



An interdisciplinary review of current and future approaches to improving human–predator relations

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Abstract: *In a world of shrinking habitats and increasing competition for natural resources, potentially dangerous predators bring the challenges of coexisting with wildlife sharply into focus. Through interdisciplinary collaboration among authors trained in the humanities, social sciences, and natural sciences, we reviewed current approaches to mitigating adverse human–predator encounters and devised a vision for future approaches to understanding and mitigating such encounters. Limitations to current approaches to mitigation include too much focus on negative impacts; oversimplified equating of levels of damage with levels of conflict; and unsuccessful technical fixes resulting from failure to engage locals, address hidden costs, or understand cultural (nonscientific) explanations of the causality of attacks. An emerging interdisciplinary literature suggests that to better frame and successfully mitigate negative human–predator relations conservation professionals need to consider dispensing with conflict as the dominant framework for thinking about human–predator encounters; work out what conflicts are really about (they may be human–human conflicts); unravel the historical contexts of particular conflicts; and explore different cultural ways of thinking about animals. The idea of cosmopolitan natures may help conservation professionals think more clearly about human–predator relations in both local and global context. These new perspectives for future research practice include a recommendation for focused interdisciplinary research and the use of new approaches, including human–animal geography, multispecies ethnography, and approaches from the environmental humanities notably environmental history. Managers should think carefully about how they engage with local cultural beliefs about wildlife, work with all parties to agree on what constitutes good evidence, develop processes and methods to mitigate conflicts, and decide how to monitor and evaluate these. Demand for immediate solutions that benefit both conservation and development favors dispute resolution and technical fixes, which obscures important underlying drivers of conflicts. If these drivers are not considered, well-intentioned efforts focused on human–wildlife conflicts will fail.*

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Una Revisión Interdisciplinaria de las Estrategias Actuales y Futuras para Mejorar las Relaciones entre Humanos y Depredadores

Resumen: *En un mundo en el que los hábitats se reducen y la competencia por los recursos naturales incrementa, los depredadores potencialmente peligrosos resaltan pronunciadamente la dificultad de coexistir con la vida silvestre. Por medio de la colaboración interdisciplinaria entre autores preparados en las humanidades, las ciencias sociales y las ciencias naturales revisamos las estrategias actuales para mitigar los encuentros adversos entre depredadores y humanos y diseñamos una visión para estrategias futuras para entender y mitigar dichos encuentros. Las limitaciones de las estrategias actuales para la mitigación incluyen demasiado enfoque sobre los impactos negativos; la equiparación demasiado simplificada de los niveles de daño con los niveles del conflicto; y los arreglos técnicos infructuosos que resultan del fracaso por involucrar a los locales, hablar sobre los costos ocultos o entender las explicaciones culturales (no científicas) de la causalidad de los ataques. La literatura interdisciplinaria emergente sugiere que para enmarcar de mejor manera y mitigar exitosamente las relaciones negativas entre humanos y depredadores, los profesionales de la conservación necesitan considerar dispensar el conflicto como el marco de trabajo dominante para pensar sobre los encuentros entre humanos y depredadores; descifrar de qué se tratan realmente los conflictos (pueden ser conflictos humano – humano); aclarar los contextos históricos de conflictos particulares; y explorar las diferentes formas culturales de pensar sobre los animales. La idea de naturalezas cosmopolitas puede ayudar a los profesionales de la conservación a pensar de manera más clara sobre las relaciones humano – depredador en el contexto global y en el local. Estas nuevas perspectivas para la futura investigación de la práctica incluyen una recomendación para la investigación interdisciplinaria enfocada y el uso de nuevas estrategias, incluidas la geografía humano – animal, la etnografía de varias especies y estrategias de las humanidades ambientales, notablemente la historia ambiental. Los manejadores deberían pensar cuidadosamente sobre cómo se involucran con las creencias de los locales acerca de la vida silvestre, trabajar con todos los actores para acordar qué constituye una buena evidencia, desarrollar procesos y métodos para mitigar los conflictos, y decidir cómo monitorear y evaluarlos. La demanda por soluciones inmediatas que benefician tanto a la conservación como al desarrollo favorece a la resolución de disputas y a los arreglos técnicos, lo que hace a un lado a importantes conductores subyacentes de los conflictos. Si no son considerados estos conductores, los esfuerzos bien intencionados enfocados en los conflictos humano – vida silvestre fracasarán.*

