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A wildlife tolerance model and case study for understanding human wildlife conflicts

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ABSTRACT

Human-wildlife conflict (HWC) is a complex conservation issue and acknowledging the human dimensions of the problem is critical. Here we propose the Wildlife Tolerance Model (WTM), a novel theoretical framework to identify key drivers of tolerance to living with damage-causing wildlife. The WTM proposes an *outer model*, where the extent to which a person experiences a species determines perceptions of *costs* relative to *benefits* of living with a species. This in turn determines tolerance. A second component, the *inner model* predicts eleven variables that may further drive perceptions of *costs* and *benefits*. In the current paper we test the *outer model* while in a forthcoming publication we test the *inner model* using a case study of human-baboon conflict in Cape Town, South Africa. Using Partial Least Squares Structural Equation Modeling we found support for the *outer model*. *Experience* explained 30% of variance in *costs* and *benefits* and 60% of *tolerance* was explained by perceptions of *costs* and *benefits*. *Intangible costs* and *intangible benefits* equally contributed to driving *tolerance* but *tangible costs* had no significant effect on *tolerance*. Separating two dimensions of experience, (i) *exposure* to a species explained *costs* more than *benefits*, and (ii) *positive experiences* explained *intangible costs* and *benefits* more than *tangible costs* while *negative experiences* equally explained *costs* and *benefits*. We discuss management implications of the findings and conclude that the WTM could be a useful diagnostic tool and theoretical framework to inform management interventions and policies to mitigate HWC.

1. Introduction

Mammals are declining worldwide and while habitat loss, habitat degradation and harvesting pose the greatest threat to mammals (IUCN, 2008) these factors indirectly promote conflicts. As the declining wildlife habitats become smaller and fragmented, contact between people and wildlife increases. Human-Wildlife Conflict (HWC) is therefore recognized as a global priority (Manfredo, 2015) and an emerging research field (Cronin et al., 2014) as it can incur major costs to rural people's livelihoods and lives, as well as reduce support for conservation projects in general (Redpath et al., 2013). Initial research focused on finding technological solutions to mitigate the impacts of wildlife, assuming damage was the main driver of intolerance. However ongoing research revealed that "*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*" (Dickman, 2010). To address this complexity a focus on the human dimensions of wildlife conflicts is increasingly being acknowledged as critical (Decker et al., 2012; Redpath et al., 2013; Manfredo, 2015). Human wildlife conflicts can therefore be framed as occurring within Social Ecological Systems (SES) where interactions between ecosystems, biodiversity and people take place (Folk et al., 2004). Framing HWC within SES acknowledges HWC as a complex conservation problem that requires multidisciplinary and trans-disciplinary approaches (Game et al., 2014). 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 themselves over how to manage the impacts between humans and wildlife.

The human dimensions of wildlife conflicts pose a number of challenges for wildlife managers. Firstly, determining the extent of a conflict and its impact. This is necessary to enable conservation managers to identify if, where and which interventions are needed. To achieve this, understanding diverse viewpoints of stakeholders is necessary. Democracy in wildlife management is increasingly being acknowledged as

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important to reduce conflict and ensure successful conservation outcomes (Decker et al., 2012; Woodroffe and Redpath, 2015). Obtaining a wider range of stakeholder views is particularly important so that those heard are not only the powerful individuals and those with extreme views, or institutions and specialized interest groups that are unrepresentative of stakeholders. Imbalances in stakeholder voices can increase the probability of species management based on non-representative views and may increase unsustainable wildlife practices, if a vocal or powerful minority favor these.

Secondly, what are the factors that determine variation in tolerance? There is sufficient evidence in the HWC literature to conclude that individuals differ widely in their attitudes and tolerance towards wildlife (Kansky et al., 2014). For example, some stakeholders remove wildlife species despite not encountering any 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 forgo different numbers of livestock to different species of wildlife (Romanach et al., 2007). Determining the extent of stakeholder tolerance and the factors driving this tolerance is therefore critical (Treves and Bruskotter, 2014). To address these questions, quantitative randomized surveys may be best suited to determine the extent of a problem as perceived by communities living in close proximity to damage-causing wildlife and their tolerance towards the wildlife.

Research on stakeholder attitudes to living with wildlife is increasing and aims to understand factors explaining tolerant behavior (Kansky and Knight, 2014; Kansky et al., 2014). Individual case studies largely make up this research, and to date few quantitative syntheses of the outcomes of these studies are available (but see Williams et al., 2002; Dressel et al., 2015). Recently, we conducted meta-analyses of attitudes of people living with four groups of damage-causing mammals (carnivores, ungulates, elephants, primates) (Kansky et al., 2014; Kansky and Knight, 2014). These analyses identified several globally apparent drivers of tolerant attitudes. In this paper we build on these findings and propose the Wildlife Tolerance Model (WTM). The WTM presents an interdisciplinary theory for application to HWC research and management. It aims to incorporate the complexity inherent in human-wildlife social ecological systems (SES) and be a diagnostic tool to identify key factors driving tolerance of people towards damage-causing mammalian wildlife. This in turn can inform management interventions and policy design. We then test the utility of the WTM using a case study of human-baboon conflict in an urban environment on the Cape Peninsula, South Africa. The WTM consists of two components; an *outer model* with six variables and an *inner model* with 11 variables (Fig. 1). In the current paper we describe the WTM and test the *outer model*. In a forthcoming publication (and Kansky, 2015) we test the *inner model*.

