positive value indicate relatively more negative emotions	
Support for management options by authorities			
Management Options		**There are a number of management tools that can be used by the authorities to manage the interactions between baboons and people on the Cape Peninsula. We would like to know the extent to which you SUPPORT these MANAGEMENT OPTIONS. Please tick the appropriate box which represents the extent of your support for each management option.**	1=Do not support at all 2= Do not support 3= Medium support 4=support 5=support completely 6=don't know
	1.	Baboon monitors/chasers to keep baboons away from residential areas-with no weapons	

		2.	Baboon monitors/chasers to keep baboons away from residential areas- with paint ball guns	
		3.	Baboon monitors/chasers to keep baboons away from residential areas- with loud noises such as bear bangers	
		4.	Shoot at and kill some baboons with live ammunition every now and again	
		5.	Treat injured baboons	
		6.	Destroy male baboons that cause repeated problems ONLY **if there are other males in the troop**	
		7.	Destroy male baboons that cause repeated problems **irrespective of how many other males there are**	
		8.	Destroy some female baboons that cause repeated problems	
		9.	Destroy whole troops that cause repeated problems	
		10.	Electric fences around residential areas	
		11.	Feeding stations in mountains to keep baboons away from residential areas	
		12.	Translocate **dispersing males** to troops with a shortage of males	
		13.	Destroy **dispersing males** when there are no other troops for them to join	
		14.	Provide water points in the mountains for baboons to drink in dry months	
		15.	Education of residents, general public and tourists	
		16.	Law enforcement for feeding baboons	
Mitigation measures implemented by residents				
Mitigation measures	Use of mitigation measures, their effectiveness and difficulty to implement	1.	Which of the following **measures have you tried to prevent and reduce baboon damage? Please mark all those you have tried by ticking the ☐ in the first column. In the remaining columns, indicate the extent to which you found them to be effective.**	Effectiveness of mitigation measures: 1= Never effective 2= Somewhat effective 3= Moderately effective 4=Quite effective 5=Very effective
		2.	Below is a list of **measures one could use to prevent damage by baboons**. We would like to know **how <u>EASY OR DIFFICULT</u> it is**, or would be **for you to use these methods. Please tick the box in the column that represents how easy or difficult it is for you.**	1=very difficult 2=difficult 3= Neither difficult nor easy

For those that are difficult, please give reasons.

4=easy
5=very easy

1. Baboon proof compost bin
2. Baboon proof rubbish bin
3. Baboon proof vegetable garden (cage, netting, e-fence etc)
4. Baboon proof fruit trees (cage, netting, e-fence etc)
5. Baboon proof windows (bars or special locks etc)
6. Baboon proof doors (Trellidoor etc)
7. Baboon proof pantry
8. Chase baboons off my property calmly without shouting or using any additional aids
9. Chase baboons off my property aggressively by shouting or running at them but without using any additional aids
10. Chase baboons off my property with water/hosepipe
11. Chase baboons off my property with a katty
12. Chase baboons off my property with a pellet gun
13. Chase baboons off my property with a paint ball gun
14. I call someone to help me chase them-a family member or neighbour
15. I use my dogs to help me chase them
16. Dogs warn me when baboons are around
17. I call the baboon hotline to help me
18. Keep windows and doors closed even when the baboons are not around
19. Keep windows and doors closed only when I know the baboons are around
20. Keep food out of sight
21. Keep food locked away at all times
22. No food in garden (pet food, bird seed, fruit trees)
23. I usually don't chase them
24. Other:

Institutions		
Institutions	Trust in and	There are a number of **ORGANIZATIONS** that have been involved in **BABOON**

efficacy of organizations involved in baboon management		**MANAGEMENT** and **RESEARCH** on the **CAPE PENINSULA** in the last 10 years. **Please indicate if you are familiar with these organizations by ticking the ☐ in the first column. Then record the extent to which you think they have undertaken the various tasks listed:**	**1=very poorly** **2=poorly** **3=average** **4=good** **5=very good** **6=don't know**
	1.	Trust in the organization	
	2.	General Performance	
	3.	Skills and knowledge to manage baboons	
	4.	Communication with residents	
	5.	Education of residents	

Nine organizations were listed:

1. City of cape Town (CoCT)-The municipality of the city of Cape Town.
2. Table Mountain National Park (SANP)-A National government organization – South African National Parks (SANP) managing specific national Parks in South Africa of which TMNP is one.
3. Cape Nature (CN)-The provincial authority responsible for natural resource management and ordinances in the western Cape
4. Baboon Technical Committee (BTT)-consisting of CoCT, SANP and CN and responsible for managing baboons on the Cape Peninsula
5. Baboon Liaison Group (BLG)-residents associations from baboon affected areas
6. Nature Conservation Corporation (NCC)-managers of baboon monitors until july 2012
7. Baboon Matters Trust (NGO) –an advocacy and education group for baboon issues
8. Baboon Research Unit (UCT) – a reseach unit at the University of Cape Town that focuses on baboon research
9. Your ratepayers association

APPENDIX VIII

Non response bias for survey respondents from Chapter 5 and 6.

Comparison between respondents who agreed to complete the survey but did not with those who did complete the survey. T test, two tailed P values. Questions used are shown in the postscript of table.

	Non response group	Response group	t-test	df	P
Problem baboons	3.58±1.91	3.39±1.98	0.518	427	0.61
Stress baboons	3.06±2.2	2.96±2.0	0.288	432	0.774
Nuisance baboons	3.5±2.1	3.26±2.1	0.64	431	0.523
Enjoy baboons	4.5±2.1	4.5±2.0	-0.017	429	0.987
Interest baboons	3.38±1.19	3.79±1.16	-1.909	35.9	0.064
Interest baboon management	3.69±1.18	3.96±1.08	-1.35	426	0.179
Like/dislike baboons	4.88±1.76	5.34±1.60	-1.58	427	0.114
People /animal	4±1.73	4.0±1.57	-0.035	427	0.972
Domestic/wild	3.81±1.34	4.23±1.31	-1.7	430	0.09
Pop area	3.04±1.23	2.95±1.28	0.034	420	0.74
Pop CT	3.29±1.24	3.26±1.28	0.118	420	0.9
Years lived in village	10.58±8.92	10.88±8.88	-0.169	412	0.87
Age gp	41.1±12	46.4±13	-2.28	31.64	0.03*

Problem baboons, Stress baboons, Nuisance baboons, Enjoy baboons-see Appendix VII for questions used.
Interest baboons: How interested are you in BABOONS?: 1=not interested at all and 5=very interested