Palabras Clave: conflicto humano – vida silvestre, depredadores, investigación interdisciplinaria, manejo de la conservación

Introduction

In a world of shrinking and fragmenting habitats and increasing competition for natural resources, potentially dangerous predators bring the challenges of coexisting with wildlife sharply into focus (Chapron et al. 2014). Conservationists have a reasonably full toolkit for the practical mitigation of conservation conflicts but very inadequate toolkits for tackling their underlying cultural and social dimensions (Macdonald et al. 2010). This may be because much of the existing research on human-predator interactions has focused on conflictual relations and specifically on human–wildlife conflict. Most conservation research has been driven by natural scientists concentrating on the biology and behavior of predators and prey and the impacts of predators on prey. More recently, social-science methods have been appropriated to improve the human cost–benefit ratio of cohabiting with such animals (Madden & McQuinn 2015).

Even within the research on relationships between humans and predators, predators and people tend to be studied separately and with different ontologies, epistemologies, and methodologies (Agrawal & Ostrom 2006;

Ghosal & Kjosavik 2015). Studies of the social dimensions of conservation tend toward quantitative social science, drawing on ideas from social psychology and economics, aimed at discovering and changing beliefs and attitudes influencing undesirable behavior, often to protect wildlife rather than humans (Blekesaune & Rønningen 2010; Dickman et al. 2011; Jhamvar-Shingote & Schuett 2013; Hayman et al. 2014). Empirical studies of the roles of culture and values in human–wildlife coexistence remain rare, and the humanities are almost entirely absent from the field.

It is recognized that although superficially conservation conflicts involve adverse human–wildlife relations, at a deeper level they usually reflect adverse human–human relations, where the views of conservationists conflict with those of others with apparently incompatible goals. In both cases, one party is perceived to assert its interests at the expense of another’s (Draheim et al. 2015; Redpath et al. 2015).

As a result, there has been a series of calls for a more broadly interdisciplinary approach to human–wildlife conflicts (Draheim et al. 2015; Linnell et al. 2015; Redpath et al. 2015; Agelici 2016). Ideas about how this broader

approach could be useful are still mostly conceptual or retrospectively applied. Over the past decade, however, there have been some intriguing individual studies exploring human-predator interactions in novel, interdisciplinary, and more integrated ways. As yet these kinds of studies are widely scattered across diverse publications and disciplines, many at the fringes of mainstream disciplinary endeavors (e.g., Álvares et al. 2011; Marvin 2012; Baynes-Rock 2013; Ghosal & Kjosavik 2015).

We drew on ideas from an emerging interdisciplinary literature and approaches from disciplines not previously involved in conservation-conflict studies to offer new perspectives for understanding and mitigating human-predator conflicts. We encourage researchers interested in conservation conflicts to collaborate and draw on their respective disciplinary skills and expertise to develop a more integrated approach to understanding and improving human-predator relations.

We reviewed the limitations of current approaches to mitigating human predator conflicts; examined the emerging interdisciplinary literature to identify key perspectives on how better to reframe and therefore successfully intervene in such conflict scenarios; and considered the implications of these perspectives for research and management practice.

Current Approaches to Human–Predator Conflict Mitigation

Human-predator conflicts appear superficially to be about negative impacts—mostly visible or direct costs such as loss of livestock or human life on the one hand and losses of individual wild predators (such as Cecil the lion) and population declines or extinctions on the other. Thus, a common response has been to build up an evidence base and develop a scientifically robust approach to understanding and mitigating these impacts (e.g., Quigley & Herrero 2005; Aust et al. 2009). Managers and ecologists have tended to make 3 key assumptions: the level of damage from predation is directly related to the level of conflict; the level of conflict elicits a response proportional to the level of damage; and mitigation activities appropriate to the level of conflict and damage lead to proportional increases in support for conservation (reported by Dickman 2010). However, there is good evidence that these assumptions are often misplaced (e.g., Cavalcanti et al. 2010; Kansky & Knight 2014; Zimmermann 2014).

