

Using pastoral ideology to understand human–wildlife coexistence in arid agricultural landscapes

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Abstract

Integrating social and ecological knowledge is requisite for solutions to global conservation problems, including human–wildlife conflict, but gathering sufficient data to facilitate integration has proved difficult. Social–ecological systems models have also traditionally overlooked individual human thought and behavior that can affect the success of management interventions. In response to these challenges, we drew upon psychological theory and long-term ecological data on wildlife populations and conflict occurrence to inform qualitative research on pastoralists' values toward wildlife in the northern Namib Desert. We explored how values and ecological conditions shaped individuals': (a) interactions with and tolerance of species; and (b) perceptions of challenges and potential solutions to living with wildlife. Semi-structured interview data revealed a prevailing domination value orientation toward wildlife, reflected in concerns for human and livestock wellbeing. Despite these concerns and high rates of reported conflicts, pastoralists were generally tolerant of wildlife, including predators, and indicated this in their proposed management solutions. In addition to its practical implications for informing human–wildlife coexistence strategies in the Namibian context, our approach advances knowledge about wildlife values globally, offers insights on the utility of qualitative assessments for cross-cultural social–ecological systems research, and furthers understanding of conservation challenges and opportunities in extreme arid environments.

KEYWORDS

human–wildlife interactions, Namibia, social–ecological systems, tolerance, wildlife value orientations

1 | INTRODUCTION

Conflicts between humans and wildlife are escalating worldwide due to human population growth, urbanization, growth of agricultural and industrial activities, and, in certain areas, increasing wildlife populations (Woodroffe, Thirgood, & Rabinowitz, 2005). Humans incur costs in the form of attacks

on people, game or livestock depredation, crop-raiding, disease transmission to stock or humans, opportunity costs to human livelihoods, and diminished psychosocial wellbeing due to stress and fear of attack (Barua, Bhagwat, & Jadhav, 2013; Woodroffe et al., 2005; Woodroffe, Frank, Lindsey, ole Ranah, & Romanach, 2007). The costs of conflict to human livelihoods may be more severe in extreme environments,

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such as desert ecosystems. Severe droughts have become more frequent, for example, in deserts worldwide, exacerbating competition between wildlife and people for resources (Figure 1; Durant et al., 2014). As another illustration, carnivores are threefold more prevalent per kilogram of prey in dry deserts than in lush savannas (Hatton et al., 2015), contributing to greater potential for carnivore-related conflicts with people and livestock. Despite being among the poorest and most marginalized people in the world in the face of these challenges (Middleton, Stringer, Goudie, & Thomas, 2011), desert pastoralists and their livestock have historically coexisted with and tolerated wildlife more so than other groups (Browne-Nuñez, Jacobson, & Vaske, 2013; Gadd, 2005). However, these relationships could shift as pastoralists become less nomadic and resources become more variable in space and time due to phenomena such as modernization and climate change. These anticipated changes in social–ecological conditions could affect human value systems as well as the frequency and severity of human–wildlife conflicts over time (Galvin, 2009; Manfredo et al., 2017).

Acknowledging the diversity of factors operating across social and ecological systems can lead to a broader understanding of the underlying causes of human–wildlife conflict (Carter et al., 2014; Morzillo, de Beurs, & Martin-Mikle, 2014; Redpath et al., 2013). While conflicts occur largely at the interface of human and wildlife behaviors, the context that shapes these interactions includes multiple, nested levels of internal and external social and ecological processes (Lischka et al., 2018; Manfredo et al., 2017; Manfredo, Teel, Gavin, & Fulton, 2014). These range from society- and ecosystem-level influences, down to individual attributes of humans (e.g., values) and wildlife (e.g., physiological conditions). Furthermore, social and ecological systems are not independent, but rather they interact through feedback mechanisms. For example, desert rivers and springs (i.e., ecosystem characteristics) drive both wildlife distributions and human settlement patterns (i.e., societal-level drivers; Lischka et al., 2018). At the individual and population levels, predators in arid landscapes may focus their hunting efforts around these scarce water resources that act to concentrate prey populations. Pastoralists and their livestock, which often occur in higher densities than wild prey, also rely on these areas where they may, as a consequence, be more likely to experience conflict with predators.

Research that integrates social and ecological knowledge through this systems lens can lead to more proactive and innovative solutions to conservation problems like human–wildlife conflict, though collection and analysis of the requisite data has often proved difficult. Limitations can stem from misperceptions about the quality and utility of social science information, particularly of qualitative research, and

from epistemological differences across disciplines (Bennett et al., 2017; Fox et al., 2006; Pooley, Mendelsohn, & Milner-Gulland, 2014). Challenges also arise from inadequate attention in social–ecological systems models to individual human thought and behavior that can form the basis for conservation problems and ultimately determine the course and success of management interventions (Lischka et al., 2018; Manfredo et al., 2014, 2017). Given the global nature of human–wildlife conflicts, it is also important to document and understand these social dimensions across cultures to enhance transferability of findings and inform more broad-based solutions (Dickman, 2010; Manfredo & Dayer, 2004; Teel et al., 2010).