Interest baboon management: How interested are you in BABOON MANAGEMENT in Cape Town?: 1=not interested at all and 5=very interested
Like/dislike baboons: Please indicate the extent to which you LIKE or DISLIKE Baboons where 1 is dislike very much and 7 is like very much.
People /animal: Would you describe yourself as more of a "PEOPLE" or "ANIMAL" person? Choose the extent on a scale of 1 to 7 where 1 = leaning towards preference for animals and 7 =preference for people.
Domestic/wild: Comparing domestic to wild animals, indicate the extent to which you PREFER DOMESTIC or WILD ANIMALS where 1=strong preference for domestic animals and 7= strong preference for wild animals?
Pop area: Would you like the population of baboons IN YOUR AREA to decrease, stay the same or increase? 1=decrease a lot, 5=increase a lot
Pop CT: Would you like the population of baboons in CAPE TOWN to decrease, stay the same or increase? 1=decrease a lot, 5=increase a lot
Years lived in village: How many years/months have you lived in this village?
Age group: ☐20's ☐30's ☐40's ☐50s ☐60's ☐>70

APPENDIX IX

Descriptive statistics of items of each of the constructs of the outer model of the Wildlife Tolerance Model

Since the WTM constructs in the Structural Equation Model (SEM) were standardized the descriptive statistics from the SEM results are not meaningful. We therefore report separate descriptive statistics for each construct indicator in order to provide the context for the case study. See Appendix VII for questions used.

1. Exposure

a. Neighborhood visits
Baboons were present in the suburbs between once a week and twice a month in summer of 2011-2012 and between once or twice a month in the winter of 2012. When considering the proportion of residents visited weekly, monthly or rarely, in the summer 56%, 30% and 14% were visited weekly, monthly and rarely respectively compared to 32%, 41%, and 27% in winter respectively (Fig 2).

b. Property visits
Properties were visited less frequently than neighborhoods in both summer and winter. In the summer of 2011-2012, 39%, 31% and 30% of residents were visited weekly, monthly and rarely respectively compared to 21%, 36%, and 43% in winter respectively (Fig 2).

c. House visits
Baboons entered houses on average 2+-3.1 times in summer and 1+-2.3 time in winter. The range was from 0 to 24 visits in summer and 0-36 in winter. In summer 39% (winter 67%) of residents never had baboons inside their house. Of the remaining 61% (winter 33%) that did, 34% had 1-2 visits, (winter 23%), 15% had 3-4 visits (winter 6%) while 12% had over 5 visits (winter 5%) (Fig 2).

2. Experiences

a. Positive experiences

The mean number of positive experiences reported by residents was 7.5+-60.3. On average half (54.6%) of respondents had some positive personal experience with baboons. One quarter (26,6%) had up to 10 positive experiences and another quarter (26%) had more than10 positive experiences at any point in their lives (Fig 4).

b. Negative experiences

The mean number of negative experiences was 2.2+-6.3. Overall 60% of residents have had at least one negative experience with baboons in their life but most (42,7%) had between 1-4 negative experiences. A minority (7.2%) had more than 5 negative experiences (Fig 4).

3. Tangible costs

a. Damage in Rands

On average residents incurred R813+- 2409 damage in summer and R331+-1411 in winter. In summer when most damage occurred, almost half (46.4%) of residents experienced no damage from baboons while in winter ¾ had no damage (74.5%). Of the remaining half who did experience some damage in summer (54.6%), one third had costs up to R500 while another third (31.1%) had costs over R500. 3.5% incurred costs over R5000 (Fig 2).

b. Mitigation measures

On average residents had spent R3200+-12212 on mitigation measures since baboons had started entering villages. But half (52.6%) of respondents had spent nothing on mitigation measures while the other half spent up to R10,000 to prevent damage from baboons. Of these 20% spent between R1-R500 while a third (27.3%) spent between R1000-R10000 (Fig 3).

Of the 23 mitigation measures listed in the survey, the mean number used by residents was 7.7+-3.8 (median =7) but 65% of residents used between 5-10 measures. Only 18% used more than 10 measures and 13% less than 5 measures (Fig 3).

c. Extent damage

The average score for predicted future damage by baboons was 2.1+-0.8 on a scale of 1-5 where 5 was high (i.e slight damage). A quarter of residents predict no damage in future while half predict slight damage. Only 19% predict medium damage while 11.6% predict high damage in future (Fig 3).

4. Intangible costs

a. Negative emotions

Ninety percent of residents have at least one negative emotion due to baboon presence but most (40%) have between 1-4 negative emotions, 21% have between 5-9 while the remaining 28% have between 10-23 negative emotions (fig x). However most of these emotions are weakly felt (78%) and only 2% are felt strongly, at intensity 4-5. The mean intensity score was 0.83+- 1(Fig 3).

Most residents (64.4%) find it stressful to some extent living with baboons. Of these a third (28.4%) feel a small stress, 20% feel medium stress while 16% feel large stress (Fig 3). The mean stress score was 3+- 1.6 (scale 1-7)

Similar trends were found for nuisance (Fig 3). The mean nuisance score was 3.3+- 2 (scale 1-7)

b. Difficulty living with baboons
Most residents (62%) disagreed with the statements around some difficulty living with baboons while a quarter (24%) agreed with these statements (Fig 4).
The average score for the six questions of this construct was 3.4+- 1.7 (scale 1-7)

c. Difficulty implementing mitigation measures
A third of residents (35.8%) find the listed mitigation measure difficult to implement while a quarter (23%) find them easy to implement. Forty one percent find them neither easy nor difficult (Fig x). The average difficulty is 3.4+-0.8 (Fig 3).

d. Fear and danger
Most residents (83%) think baboons are dangerous to humans to some extent but most think they are a small to moderate danger (62%) while a quarter (24%) think they are quite or very dangerous (Fig 3). The mean danger score was 2.6+-1.1 (scale 1-5)

Most residents (60%) are afraid of baboons to some extent in general. But of these most (45.2%) have a small to medium fear while only 15.1% are quite or very afraid (fig 3). The mean score was 2.1+-1.2 (scale 1-5)

But when baboons enter their home the level of fear increases to 83.6% of residents feeling some fear and to 32.6% feeling quite or very afraid (fig 3). The mean score also increased to 2.9+-1.3 (scale 1-5)

But when residents estimated the fear of other members in their household when baboons enter the house, the levels of fear increased further. Almost 90% reporting that other members of their household are afraid to some extent and 52.2% reporting these members feel quite or very afraid (fig 3). The mean score also increased to 3.3+-1.4 (scale 1-5)

5. Benefit Intangible

a. Emotions
Most (87.8%) of residents felt at least one positive emotion towards baboons and half (49.1%) felt 10-12 of the 12 positive emotions listed. However most (39.6%) felt them weakly. The remaining felt them at equal frequencies 16%, 15.3% and 15.8% at

intensities of 2,3 and 4 respectively. Only 3.3% felt them very strongly (fig 4). The mean intensity felt was 2.2+-1.6.