Examples of approaches tackling impacts include lethal control or translocations of so-called problem animals, provision of information about predator behavior, technical fixes to prevent damage (Woodroffe et al. 2005; Athreya et al. 2011; McManus et al. 2015), and the development of financial instruments to offset impacts (Dickman et al. 2011). Attempts to understand the be-

havior of damage-causing predators determine the most effective methods for reducing attacks (such as guarding livestock or providing safe water-collection points to avoid crocodile attacks), and educate local communities about employing methods to reduce their vulnerability have had some success (e.g., Balme et al. 2009; Marker & Boast 2015). However, such interventions have also foundered in many places for a range of reasons, including failure to involve local people, high opportunity costs of effective livestock protection methods, and resistance to perceived infringements on freedom of behavior (Barua et al. 2013), or as a result of epistemological disagreements over what causes predator attacks (Wallace et al. 2011; Pooley 2016).

Where negative attitudes to predators are expressed as objections to the damage they cause, actual damage is often negligible. In some cases, it is the fear of an attack by an animal perceived as targeting humans (e.g., sharks) that promotes these attitudes (Neff 2012). In others, it is people's dislike of a risk they believe is imposed upon them by an external authority, for example conservation authorities reintroducing predators to a region (Dickman & Hazzah 2016). Kansky and Knight (2014) suggest that intangible costs (e.g., psychological costs of danger) are the most important variables explaining attitudes to carnivores—significantly more so than tangible costs (e.g., direct monetary losses). Cavalcanti et al. (2010) conclude that human persecution of jaguars (*Panthera onca*) in Brazil is less related to the economic impacts of livestock depredation than conservationists thought and more related to the cultural and social perceptions of potential threat and the enjoyment and status associated with jaguar hunting.

It has become increasingly apparent that even the best analyses and advice on impact reduction do not necessarily resolve conservation conflicts. An under-researched subject is why scientifically sound mitigation measures are so often ignored or discontinued. Evaluative research on conservation-conflict mitigation suggests that the superficial impacts of predation often conceal a diversity of underlying issues related to different epistemologies, historical contexts, and identity differences that are beyond the competencies of natural scientists to resolve (Madden & McQuinn 2015; Dickman & Hazzah 2016). There are still important gaps and shortfalls in current understanding of and approaches to mitigating the more intractable of these human-predator conflict scenarios.

Reframing Conservation Conflicts

Conflict as a Framework

Conservationists are actors within conflict scenarios, and conflicts arising over how to manage and interact with large predators may be human-human conflicts between people with different world views and ways of valuing

predators. In some cases, the killing of predators may be manifestations of deep underlying differences and perceived injustices (Dickman 2010). Or conflicts may be purely about impact and pest management, in which case a focus on mitigation will suffice. When it comes to specific situations, it is crucial to understand what the issue really is.

A first step is to think through the actions and relations the term *conflict* promotes and what it constrains and omits. It may be preferable to talk about human–predator relations, with conflict as a subset of relations, alongside coexistence predicated on interventions to alleviate negative impacts of predators; coadaptation, where humans and predators adapt to accommodate one another; mutual avoidance; and mutual flourishing (Peterson et al. 2010; Carter & Linnell 2016).

Framing a particular encounter as a conflict between humans and a predator species (therefore requiring a predator-focused solution) may polarize and redefine a situation. Where such encounters may have been experienced previously as facts of life within certain social contexts, examining and trying to mitigate conflicts may lead to them being reinterpreted as unacceptable problems requiring redress by the state or a nongovernmental conservation organization that is given moral and legal responsibilities for resolving the conflict. This reframing may have unintended consequences for both predators and people (Peterson et al. 2013; Redpath et al. 2015). When conservationists attempt to resolve conflicts, the problem becomes identified with them. A lion becomes a problem animal associated with (and often perceived as owned by) the conservationists, rather than being perceived as a natural phenomenon (Macdonald et al. 2010).