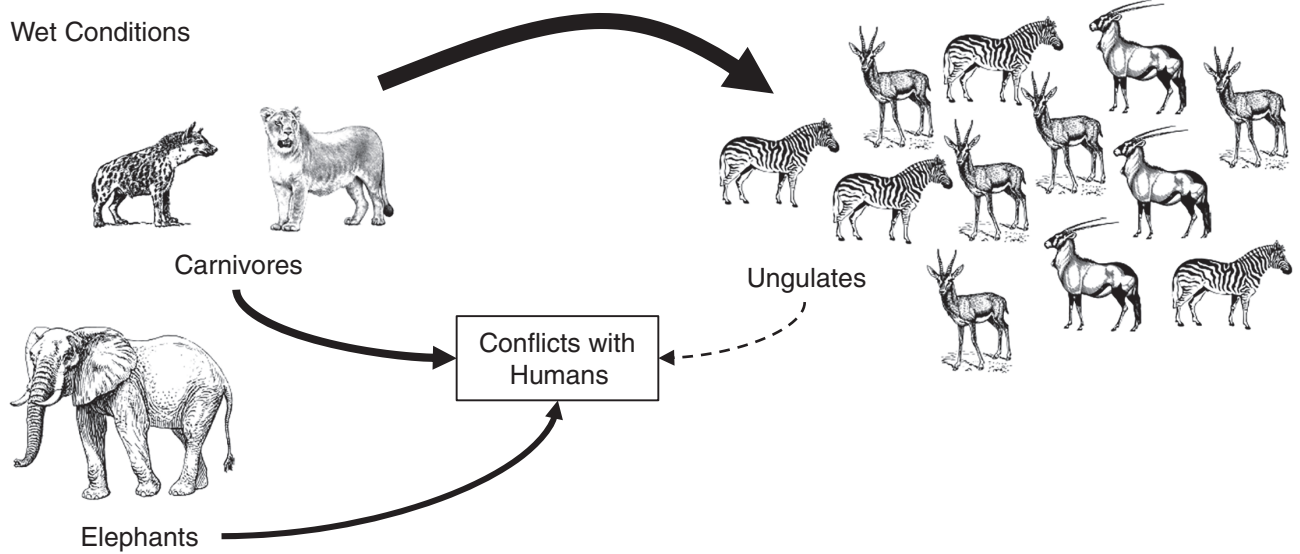
To help address these gaps, we paired theory from social psychology that emphasizes individual thought and behavior with a unique suite of long-term ecological data to inform a qualitative investigation of pastoralists' values toward wildlife in the northern Namib Desert of Namibia.

1.1 | Conceptual background

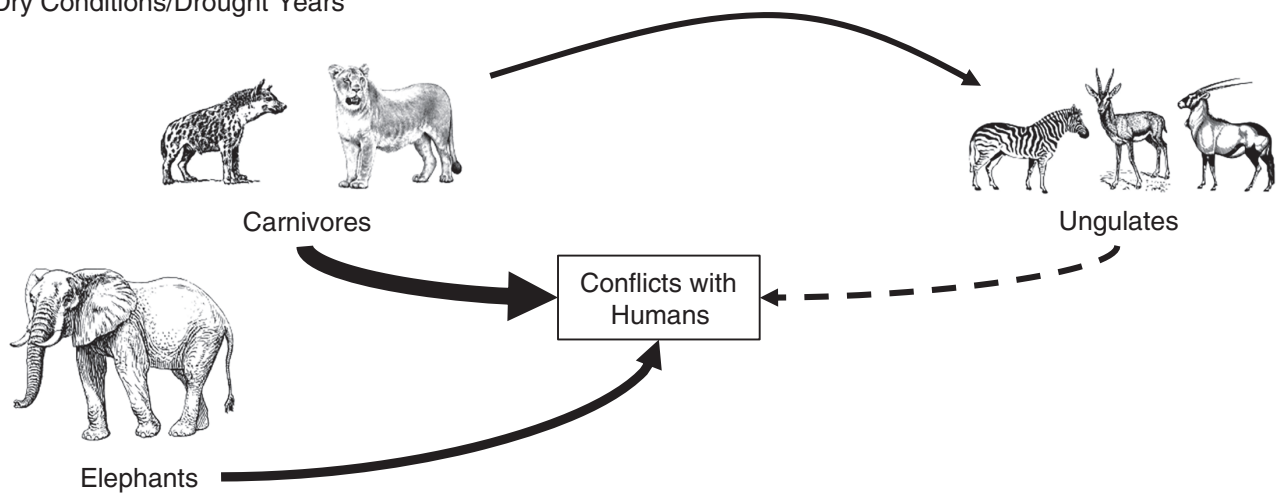
Values are basic patterns of thought formed early in life that guide behavior over a wide array of situations and events (Rohan, 2000; Schwartz, 1992). They allow people to determine what is good and bad or right and wrong, and inform rules of behavior for members of a social group. Once formed, values persist within individuals and across generations (Manfredo, Teel, & Dietsch, 2016). Recognizing the importance of values in conservation, Manfredo et al. (2017) recently called for a broader social–ecological systems approach to expand and improve the concept's application. According to this approach, values are embedded in a complex, multilevel social structure and manifest in daily routines, communication patterns, societal culture, and ways that people perceive and relate to their surroundings.

Wildlife value orientations, which serve to strengthen and give personal meaning to more basic values in relation to wildlife, form the foundation for individual behavior in wildlife-related contexts (Manfredo et al., 2016; Teel & Manfredo, 2009). Recent studies have primarily focused on two core orientations: mutualism (emphasizing equality, caring, and compassion for wildlife) and domination (prioritizing human well-being over wildlife). These orientations can explain variation in attitudes and behaviors across a diversity of wildlife-related issues, particularly those involving harm to wildlife and trade-offs between human interests and wildlife protection (e.g., Cerri, Mori, Vivarelli, & Zaccaroni, 2017; Hermann, Voß, & Menzel, 2013; Manfredo et al., 2016; Teel et al., 2010; Teel & Manfredo, 2009). Individuals with a domination orientation tend to be less tolerant of wildlife when it competes with human interests and more

(a) Wet Conditions



(b) Dry Conditions/Drought Years



(c) Food Pyramid

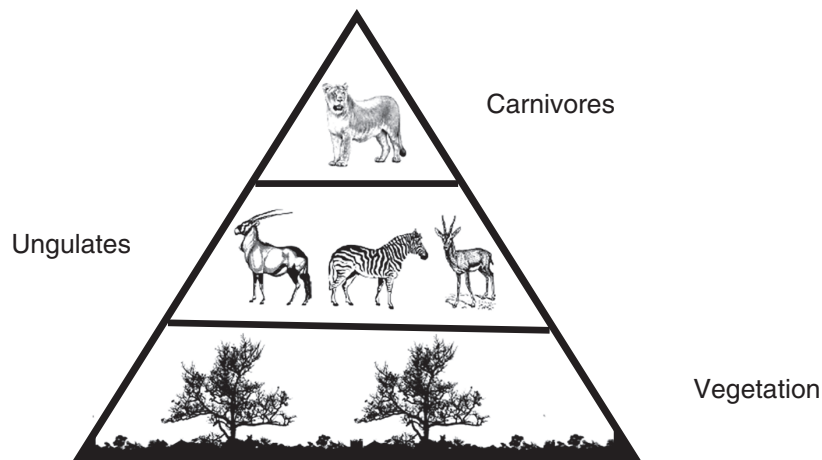


FIGURE 1 Wildlife behaviors, relative abundance, and threats to human livelihood differ between (a) wet conditions and (b) dry conditions or drought years. Arrow width signifies the relative strength of interactions. Solid arrows indicate direct effects of one trophic level on another or their contribution to human–wildlife conflicts, while dashed arrows indicate the indirect effect of ungulates on pastoralists’ livestock through competition for grazing. Conflicts with humans also refer to the destruction of water structures and crops, as well as threats to livestock and personal safety. The food pyramid (c) illustrates that biomass reduces at higher trophic levels and is dependent on the amount of vegetation in desert landscapes