b. Perception of benefits

Most residents thought baboons were beneficial to some extent, mostly for nature (95%)and to a lesser extent for mankind (88%), their community (76%) and personally (89%). The extent of benefit was larger more often than smaller regarding benefits to self (small=36%, large=53%), mankind (small=33%%, large=55%), and nature (small=21%, large=74%), but equally small and large for community (small=38%, large=38%), (fig 4). The mean scores for benefit you, community, mankind and nature were 3.1+- 1.5, 3+-1.4, 3.6+-1.3 and 4.1+-1.1 respectively

6. Tolerance

a. Spatial
Most (75%) residents would not tolerate baboons inside their house at all but most (79%) would tolerate them to some extent in their neighborhood or on their property (69%) to some extent. Of those who would tolerate them inside their house, 23% would tolerate them up to 1 month per year and 2% would tolerate them for 3 or more months of the year. Of those who could tolerate baboons visiting their neighborhood, 39% would tolerate them for up to one month of the year and 20% would tolerate them for more than 3 months a year. Of those who could tolerate property visits, 40% would tolerate visits up to one month a year 20% would tolerate them for more than 3 months a year. (Fig 5)

The mean number of days residents would tolerate baboons in their neighborhood was 94+-136 days per year (i.e. 3 months), 59+-109 (2 months) on their property and 8+-50 inside their home.

b. Damage
Most residents (62.9%) would not tolerate any damage from baboons. Of the remaining 37.1% who would tolerate some damage, a quarter (25.7%) would tolerate damage upto R500, 9.8% would tolerate up to R5000 and 1.6% would tolerate upto R10,000 (Fig 4). Extrapolating these figures into total rands per year (26%x 403 respondents x R250+10% x 403 x R2500+1.6% x 403 x R5000) amounts to R159,185 of damage per year that residents are willing to tolerate. Assuming 10% of the population was sampled in our survey, R159,185 x 10 = R1.6 million

The mean amount of money residents would tolerate was R340+-1348.

c. Population size
Most (51%) residents would like the population of baboons in their area and in Cape Town (46%) to stay the same. A third (28%) of residents would like the population in

their area to decrease while only 13% would like them to increase. A quarter of residents would like the pop in CT to decrease (22%) and an additional quarter to increase (22%). Most residents would like the population in Africa to stay the same (43%) or increase (38%). Only 4% would like to see it decrease. (fig 5).

The mean score for desired population size in a residents area was 3+-1.3, in Cape Town 3.3+-1.3 and in Africa 3.9+-1.2 (scale1-5)

d. Killing

When taking the first yes answer, most residents think there are contexts when a baboon should be killed when baboons are common (80%) or rare (76%) in an area.

Most residents think consideration of killing a baboon should take place only after it has first injured a child or adult human, 69% if baboons are common and 71% if it is rare. Of these a quarter (22%, 25%) think it should be killed after it has injured a child or human and a further 20% think it should only be killed after it has killed a child or human. A further 20%-26% think a baboon should never be killed irrespective of its behavior both when it is common or rare (20%, 26%) (fig 5).

A minority of residents, between 8%-14% think baboons should be killed if it has caused damage for the first time, while only 1%-3% think baboons should be killed when it is first seen in an area close to human habitation (fig 5).

The mean score for when baboons are common was 5.8+-1.8 and 6.1+-1.6 with When however one considers the first uncertain record, residents are less tolerant (fig 5). In this case only 35%-49% think consideration of killing a baboon should take place only after it has injured a human. Therefore 22-33% of respondents were uncertain about if it should be killed before. The mean score for when baboons are common was 4.6+-1.9 and 5.1+-1.8

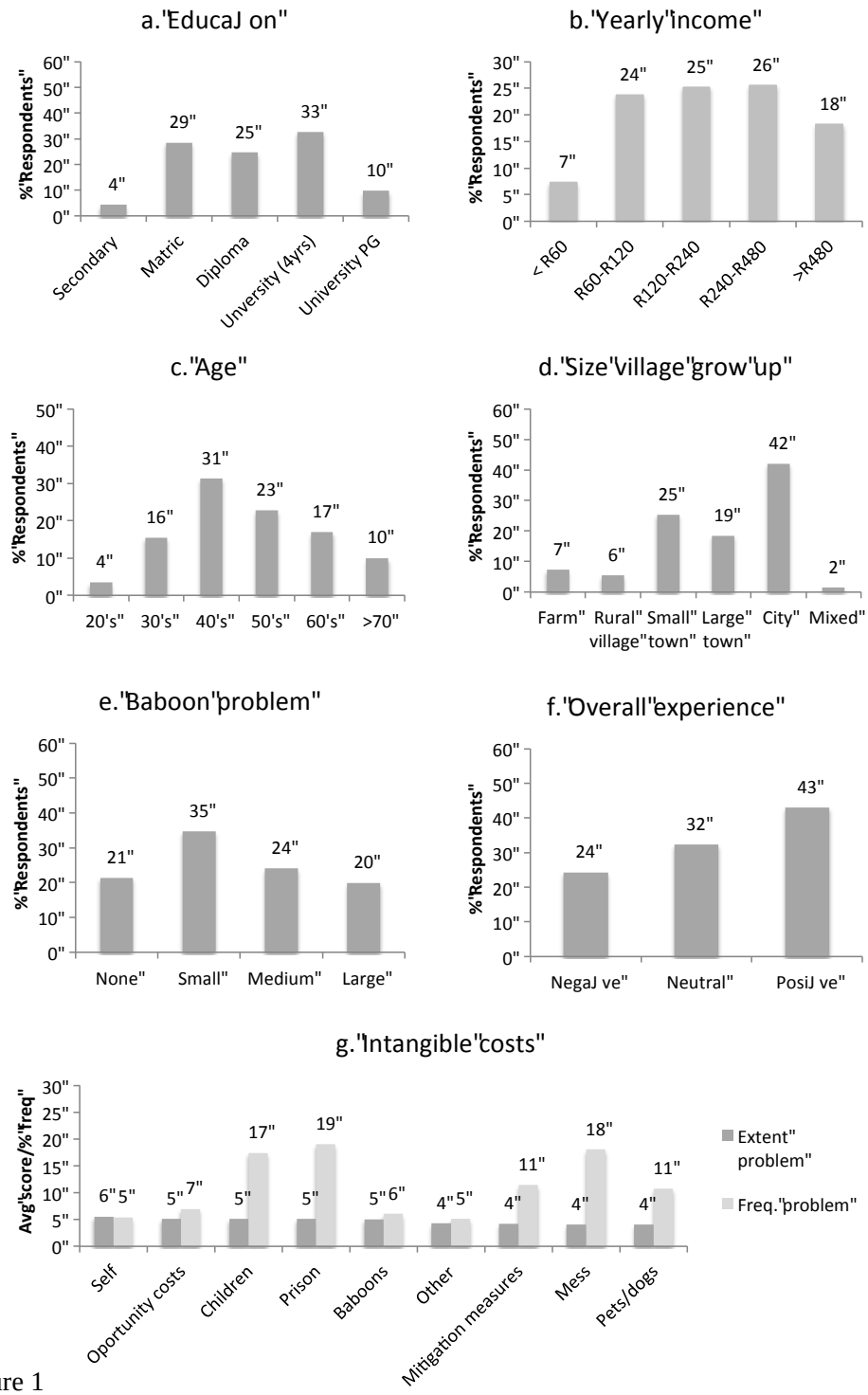

Figure 1

Figure 1. Descriptive statistics for a. the educational profile of respondents, b. yearly income of respondent, c. age profile and d. size of village where respondent grew up. e to g are responses to survey questions as shown in Table 1 of the main manuscript