2. The wildlife tolerance model

2.1. Outer model

In the *outer model*, experience is the first variable and is operationalized using two variables; (i) recent *Exposure* to a species (ii) number of *Meaningful Experiences* a person has had with the species. *Meaningful Experiences* are strong emotionally charged experiences, which can be either positive (*Positive Meaningful Experience*) or negative (*Negative Meaningful Experience*) and are not time constrained, meaning they could have occurred at any time in a person's life. *Exposure* measures the frequency and spatial proximity a person has been exposed to in a particular time frame. *Benefits* and *Costs* are the next pair of variables. These are separated into *tangible* and *intangible*. *Tangible* refers to the monetary costs and benefits, while *intangible* refers to non-monetary values, such as the existence value of a species or feelings of fear or stress due to a species. The first prediction of the model (H1) is that *experience* drives perceptions of *costs* and *benefits*. So if experiences are more positive than negative, the scale will tilt towards greater

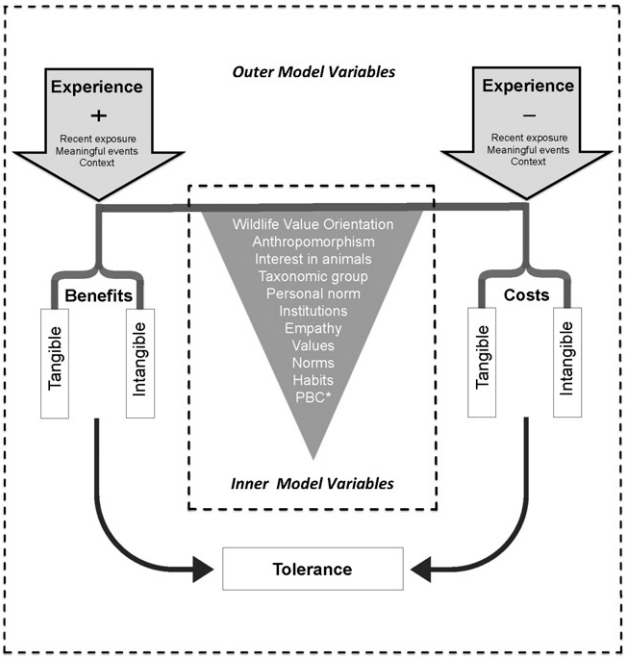

Fig. 1. A diagram of the Wildlife Tolerance Model (WTM) proposed in this paper. The two-tiered model consists of an *outer and inner model*. In the *outer model*, *tolerance* is determined by the net perceived *costs* and *benefits* of living with a species based on the extent to which a person *experiences* a species. The *inner model* consists of an additional eleven variables that impact on tolerance through *costs* and *benefits*. The order of *inner model* variables in the triangle is random.*PBC = Perceived Behavioral Control. See Appendix A for additional discussion of variables.

perceptions of *benefits*, and vice versa with negative experiences and *costs*. The second hypothesis (H2) is that *cost* and *benefit* perceptions drive tolerance (Fig. 1, Table 1).

We define tolerance as "The ability and willingness of an individual to absorb the extra potential or actual costs of living with wildlife" as anyone living in an area with wildlife has to bear the risk of added costs which would not be present in the absence of wildlife. Based on a critical evaluation of seven categories of questions used to elicit tolerant attitudes and perceptions towards damage-causing mammals in a meta-analysis (Kansky and Knight, 2014) we identified five tolerance indicators that could be used in surveys: 1. **Spatial** - tolerance to spatial proximity, 2. **Damage** - tolerance to undergoing monetary costs due to a species, 3. **Killing** - tolerance to killing under different contexts, 4. **Population size** - of a species that a person is willing to accept (Carpenter et al., 2000), 5. **Prevention** - ability and willingness to undergo extra costs (tangible and intangible) to apply mitigation measures that are effective, sustainable, legal and comply with welfare norms. These indicators are further discussed in Appendix A.

All variables in the *outer model* were found to be important in our meta-analysis and discussed in detail in Kansky and Knight (2014) and Appendix A. Table 1 presents key hypotheses predicted from the WTM.

2.2. Inner model

The *inner model* consists of 11 variables predicted to impact on perceptions of *costs* and *benefits*. These are *Wildlife Value Orientations*, *Anthropomorphism*, *Interest in animals*, *Taxonomic group*, *Personal norm*, *Institutions*, *Empathy*, *Values*, *Norms*, *Habits*, *Perceived behavioral Control* (Fig. 1). For example, for *interest in animals*, the prediction is that people who are more interested in animals will perceive relatively more *benefits* than *costs* and therefore be more tolerant than those who dislike animals. And for *institutions*, individuals who perceive institutions