supportive of management actions like lethal control for dealing with human–wildlife conflicts (Manfredo et al., 2016). Tolerance is an indicator of attitudes toward wildlife, defined more specifically as an individual's acceptance of negative effects and desire for positive effects that arise from interactions with wildlife (Bruskotter, Singh, Fulton, & Slagle, 2015). People who have high tolerance of a wildlife species prefer larger populations of that species. In contrast to domination, individuals with a mutualism orientation are more likely to prioritize concerns for animal welfare and wildlife-focused interests (e.g., habitat protection, support for endangered species) in their attitudes and behaviors. Differences in these orientations can form the basis for social conflict among stakeholder groups over wildlife conservation and management efforts.

Recent research has suggested that a shift from domination to mutualism wildlife value orientations may be occurring globally, in line with broader value shifts due to modernization (Inglehart & Welzel, 2005; Manfredo et al., 2016), with important implications for biodiversity conservation. However, knowledge of the cognitive basis for human–wildlife relationships is geographically limited, and prior research has largely been conducted using quantitative survey assessments in modernized societies such as the United States and western Europe. Recent exceptions in the Netherlands, China, Estonia, Mongolia, Republic of the Congo, and Thailand (see *Human Dimensions of Wildlife* volume 12, issue 5; Rickenbach, Reyes-García, Moser, & García, 2017) that were more exploratory in nature utilized a qualitative technique consisting of semi-structured interviews to measure wildlife value orientations among people of variable literacy and comprehension skills (Dayer, Stinchfield, & Manfredo, 2007). A need to better integrate ecological data in a way that both informs and reinforces interpretation of wildlife orientation data (including both qualitative and quantitative) is also needed to better understand the challenges of coexisting with wildlife across cultures.

Recognizing these gaps in cross-cultural understanding and the important role of values in influencing human attitudes and behaviors, we explored pastoralists' value orientations toward wildlife in the northern Namib Desert and how those value orientations may affect: (a) local levels of species tolerance on the landscape; and (b) perceptions of challenges and potential solutions to living with wildlife. We also interpreted our findings in relation to concurrent ecological data on wildlife populations and conflict occurrence in Namibia. We sought to further our understanding of human–wildlife relationships in arid landscapes to inform more effective solutions for conflict management. More broadly, this approach advances understanding of wildlife values globally and offers insights on the utility of qualitative assessment tools for cross-cultural social–ecological systems research.

2 | METHODS

2.1 | Study area

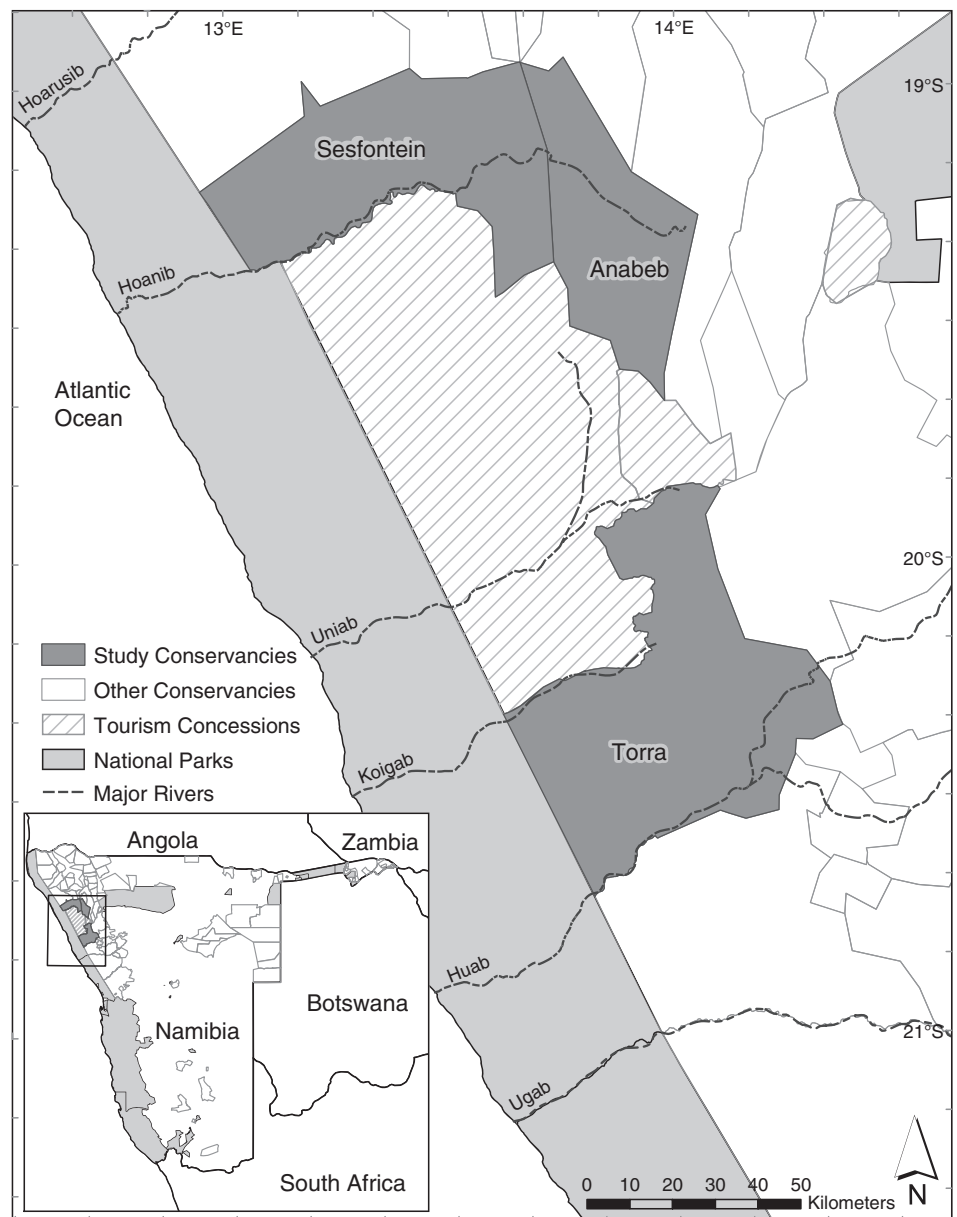
We conducted research in pastoralist communal conservancies in the Kunene Region of the Namib Desert, a region receiving ~100 mm of rainfall, on average, between January and April each year (Figure 2; Jacobson & Jacobson, 2013). Surface water is limited temporally and spatially, with ephemeral rivers typically sustaining aboveground flows less than 20 days per year during the wet season (Jacobson, Jacobson, & Seely, 1995). Plants, animals, and people tend to be concentrated around these sparse water resources throughout the majority of the year, contributing to potentially higher rates of human–wildlife interactions. Communities in this region ranged in size from 2 to ~150 households.