as follows: e. extent of problem respondents experience due to baboons on a scale of 1-7 where 1 is no problem and 7 a crisis. This scale was collapsed where 1=none, 2-3=small, 4-5=medium and 6-7 =large, f. Overall experience of baboons on scale of 1-5 where 1 is very negative and 5 is very positive. Scale collapsed where 1-2=negative, 3=neutral, 4-5=positive, g. Categories of intangible costs as reported by respondents in open ended question "Please describe the problems you have with baboons". Extent of problem is the average score for all respondents associated with the quantitative part of the question (see "General" Table 1). Frequency is the number of times the problem category was listed by all respondents reported as a percentage.

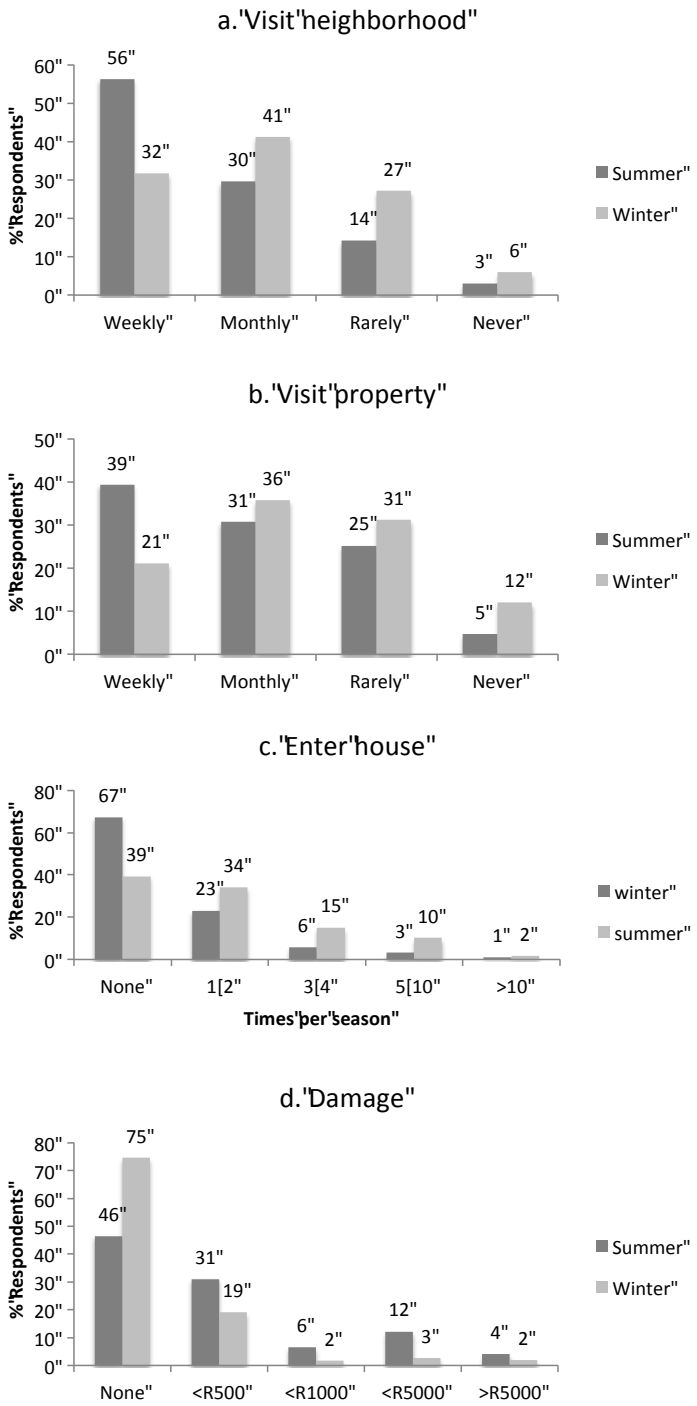

Figure 2

Figure 2. Exposure to baboons during summer and winter and monetary damage (tangible costs). Exposure: a,b, the proportion of days respondents were exposed to baboons as reported by the question “how often did baboons visit you a. your

neighborhood, b. your property in summer and winter" (see "exposure" table 1 main text). Weekly= 2-7 days a week (6-30 days a month), monthly=1-4 days a month, rarely =1x month-1 x 3 months (1-4 days in 3 months). c. number of times baboons entered inside their house. Tangible costs: d. damage in Rands experienced by respondents during summer and winter

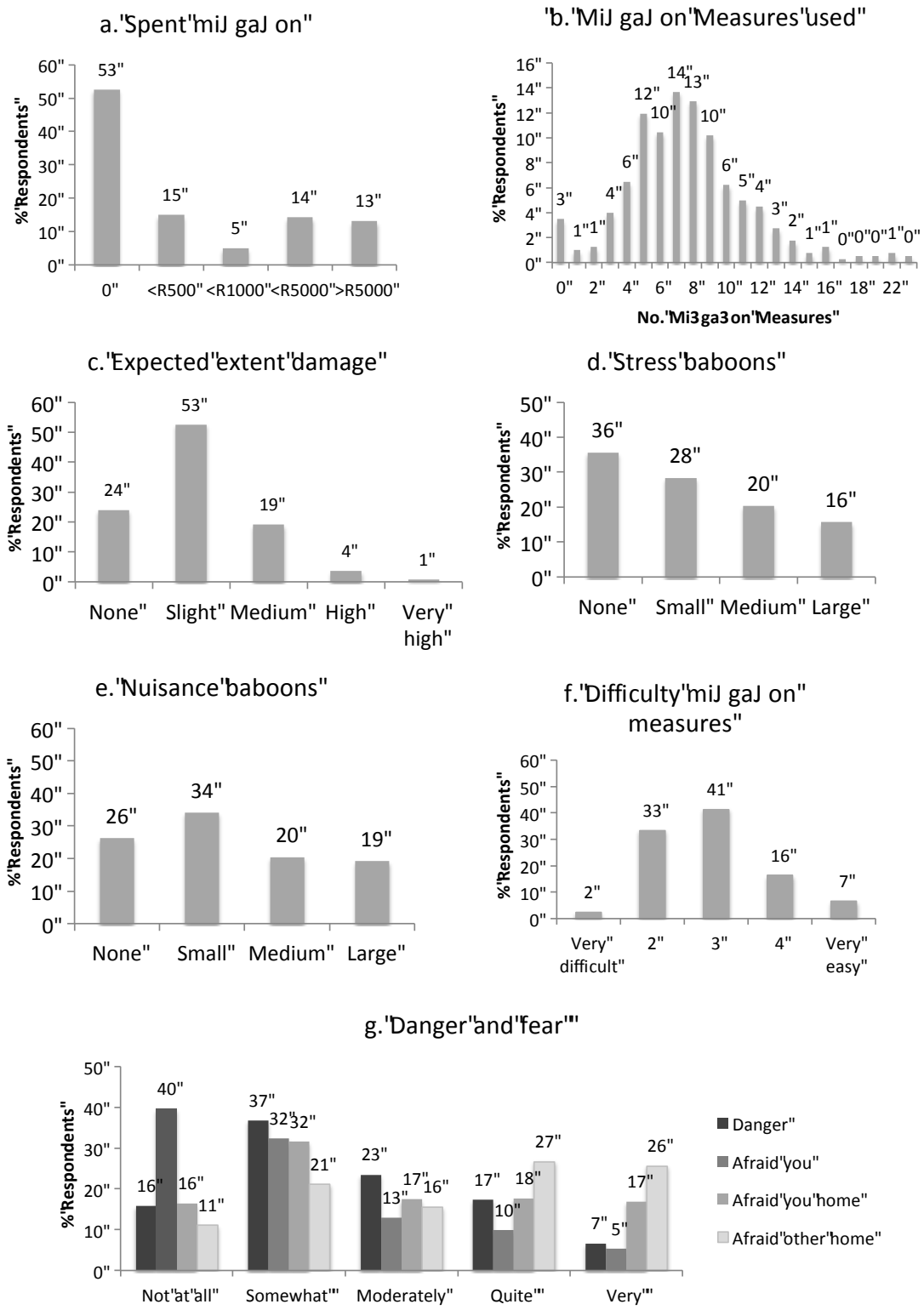

Figure 3

Figure 3. Tangible and intangible costs (see table 1. main text for questions used). Tangible costs: a. The amount of money residents have spent on mitigation measures to prevent or reduce impacts from baboons since they started raiding their village. b. the number of mitigation measures used on a regular basis to prevent impact of baboons from a list of 23. Intangible costs: c. the extent to which residents expect future damage from baboons. d,e the stress (d) and nuisance (e) respondents feel due to the presence of baboons on a scale of 1-7 where 2-3=small, 4-5=medium and 6-7 large. F. the extent to which respondents find implementing the 23 mitigation measures difficult where 1 is very difficult and 5 very easy. g. The extent to which respondents think baboons are dangerous to human, afraid of baboons in general, afraid when they enter their home and the extent to which other members of their household are afraid when they enter the home.

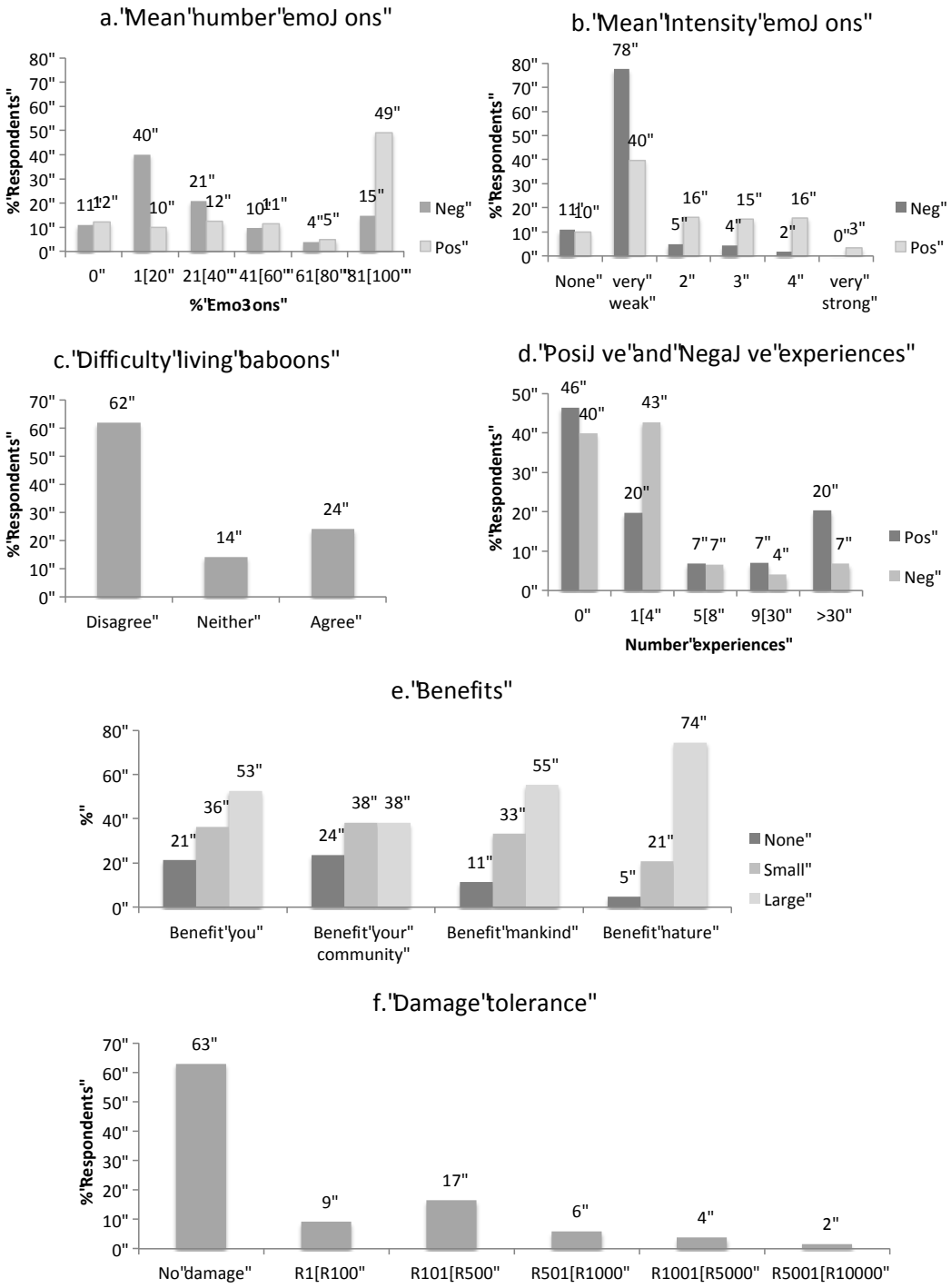

Figure 4

Figure 4. Intangible costs, Intangible benefits and Tolerance (see table 1. main text for questions used). a. Mean number of emotions due to baboons as a proportion of 12 positive and 23 negative emotions listed. b. Mean intensity of emotions. c. Extent to which respondents agreed with five questions relating to difficulties of living with

baboons. d. Categories of the number of negative and positive experience respondents have ever had with baboons, e. the extent to which respondents rated baboons as beneficial to themselves, their community, mankind in general and nature on a scale of 1-5 where1=none, 2-3= small and 4-5=large, f. The amount of damage in Rands that respondent could tolerate due to baboons.