Northwestern Namibia has been the focus of conservation efforts since the early 1980s, following large declines in wildlife populations due to expanding human settlements, war, intensive hunting and poaching, and drought (Leggett, Fennessy, & Schneider, 2003). With effective law enforcement, the creation of communal conservancies, and the shift in natural resource ownership from government entities to property owners, wildlife populations have stabilized or increased since the country's independence in 1990 (NACSO, 2016; Scanlon & Kull, 2009). Communal conservancies in Namibia are demarcated land areas collectively managed by a group of land residents who agree to conserve and share their natural resources in a sustainable and economically beneficial manner (Shaw & Marker, 2010). Torra, Anabeb, and Sesfontein conservancies were among the first conservancies established in Namibia after the 1996 Nature Conservation Amendment Act (in 1998, 2003, and 2003, respectively), and comprise a mix of ethnic groups (e.g., Damara, Herero, Himba, and Riemvasmaker) due in part to forced relocations of people imposed by successive colonial governments (Jones & Mosimane, 2000). Local pastoralists in the region rely on livestock for income, although ecotourism and trophy hunting are also increasingly important (Bandyopadhyay, Shyamsundar, Wang, & Humavindu, 2004; Lindsey, Roulet, & Romanach, 2007). These conservancies are mostly unfenced, which permits free movement of wildlife and livestock (Rust & Marker, 2014). As in other areas in southern Africa using community-based natural resource management (CBNRM), these conservancies allow both consumptive and nonconsumptive uses of wildlife, and have devolved management responsibility to local people (Van Schalkwyk, McMillin, Witthuhn, & Hoffman, 2010).

2.2 | Data collection

Our qualitative data collection approach consisted of face-to-face semi-structured interviews, which also addressed

FIGURE 2 Study area map featuring conservancies in northwestern Namibia



other research questions as part of a larger investigation. The first and fourth authors, the latter being a former Sesfontein Conservancy committee member and ecological field assistant across the Kunene Region, collaboratively developed the interview questions, and piloted the full interview instrument with four residents of different ethnic groups in Sesfontein Conservancy to ensure the questions were culturally appropriate and contextually clear (see Supporting Information). In May 2017 (i.e., immediately after the wet season), the first and fourth authors conducted 86 interviews in 31 villages in Sesfontein, Anabeb, and Torra conservancies (Table S1). In total, we conducted 64 individual interviews and 22 focus group interviews comprised of two to six individuals each (Table S2). Focus groups helped to enhance the comfort level and gender diversity of respondents, as some women denied consent to be interviewed

individually without their husbands who were absent at the time of the interviews. This resulted in a total of 112 conservancy residents who were interviewed, ranging in age from 19 to 88 years. One man and four women declined to participate, and we excluded responses from one man who chose not to complete the full interview. In addition to attempting to achieve a gender balance in our sample, we prioritized obtaining representation of all ethnic groups within each conservancy.

Given the low density of occupied households in our study area, we used snowball sampling to identify potential participants after beginning at a randomly selected, occupied household in each village (Newing, Eagle, Puri, & Watson, 2011). At the conclusion of each interview, we asked respondents to provide a list of nearby occupied households. Interviews typically occurred at the location where we

encountered recommended participants. Most interviews were at private residences, but a few were in public locations (e.g., restaurants, hotels).

The fourth author translated interview questions into Khoekhoegowab, Otjiherero, or Afrikaans as appropriate in real time, allowing the first author to ask follow-up questions as necessary. We recorded all interviews after receiving verbal consent from participants. Interview duration ranged from 19 to 129 min for the full suite of questions and English translation. All interviews were transcribed verbatim by the first author from the fourth author's English translation. Final interview procedures were approved for use with human subjects prior to implementation by Colorado State University's Institutional Review Board (Protocol #043-18H) and the Namibian Ministry of Environment and Tourism (Permit #2225/2016).

To measure wildlife value orientations, we followed the cross-cultural interview guide developed by Dayer et al. (2007). This technique, which relies on basic human emotions as being universally understood across cultures, is designed to elicit stories about wildlife through emotional prompts. More specifically, this method asks respondents for depictions of personal experiences with wildlife that made them happy, sad, angry, and afraid in addition to a description of how they feel about wildlife in general. As an indicator of tolerance, we asked which species, if any, respondents thought should not be conserved or protected by their conservancy. For this measure, we relied on the assumption from the relevant literature (e.g., Bruskotter et al., 2015) that people with lower tolerance of a species prefer smaller populations or complete exclusion of that species. We also recorded which species were mentioned in responses to the emotional prompt questions and whether each interaction was perceived by respondents to be a positive or negative experience. We asked two additional questions to elicit perceived challenges and solutions to human–wildlife coexistence (see Supporting Information).