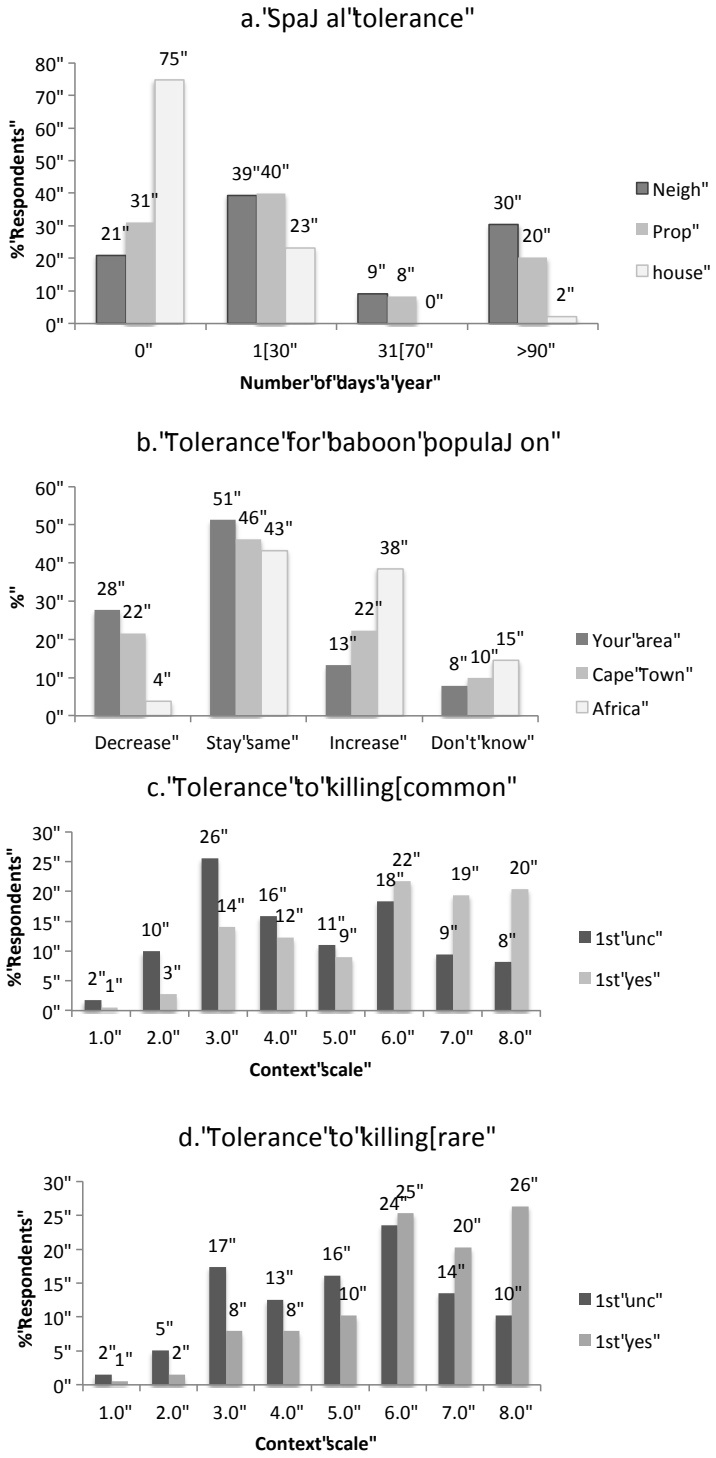

Figure 5

Figure 5. Tolerance indicators (see table 1. main text for questions used). a. proximity tolerance-the number of days per year that respondents could tolerate baboons in their neighborhood, on their property and inside their house, b. population tolerance-the extent to which respondents would like the baboon population in their area, in Cape Town and in Africa to decrease, increase or stay the same, c,d. tolerance to killing of baboons for 7 different contexts and two cases; when baboons are common or rare.

Two indexes were computed; "1st yes" and "1st uncertain". See methods section in main text for index calculation.

APPENDIX X

Construct reliability and validity for variables in chapter 6

Indicator reliability

Indicator reliability is the square of a standardized indicator's outer loading. It represents how much of the variation in an item is explained by the construct and is the results of single regressions of each indicator variable on their corresponding construct (Hair et al. 2014). At a minimum all outer loadings should be statistically significant (Hair et al. 2014). A value of 0.70 or higher is preferred. If it is exploratory research, 0.4 or higher is acceptable (Hulland 1999).

Internal consistency

Internal consistency is used to determine whether the items measuring a construct are similar in their scores (i.e. if the correlations between the items are large) (Hair et al. 2014). Traditionally, Cronbach's α is used but composite reliability is considered more suitable in PLS-SEM (Hair et al. 2014). Composite reliability should be between 0.7 -0.9. For exploratory research 0.6 is acceptable. (Hair et al. 2014).

Convergent validity

Convergent validity is the extent to which a measure correlates positively with alternative measures of the same construct and is a measure of communality of a construct, measured by average variance extracted (AVE) (Hair et al. 2014). An AVE value of 0.5 or higher indicates that on average the construct explains more than half of the variance of its indicators. An AVE value of 0.5 or higher is required (Bagozzi and Yi 1988).

Discriminant validity

Discriminant validity is the extent to which a construct is truly distinct from other constructs and therefore captures phenomena not represented by other constructs in the model (Hair et al. 2014). The Fornell-Larckner criterion compares the square root of the AVE values with the latent variable correlations, which should be greater than its highest correlation with any other construct. The logic of this method is based on the idea that a construct shares more variance with its associated indicators than with any other construct (Hair et al. 2014).

Latent variable	Indicators	Indicator reliability (outer loadings)	Internal consistency (composite reliability)	Convergent validity (AVE)	Discriminant validity
Interest in wildlife					
Passive	PAS1	0.82	0.817	0.533	Yes
	PAS2	0.73			

	PAS3	0.78			
	PAS4	0.56			
Active	ACT1	0.78	0.845	0.523	Yes
	ACT2	0.61			
	ACT3	0.67			
	ACT4	0.76			
	ACT5	0.78			
Area	AR1	0.79	0.864	0.517	yes
	AR2	0.70			
	AR3	0.82			
	AR4	0.68			
	AR5	0.64			
	AR6	0.67			
Wild baboon	WB1	0.75	0.891	0.622	yes
	WB2	0.68			
	WB3	0.88			
	WB4	0.88			
	WB5	0.74			
Wildlife Value Orientation	USE1	0.7	0.747	0.385	Yes
	USE2	0.82			
	USE3	0.62			
	USE4	0.42			
	USE5	0.44			
	HUN1	0.51	0.835	0.510	Yes
	HUN2	0.84			
	HUN3	0.81			
	HUN4	0.74			
	HUN5	0.62			
	CAR1	0.82	0.883	0.654	Yes
	CAR2	0.71			
	CAR3	0.82			
	CAR4	0.87			
	AFF1	0.84	0.825	0.613	yes
	AFF2	0.8			
	AFF3	0.71			
Anthropomorphism	Happiness	0.82	0.819	0.439	Yes
	Hatred	0.52			
	Pain	0.54			
	Past	0.71			
	Plans	0.55			
	Reason	0.77			
Belief in Animal Mind	BAM1	0.52	0.758	0.444	yes
	BAM2	0.73			
	BAM3	0.77			
	BAM4	0.62			
Difficulty living with baboons	DIF1	0.87	0.909	0.626	Yes
	DIF2	0.79			
	DIF3	0.73			
	DIF4	0.79			
	DIF5	0.81			
	DIF6	0.74			

Economic Stress	ES1	0.84	0.855	0.664	Yes
	ES2	0.72			
	ES3	0.88			
Personal Norm	RESP1	0.63	0.813	0.597	yes
	RESP2	0.76			
	RESP3	0.9			
People empathy	EC1	0.72	0.820	0.404	yes
	EC2	0.68			
	EC3	0.63			
	EC4	0.47			
	EC5	0.38			
	EC6	0.74			
	EC7	0.72			
	FS1	0.4	0.836	0.433	yes
	FS2	0.68			
	FS3	0.55			
	FS4	0.51			
	FS5	0.75			
	FS6	0.8			
	FS7	0.8			
	PD1	0.75	0.862	0.474	Yes
	PD2	0.63			
	PD3	0.76			
	PD4	0.71			
	PD5	0.71			
	PD6	0.63			
	PD7	0.62			
	PT1	0.61	0.856	0.468	yes
	PT2	0.70			
	PT3	0.76			
	PT4	0.36			
	PT5	0.7			
	PT6	0.76			
	PT7	0.79			
Baboon empathy	EC1	0.87	0.872	0.541	no
	EC2	0.84			
	EC3	0.66			
	EC4	0.56			
	EC5	0.55			
	EC7	0.85			
	PD5	0.23	0.609	0.52	yes
	PD7	0.99			
	PT	0.93	0.949	0.86	yes
	PT3	0.94			
	PT6	0.91			
	EC+PT		0.92	0.573	yes
Values	AC1	0.86	0.763	0.531	Yes
	AC2	0.8			
	AC3	0.47			
	BEC1	0.83	0.874	0.698	Yes
	BEC2	0.89			

BEC3	0.78			
BED1	0.76	0.834	0.626	Yes
BED2	0.81			
BED3	0.81			
COI1	0.8	0.881	0.711	Yes
COI2	0.86			
COI3	0.86			
COR1	0.91	0.931	0.817	Yes
COR2	0.9			
COR3	0.91			
FAC1	0.8	0.871	0.692	Yes
FAC2	0.82			
FAC3	0.87			
HE1	0.84	0.868	0.687	Yes
HE2	0.86			
HE3	0.78			
HUM1	0.67	0.751	0.508	Yes
HUM2	0.86			
HUM3	0.57			
POD1	0.73	0.844	0.645	Yes
POD2	0.84			
POD3	0.84			
POR1	0.89	0.781	0.556	Yes
POR2	0.8			
POR3	0.49			
SDA1	0.85	0.829	0.620	Yes
SDA2	0.65			
SDA3	0.84			
SDT1	0.75	0.816	0.597	Yes
SDT2	0.79			
SDT3	0.78			
SEP1	0.83	0.804	0.584	Yes
SEP2	0.85			
SEP3	0.57			
SES1	0.74	0.859	0.671	Yes
SES2	0.85			
SES3	0.86			
ST1	0.84	0.815	0.599	Yes
ST2	0.64			
ST3	0.83			
TR1	0.85	0.900	0.751	Yes
TR2	0.83			
TR3	0.91			
UNC1	0.8	0.842	0.640	Yes
UNC2	0.77			
UNC3	0.83			
UNN1	0.86	0.870	0.691	Yes
UNN2	0.76			
UNN3	0.86			
UNT1	0.83	0.842	0.640	Yes
UNT2	0.82			

	UNT3	0.75

APPENDIX XI

Structural equation model for Group1 (GP1) and Group2 (GP2) and comparison of path coefficients

1. GP1 Evaluation criteria of Structural Equation Model (SEM) measurement model. Indicators are described in Appendix B

Latent variable	Indicators	Indicator reliability (outer loadings)	Internal consistency (composite reliability)	Convergent validity (AVE)	Discriminant validity
Exposure	Enterhousesum	0.69	0.871	0.576	yes
	Visitneighsum	0.76			
	Visitneighwin	0.74			
	Visitpropsum	0.81			
	Visitpropwin	0.79			
Positive meaningful event	Experiencepos	-			
Negative meaningful event	Experienceneg	-			
Cost tangible	Totyesnomitmeas	0.45	0.788	0.492	yes
	Damagesum	0.74			
	Damagewin	0.77			
	Extentdamage	0.79			
Benefit intangible	Avgposemotion	0.74	0.920	0.666	yes
	Benefit community	0.86			
	Benefitmankind	0.85			
	Benefit nature	0.73			
	Benefityou	0.88			
	Enjoy	0.79			
Cost intangible	Avgnegemotion	0.83	0.911	0.57	yes
	Costbabavg	0.87			
	Afraidotherhouse	0.59			
	Afraidyou	0.69			
	afraidyouhouse	0.59			
	Dangerhumans	0.68			
	Nuisansbabs	0.82			
	Stressbabs	0.88			
Tolerance	Tolkillindxfirstunscom	0.66	0.86	0.47	no
	Tolkillindxfirstunsrar	0.65			
	Popct	0.78			
	Popafrica	0.68			
	Poparea	0.76			
	Tolneigh	0.63			
	Tolprop	0.63			

2. GP1 Path coefficients of latent variables. EXPO=exposure, NME= negative meaningful event, PME=positive meaningful event, CT=cost tangible, CI=cost intangible, BI=benefit intangible, TOL=tolerance.