External ecological data sources were used to inform interview questions and interpret responses. Wildlife road surveys have occurred in the study area every June since 2001 as part of the North-West Game Count, with data publicly available from the Namibian Association of CBNRM Support Organizations (NACSO, 2018b). These survey results are used to estimate populations of large-bodied species, including oryx (*Oryx gazella*), ostrich (*Struthio camelus*), springbok (*Antidorcas marsupialis*), and Hartmann's mountain zebra (*Equus zebra hartmannae*), using distance sampling in the program DISTANCE (Laake, Buckland, Anderson, & Burnham, 1993), which accounts for reductions in species' detections with distance from the transect line. These population estimates, which are likely conservative due to a lack of system-wide accessibility, are

in turn used to set annual harvest quotas for each conservancy. In addition to these population data, long-term records of monthly reports of human–wildlife conflicts at the species level are also available for each conservancy (NACSO, 2018a). We analyzed these records from June 2004 to May 2017, as data were inconsistently recorded prior to 2004. By assessing the frequency and types of human–wildlife conflicts documented in the region as well as general trends in wildlife populations, we were able to obtain a broader understanding of the conditions that may be affecting pastoralists' wildlife-related perceptions and interactions reported in the interviews. It also allowed us to explore whether interviews disproportionately reported conflicts with particular species.

2.3 | Analysis

To analyze wildlife value orientation data, the first author coded the relevant responses for each interview without predetermined categories (i.e., inductive *in vivo* coding), with attention given to repeated codes (Levy, Hollan, & Bernard, 1998), and then used existing studies on wildlife value orientations as guides for creating and grouping codes into axial categories (i.e., deductive coding; Strauss & Corbin, 1998). Research objectives were then used to integrate, refine, and organize axial codes into broader theoretical categories, or selective codes (Table S3). Interviews were our unit of analysis rather than individuals because some interviews involved more than one respondent.

Triangulation was accomplished through peer review by the third author, who was not part of the original study team but has expertise in cross-cultural qualitative research and wildlife value orientations. After the first author generated a list of themes, the third author reviewed the interview responses independently and coded 68 (15.8%) passages selected by the first author to contain the entire suite of value orientations and corresponding belief dimensions (i.e., sets of basic beliefs; Teel & Manfredi, 2009) identified across interviews. Intercoder agreement (95.8%) was calculated for each code based on the number of passages in which both coders determined the presence or absence of a code divided by the total number of passages (Table S3; Coffey & Atkinson, 1996). After the two authors reached agreement on code definitions and interpretation, the first author independently reviewed the codes that were previously assigned to the remaining 362 coded passages and made minor adjustments.

For responses to questions about tolerance, challenges, and solutions, the first author again took an *in vivo* coding approach to generate a list of themes, which were grouped into categories (Tables S4 and S5). We determined these responses were more straightforward and less open to

variable interpretation, reducing the need for a second reviewer. After coding all responses for a question, previously coded responses were reexamined and adjustments were made where necessary (Creswell, 1998; Glesne, 2006). Following our final coding procedures, results and interpretations drawn from data on wildlife populations and human–wildlife conflicts were used to provide more context for interpretation of interview responses and to assess, in particular, potential differences in reported conflicts across data sources.

3 | RESULTS

3.1 | Wildlife value orientations

Responses predominately reflected a domination wildlife value orientation (Table 1). Concern for property, including livestock, crops, and water structures, and human safety were the most commonly identified belief dimensions for this orientation, detected in 96.5 and 75.6% of all interviews, respectively (Table S3). Personal stories reflecting these themes often included predator attacks on livestock and humans, or elephants (*Loxodonta africana*) destroying crops or water structures. Responses also contained beliefs about economic gains from wildlife (29.1%), including monetary benefits or opportunities from conservation efforts, and hunting (18.6%), mostly for meat consumption. Fewer interviews (24.4%) expressed a mutualism value orientation toward wildlife. Of those that did, they described wildlife as “like [my] own children” that were deserving of trust, respect, and care. Other orientations identified in previous cross-cultural research on wildlife value orientations were also detected (see *Human Dimensions of Wildlife* volume 12, issue 5). Attraction or interest was a commonly reported value orientation, with 83.7% of interviews indicating a desire to see wildlife and 12.8% expressing the importance of future generations being able see and know all local wildlife species. A rational or scientific value orientation, tied to stories about how the natural world works and animals behave, was detected in 11.6% of interviews. Lastly, 5.8% of interviews indicated a spiritual or religious value orientation in which wildlife and the environment are thought to be created and controlled by a higher power.

3.2 | Interactions with and tolerance of wildlife species

Respondents were relatively tolerant of wildlife, although tolerance varied by species (Table 2). When asked which species, if any, should not be conserved, most interviews (67.4%) indicated that all species should be protected, although many (30.2%) also suggested the need for

managing predator populations. Many interviews mentioned the importance of conserving all species for future generations to experience, with one man reporting that, “our children should not just hear from our stories, but the next generation should also see the wildlife [themselves].” When interviews did provide a species that they thought should not be conserved, lions (*Panthera leo*) were by far the most frequently listed animal (20.9%) because they kill livestock. One woman remarked that, “the conservancy program's compensation is very weak. If the lion kills my cattle, I am supposed to pay [my children's] school fees from those cattle. Because we are getting almost [no compensation], we don't want lions to be conserved. However, if the system changes, then it would be fine.” The predominant value orientation—domination—influenced pastoralists' tolerance of particular species as tolerance was lower for species, such as lions, leopards (*Panthera pardus*), and elephants, that threaten human and livestock wellbeing.

From the emotional prompt questions, we gathered stories describing both positive and negative interactions with 18 wildlife species (Table 2). Most positive interactions were with prey species, such as Hartmann's mountain zebra, springbok, ostrich, elephants, and giraffes (*Giraffa camelopardalis angolensis*), and primarily emerged in interviews where the attraction and mutualism value orientations were also detected. One man described his encounter with zebra and springbok as, “we stood for almost two hours [watching] the way they were grazing and running and [how they] came close to us. It was amazing.” Some respondents were also thankful for the meat received from prey species as indicated in interviews in which the hunting belief dimension (linked to domination) was detected. Interviews expressing a mutualism value orientation were more likely to describe positive interactions with several species otherwise prone to reports of human–wildlife conflict (i.e., hyenas *Crocuta crocuta* and *Hyaena brunnea*, lions, black rhinoceroses *Diceros bicornis*, black-backed jackals *Canis mesomelas*, and baboons *Papio ursinus*). We often detected a domination value orientation in interviews describing negative interactions with wildlife. These stories related to concerns over human safety and livestock wellbeing. One man described it as, “The elephants are destroying the fields and the lions and leopards are killing our cattle.”

The ecological data revealed how prey population sizes (and presumably those of predators) have widely fluctuated across conservancies over the last 16 years, varying more than tenfold (Figure 3a). Population sizes recorded in 2017 appear near the median of 6,787 individuals per conservancy (Figure 3b). Despite this variation, annual reports of human–wildlife conflicts remained consistently high, with only 7 of 42 measured conservancy-years recording less than 80 attacks on livestock (Figure S1). The species responsible

TABLE 1 Wildlife value orientations and belief dimensions from a 2017 interview of Namibian pastoralists

Wildlife value orientations and belief dimensions	Example quotation(s) ^a
Domination	
Hunting	“Sometimes you are so hungry at home, you think it is better to go around in the bush and shoot the animal”
Economic gains	
Compensation	“Now-a-days there's less farmers because of predators and so on, so that's the sad side of the story, but we gain something like a certain compensation, but... it's not really market-related”
Employment	“In general, he's quite happy with wildlife because it brings, it creates employment and the conservancy all them enter in joint ventures and they make also money out of it, so he just wants to be more educated, to be more involved in wildlife management”
Tourism	“They do make not only me, but all of us in Namibia happy because we get tourism from the outside. They come look at animals they do not have [where they are from] and it brings income to Namibia”
Concern for human safety	“And then he saw the leopard coming down with the klipspringer in her mouth and then he ran down. And then he moved on the other mountain and ran away... He was never coming so close in his life to the leopard”
Concern for property	
Livestock wellbeing	“So he was also a farmer, but when the lions and the cheetah went in his corral and killed all his animals that is the day when he quit or gave up farming.” “Zebra [will make you sad]. It's grazing too close to the people and using a lot of grazing”
Crops	“The elephants come and they come and destroy our gardens...”
Water structures/buildings	“[The elephants] break our pump and the pipes that bring the water to our homes...”
Mutualism	
Caring	“One day I was on my patrol... and when I went somewhere I saw an oryx in a foot trap. He was still alive maybe for two to three days. It made me really sad”
Extended family/friends	“For me there's some wildlife that makes me sad, like for me I like mostly the elephant, so I have been adapted from elephant currently. I'm just feeling like if I saw an elephant die, [it would] just feel like I have saw my own cattle [die]”
Trust/respect	“All you have to do is just train [wild animals]. They will understand it.” “It's wrong if I caught a snake there at the mountain and I want to kill it- it's totally wrong and I will not even support such an activity—just killing because you come together. I don't think that that snake will enter up here, so that's the snake's habitat. Respect and I also want [my habitat] to be respected”
Attraction/interest	
For self	“For me, it makes me happy to see wild animals roaming freely all over”
For future generations	“I like wild animals because I don't want them to die out because if those wild animals are dying out, my future generation will never see what it's looking like and those kind of business”
Rational/scientific	“[Elephant manure] was also used to help us with medicine- maybe the blood, your nose is running, or you're having a headache or you're scratching your body then you put in the water and then you shower [in] it.”
Spiritual/religious	“You know God created everything and after that he went to sit and said to himself now I must create the human being to guard over these things”

^aAdditional example quotations and code descriptions can be found in Table S3.

for conflicts (primarily predators and elephants) differed by conservancy (Figure S2), and corresponded to negative interactions described in the interviews. For instance, median reported attacks on livestock by cheetah (*Acinonyx jubatus*) were over two times greater in Sesfontein Conservancy, where interviews described three times as many

negative experiences with cheetah, as compared to other conservancies. Interviews across all conservancies, however, consistently offered more negative stories about lions than any other wildlife species (Table 2), even though lions were not reported as causing the highest number of conflicts each year according to the conflict record data (Figure S2).

TABLE 2 Measurements of species tolerance from a 2017 interview of Namibian pastoralists (n = 86)

Species	Positive interactions % of interviews ^b	Negative interactions % of interviews ^b	Would not conserve ^a % of interviews ^b
Herbivores			
Elephant	27.9%	54.7%	4.7%
Giraffe	15.1%	–	–
Kudu	5.8%	–	–
Oryx	7.0%	–	–
Rhino	4.65%	5.8%	1.2%
Springbok	34.9%	1.2%	–
Zebra	24.4%	2.3%	–
Predators			
Cheetah	–	23.3%	4.7%
Hyena	1.2%	23.3%	2.3%
Jackal	2.3%	12.8%	3.5%
Leopard	–	36.0%	5.8%
Lion	5.8%	66.3%	20.9%
Predators ^c	–	3.5%	–
Other			
Baboon	2.3%	3.5%	1.2%
Honey badger	1.2%	–	–
Ostrich	3.5%	–	–
Snakes	–	3.5%	–
Vultures	–	1.2%	–
Warthog	1.2%	–	–

^aInterview responses to the question, “which wild animals, if any, do you think should not be conserved or protected?”

^bWe report the percentage of total interviews, including focus groups, that mention these themes as opposed to individual respondents.

^cInterview responses that failed to specify a particular predator species.

3.3 | Challenges and proposed solutions to human–wildlife coexistence

The most commonly reported challenges were predators that kill livestock and drought, as noted in 91.9 and 53.5% of interviews, respectively (Tables 3 and S4). Indeed, our ecological data confirmed that livestock predation occurred consistently across years, regardless of environmental conditions (Figure S2). Other challenges included elephants destroying crops or water structures (14.0%), wildlife threatening human safety (8.1%), and unreliable access to water (8.1%). These problems were often associated with a domination orientation and accounts of negative interactions with elephants and predators. Challenges also included ethnic

conflicts (14.0%), such as the recent arrival of Himba immigrants with many livestock, and conservancy management issues (10.5%), including confusion about conservancy goals, poaching, overgrazing, and the inability to control wildlife populations. As one man stated, “I cannot implement the policies that I do not know. I do not understand even what the conservancy is, what are its goals, [and] why the conservancy has been set up.”

Proposed solutions to these challenges were more variable. Most frequently reported were methods designed to reduce human–wildlife conflict (Tables 3 and S5), including harvesting predators through trophy or community hunts (31.4%), translocating wildlife to other protected areas (29.1%), fencing predators within portions of the conservancies themselves (23.3%), and increased monitoring of wildlife movements (17.4%). Many of these solutions reflected a perception that human–wildlife conflicts are a constant threat (Figure S2) no matter the natural prey population size (Figure 3a). Interviews that suggested fencing predators frequently noted the value of those species for attracting tourists. Interviews mentioning challenges around ethnic conflicts often suggested that conservancies enact stricter immigration laws and greater penalties for stealing livestock (10.5%).