	Path Coefficients	**95% confidence intervals**	**Significance**
BI → T	0.3	0.14, 0.46	Significant
CI → T	-0.46	-0.63, -0.27	Significant
CT → T	-0.11	-0.24, 0.05	Not Significant
EXPO→T	-0.02	-0.18, 0.12	Not Significant
PME→T	0.09	-0.05, 0.23	Not Significant
NME→ T	0.01	-0.14, 0.16	Not Significant
NME → BI	-0.26	-0.44, -0.12	Significant
NME →CI	0.39	0.21, 0.58	Significant
NME →CT	0.39	0.26, 0.53	Significant
PME →BI	0.45	0.32, 0.57	Significant
PME →CI	-0.29	-0.43, -0.14	Significant
PME →CT	-0.15	-0.26, -0.03	Significant
EXPO →BI	0.12	-0.05, 0.27	Not Significant
EXPO →CI	-0.2	-0.33, -0.05	Significant
EXPO →CT	-0.38	-0.49, -0.26	Significant
EXPO→ NME	-0.37	-0.53, -0.17	Significant
EXPO →PME	-0.01	-0.19, 0.16	Not Significant

3. GP2 Evaluation criteria of Structural Equation Model (SEM) measurement model. Indicators are described in Appendix B

Latent variable	**Indicators**	**Indicator reliability (outer loadings)**	**Internal consistency (composite reliability)**	**Convergent validity (AVE)**	**Discriminant validity**
Exposure	Enterhousesum	0.47	0.867	0.574	yes
	Visitneighsum	0.83			
	Visitneighwin	0.77			
	Visitpropsum	0.87			
	Visitpropwin	0.79			
Positive meaningful event	Experiencepos	-			
Negative	Experienceneg	-			

meaningful event					
Cost tangible	Totyesnomitmeas	0.62	0.915	0.465	yes
	Damagesum	0.72			
	Damagewin	0.64			
	Extentdamage	0.75			
Benefit intangible	Avgposemotion	0.68	0.875	0.544	yes
	Benefit community	0.84			
	Benefitmankind	0.77			
	Benefit nature	0.54			
	Benefityou	0.84			
	Enjoy	0.72			
Cost intangible	Avgnegemotion	0.77	0.915	0.579	yes
	Costbabavg	0.88			
	Afraidotherhouse	0.54			
	Afraidyou	0.74			
	afraidyouhouse	0.68			
	Dangerhumans	0.64			
	Nuisansbabs	0.87			
	Stressbabs	0.89			
Tolerance	Tolkillindxfirstunscom	0.60	0.837	0.428	yes
	Tolkillindxfirstunsrar	0.56			
	Popct	0.76			
	Popafrica	0.52			
	Poparea	0.79			
	Tolneigh	0.67			
	Tolprop	0.63			

4. GP2 Path coefficients of latent variables. EXPO=exposure, NME= negative meaningful event, PME=positive meaningful event, CT=cost tangible, CI=cost intangible, BI=benefit intangible, TOL=tolerance.

	Path Coefficients	**95% confidence intervals**	**Significance**
BI → T	0.36	0.25, 0.47	Significant
CI → T	-0.4	-0.53, -0.27	Significant
CT → T	-0.07	-0.18, 0.03	Not Significant
EXPO→T	-0.1	-0.19, 0.01	Not Significant
PME→T	0.05	-0.07, 0.17	Not Significant
NME→ T	-0.02	-0.11, 0.10	Not Significant

NME → BI	-0.24	-0.37, -0.12	Significant
NME →CI	0.33	0.19, 0.45	Significant
NME →CT	0.2	0.05, 0.35	Significant
PME →BI	0.44	0.33, 0.54	Significant
PME →CI	-0.27	-0.38, -0.14	Significant
PME →CT	-0.09	-0.20, -0.02	Significant
EXPO →BI	0.04	-0.10, 0.18	Not Significant
EXPO →CI	-0.31	-0.43, -0.19	Significant
EXPO →CT	-0.38	-0.49, -0.28	Significant
EXPO→ NME	-0.28	-0.39, -0.16	Significant
EXPO →PME	-0.08	-0.22, 0.07	Not Significant

5. Comparison of path coefficients between two groups using t-tests

Path	**GP1 Path Coefficients (n=136)**	**95% confidence intervals**	**GP2 Path Coefficients (n=209)**	**95% confidence intervals**	**t**	**df**	**P value**
BI → T	0.3	0.14, 0.46	0.36	0.25, 0.47	0.59	253	0.55
CI → T	-0.46	-0.63, -0.27	-0.4	-0.53, -0.27	0.53	343	0.59
CT → T	-0.11	-0.24, 0.05	-0.07	-0.18, 0.03	0.45	257	0.65
EXPO→T	-0.02	-0.18, 0.12	-0.1	-0.19, 0.01	0.85	260	0.4
PME→T	0.09	-0.05, 0.23	0.05	-0.07, 0.17	0.4	343	0.69
NME→ T	0.01	-0.14, 0.16	-0.02	-0.11, 0.10	0.27	255	0.79
NME → BI	-0.26	-0.44, -0.12	-0.24	-0.37, -0.12	0.16	343	0.88
NME →CI	0.39	0.21, 0.58	0.33	0.19, 0.45	0.58	251	0.56
NME →CT	0.39	0.26, 0.53	0.2	0.05, 0.35	1.75	343	0.08
PME →BI	0.45	0.32, 0.57	0.44	0.33, 0.54	0.13	343	0.9
PME →CI	-0.29	-0.43, -0.14	-0.27	-0.38, -0.14	0.26	343	0.8
PME →CT	-0.15	-0.26, -0.03	-0.09	-0.20, -0.02	0.66	343	0.51
EXPO →BI	0.12	-0.05, 0.27	0.04	-0.10, 0.18	0.73	343	0.47
EXPO →CI	-0.2	-0.33, -0.05	-0.31	-0.43, -0.19	1.16	343	0.25
EXPO →CT	-0.38	-0.49, -0.26	-0.38	-0.49, -0.28	0.01	343	1
EXPO→ NME	-0.37	-0.53, -0.17	-0.28	-0.39, -0.16	0.88	246	0.38
EXPO →PME	-0.01	-0.19, 0.16	-0.08	-0.22, 0.07	0.57	343	0.57

6. R^2 values for GP1 and GP2.

	GP1	GP2
Exposure	0	0
Positive meaningful event	0.0001	0.006
Negative meaningful event	0.136	0.076
Cost tangible	0.435	0.224
Benefit intangible	0.317	0.224
Cost intangible	0.337	0.289
Tolerance	0.606	0.503