Few interviews addressed water-related concerns, but those that did requested continued access to drought-relief feed for livestock (7.0%) and better access to water (7.0%) by fixing existing boreholes and constructing others away from human settlements. One man suggested that, “Where no one is living, they should drill more water points for wildlife so that [the wildlife] can stay there. If there's enough water points in the field, the wildlife might stay [away from settlements].” Concerns about subsistence needs, such as access to water, human safety, and livestock wellbeing, all tied to a domination orientation, prevailed in both reported challenges and solutions to living with wildlife.

4 | DISCUSSION

Our study investigated pastoralists' value orientations toward wildlife and impacts of these orientations on species tolerance and perceptions of challenges and potential solutions to living with wildlife in the northern Namib Desert. The conditions of extreme environments like deserts may uniquely shape human–wildlife relationships and thought patterns in complex ways. Where desert pastoralists settle and how often they move with their livestock are driven by basic human needs, such as access to food and water. The strong prevalence of a domination value orientation toward wildlife expressed in all of our interviews is reflective of these subsistence needs. This orientation promotes a view prioritizing human well being over wildlife and relegating wildlife to

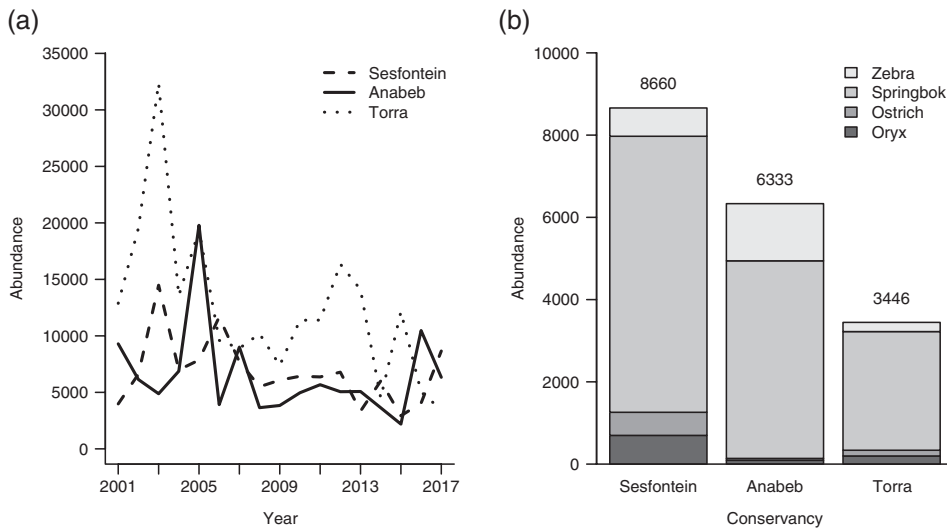


FIGURE 3 Wildlife abundance trends estimated from road surveys (a) for summed populations of oryx, ostrich, springbok, and Hartmann's mountain zebra across time, and (b) for the year of 2017 alone. Numbers above the bars in (b) represent the summed abundance of oryx, ostrich, springbok, and Hartmann's mountain zebra for each conservancy. Annual estimates are presented from June 2001 to 2017 (NACSO, 2018b)

TABLE 3 The top five themes mentioned as perceived challenges and solutions to living with wildlife from a 2017 interview of Namibian pastoralists ($n = 86$)

Themes	% of interviews ^a
Challenges	
Predators killing livestock	91.9%
Drought	53.5%
Elephants destroying crops and water structures	14.0%
Ethnic conflicts over land and cattle	14.0%
Problems related to conservancy management (e.g., poaching, overgrazing, and a lack of understanding of the conservancy system's goals)	10.5%
Solutions	
Harvest or trophy hunt predators	31.4%
Translocate wildlife to parks, private farms, or concession areas	29.1%
Fence predators within conservancy boundaries	23.3%
Hire more people to monitor wildlife movements and notify residents of their whereabouts	17.4%
Stricter immigration laws and greater penalties for stealing livestock	10.5%

^aWe report the percentage of total interviews, including focus groups, that mention these themes as opposed to individual respondents.

roles and uses that benefit humans. At the same time, however, a mutualism orientation was also detected in nearly one-quarter of the interviews, emphasizing notions of caring, compassion, and equality in wildlife treatment. Other research in western societies suggests that this orientation surfaces as modernization contributes to greater emphasis on belongingness and social affiliation needs; wildlife, as a reflection of those needs, are then seen as more human-like

and part of one's extended social network (Manfredo et al., 2016). In the Namibian context, however, mutualism may also be an extension of how livestock are treated, given that they are not only sold to cover living expenses and used as sources of transportation, milk, and meat, but are also considered part of a pastoralist's family. Indeed, we found evidence of this complexity in similar conceptions of both wildlife and livestock in our interviews, consistent with findings of wildlife value orientation assessments in certain other non-western cultural contexts including Mongolia and Kenya (Browne-Nuñez et al., 2013; Kaczensky, 2007).

Wildlife value orientations were also reflected in pastoralists' tolerance of wildlife and their perceptions of human-wildlife interactions. Our respondents indicated a strong affinity for herbivores among pastoralists as found in other studies (e.g., Browne-Nuñez et al., 2013; Gadd, 2005), notwithstanding inferred competition with livestock for access to water and pasture. These prey species (e.g., Hartmann's mountain zebra, springbok) often resemble livestock (e.g., donkeys, goats) in appearance and behavior (Kaczensky, 2007), and interviews, particularly those in which mutualism and attraction value orientations surfaced, revealed how pastoralists enjoyed seeing and living among them. However, pastoralists' tolerance of these species also reflected beliefs tied to a domination value orientation, in that participants highlighted the importance of herbivores for providing sustenance (i.e., meat for human consumption).

While pastoralists in our study were generally favorable toward wildlife as a whole, their relationship with predators is strained due to significant livestock depredation (e.g., Thomas et al., 2015). As in other parts of the world, Namibians kill predators due to the real and perceived threats they pose to livestock (Marker, Mills, & Macdonald, 2003; Rust & Taylor, 2016; Stein, Fuller, Damery, Sievert, & Marker, 2010), a growing challenge in Namibia despite concerted efforts to limit such conflicts (NACSO, 2016).

Negative interactions with lions, in particular, were reported across a majority (66.3%) of interviews, although the conflict report data we accessed for the same region showed that lions were not the most damaging species to livestock (NACSO, 2018a). Despite these interactions, a much lower percentage (20.9%) of interviews reported that lions should not be conserved, indicating that pastoralists may still be relatively tolerant of the species.

Our respondents identified a greater diversity of potential solutions, compared to perceived challenges, to living with wildlife in the northern Namib Desert. Challenges were related to subsistence needs, such as access to water and grazing as well as human and livestock safety, reflective of a domination value orientation. Living in extreme deserts likely magnifies these issues, many of which are also associated with poverty (Durant et al., 2014; Middleton et al., 2011). Pastoralists in our study suggested multiple ways to reduce the primary challenge of predators killing livestock. Some supported harvesting predators to manage to population sizes. Others favored translocating them to parks, private farms, or concession areas (i.e., removing some proportion of individual animals from the conservancies). Nearly one-quarter of interviews favored fencing predators on the conservancies, but away from human settlements. This would allow them to retain the benefits that predators bring as tourist attractions (reflective of beliefs about economic gains tied to domination), but also would provide local residents and their children the chance to still encounter these species (reflective of the attraction value orientation). Although drought was also frequently described as a challenge to living in the region, many felt that little can be done to address this problem and instead focused their responses on ways to reduce conflicts with predators.

Our findings can be used to inform future conservation efforts in northwestern Namibia and other similar arid landscapes. The data we collected not only offer a baseline for future studies, but also identified several potential solutions to reduce human–wildlife conflicts in the region. While most interviewees showed relatively high levels of tolerance of the local wildlife community, including predators, many also recognized the threats that predators pose for livestock and human safety. Participants suggested means to address these risks through reductions in predator populations or limiting the spatial overlap between predator species and people with their livestock. Our research initially focused on identifying wildlife value orientations among Namibian pastoralists (a new geographic contribution to previous cross-cultural research on wildlife value orientations) because, by understanding existing value structures, one can anticipate human attitudes and behaviors and work within those value structures to design more effective solutions to conservation challenges (Manfredo et al., 2016, 2017). Our findings suggest

that pastoralists would not favor the complete removal of predators, as they value their existence, but recognize that management efforts are needed to mitigate the conflicts affecting livestock and human safety. Combined with our results on value orientations in the region, the solutions identified in this study highlight potential opportunities for management interventions that may have a greater likelihood of success based on local pastoralists' support. Managing these issues over time, however, will require further monitoring to understand the dynamic social and ecological factors at play that could alter the system.

Some of our findings point to areas where future research would be beneficial to contribute to this need for monitoring. Modernization, globalization, and climate change are likely to affect the social–ecological conditions of this pastoralist society over time (e.g., increased drought, transitions to less nomadic lifestyles), which could in turn result in changes to value structures, rates of human–wildlife conflicts, and species tolerance. We detected traces of these outside influences that may warrant further exploration. For example, responses indicating a spiritual/religious value orientation referenced a Judeo-Christian God, suggestive of the far-reaching influence of missionaries in rural Namibia. Additionally, as Namibian pastoralists increasingly settle and adopt small-scale subsistence farming, their tolerance for conflict-prone species may be reduced, as was the case in central Kenya (Gadd, 2005). We recommend exploring these dynamics of tolerance in greater depth, perhaps with additional questions and methods that could expand upon our qualitative approach.

Our methodology consisted largely of semi-structured interviews, which included questions containing emotional prompts to elicit stories about wildlife. The latter allowed us to build upon and extend previous cross-cultural research on wildlife value orientations employing a similar approach (e.g., see *Human Dimensions of Wildlife* volume 12, issue 5). Replication of these qualitative methods and thorough descriptions of local contexts can allow for comparison across societies, including those where barriers to quantitative survey research such as limited literacy may exist (Dayer et al., 2007). In addition, had we used quantitative survey methods typical of wildlife value orientation assessments in more modernized countries (e.g., Teel & Manfredo, 2009; Manfredo et al., 2016), we would not have obtained an in-depth understanding of pastoralists' relationships and interactions with specific species. Nor would we have been able to adequately understand some of the ecological and cultural conditions shaping these relationships, an understanding that was also enhanced by the inclusion of an ecological component in our study. In the future, we suggest using a plurality of quantitative and qualitative methods to allow researchers the flexibility to generalize across a larger

sample of respondents, while still maintaining credibility by remaining grounded in the participants' lived realities and the local context of the conservation issues of interest.

Our work advances knowledge about wildlife values globally as part of a social–ecological systems approach, illustrating the preponderance of a domination ideology in an African pastoralist society not previously explored in cross-cultural wildlife value orientation assessments. In addition to domination, we identified a diverse suite of other value orientations and belief dimensions, some of which have been detected in these earlier assessments for other cultures and geographic locations. Our qualitative approach was also useful for eliciting pastoralists' perceptions of challenges and potential solutions to human–wildlife coexistence, furthering our understanding of conservation issues and opportunities in extreme arid environments. Our findings, as a whole, can contribute to development of more effective conservation initiatives, management interventions, and monitoring efforts that better account for the local cultural context, particularly in similar regions practicing community-based natural resource management.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to report.

AUTHOR CONTRIBUTIONS

T.M.L., T.L.T., and J.B. conceived the ideas for this study. T.M.L., T.L.T., and A.A.G. designed the social science methodology. T.M.L. and A.A.G. collected the social science data. T.M.L. and R.E.W.T. analyzed the social science data; T.M.L. analyzed the ecological data. T.M.L. and T.L.T. led the writing of the manuscript. All authors contributed to the drafts and approved publication.

DATA ACCESSIBILITY

Due to possible sensitivity of human subjects' data, interview files and transcriptions are only accessible by the authors. Ecological data are publicly available on the Namibian Ministry of Environment and Tourism's website.

ETHICS STATEMENT

Final interview procedures were approved for use with human subjects prior to implementation by Colorado State University's Institutional Review Board (Protocol #043-18H) and the Namibian Ministry of Environment and Tourism (Permit #2225/2016).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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