History, Society, and Politics

Tracking the history of how particular conflicts have arisen and been framed over time can improve understanding of the legacies of local land use, social and political interactions, and management interventions by the relevant players (human and nonhuman). This tracking provides a more in-depth understanding of the conflicts these factors have caused, manifested themselves in, or been designed to solve (McGregor 2005; Lambert 2015; Sprage & Draheim 2015). For example, a public campaign to exterminate all crocodiles (*Crocodylus niloticus*) in Zululand, South Africa, in the late 1950s was presented in the media as a straightforward response to attacks on humans by crocodiles. It was actually the result of a complex set of underlying social, economic, political, and ecological drivers and events that manifested as a predator-eradication campaign (Pooley 2013).

In many developing countries conservation policies are legacies of colonial occupation, and current attitudes to conservation are shaped by long histories of wildlife policies and management (Mackenzie 1988; Adams &

Mulligan 2003; Beinart & Hughes 2007). This plays out in disputes over land ownership, boundaries, and the use of natural resources brought about by the creation and administration of protected areas and over the ownership and governance of living resources by the state (West et al. 2006; Barua 2014a). These legacies have polarized conflicts over predators, disempowered and excluded local people from conflict management, reduced benefits for tolerating dangerous animals, and resulted in conservation authorities avoiding responsibility for wildlife impacts outside protected areas (Western & Waithaka 2005; Ghosal & Kjosavik 2015). This is despite the fact that a major function of conservation authorities in colonial times was to control such predators (Mackenzie 1988).

Perspectives from political ecology and politics are useful for thinking about how both conservationists and local communities create and enforce the kinds of human–predator relations they want (Adams 2015). Different parties have different tools, or forms of power, that they use to negotiate and create these kinds of relations. Treves et al. (2015) advocate that conservationists lobby to create regulations regarding what humans can do to predators and that these regulations be enforced through juridical means (fines, imprisonment, or other punishments). Conservationists may use economic power to encourage humans to change their behavior toward predators. They offer compensation for predated livestock (Boitani et al. 2011), reward payments for coexisting with healthy populations of predators (Persson et al. 2015), or, more indirectly, encourage locals to engage in predator-based ecotourism enterprises.

An important trend in the literature is the realization that in many situations, particularly in developing countries, rural residents choose not to use the tools and forms of power of formal politics, such as lobbying and political pressure (Scott 1998). They may lack the knowledge, skills, time, and resources to engage in formal politics or they may be fearful of the consequences of doing so. Instead, they engage in hidden, everyday forms of political action to alter human–predator relations, particularly illegal killing of predators (Holmes 2007). This sends a powerful yet anonymous signal of discontent with the state of human–predator relations, particularly conservation regulations. Indeed, such conflicts may not even be about predators and conservation. For example, rural hunters in Scandinavia kill wolves (*Canis lupus*) to express anger at what they see as an overbearing urban-centric state intent on wolf conservation (von Essen et al. 2014).

Cultures and Conflicts

Animals have a physical existence independent of humans, and for the purposes of management, it is essential to understand their physiology, behavior, and ecological

relations. However, when humans' lives intersect with them, these creatures are drawn into webs of human significances. When humans think about predators, the real creature includes the cultural animal, and the real animal cannot be revealed by stripping away its cultural accretions. Thus, cultural constructions of the wolf, for example, vary between different groups of people. *Canis lupus* is the organism studied by scientists (Mech & Boitani 2003). In many northern indigenous cultures the wolf is a revered hunter who is regarded as animal kin (Laugrand & Oosten 2014). For pastoralists and livestock farmers, the wolf is a destructive predator (Coleman 2004). The reemergence or reintroduction of wolves is celebrated by many as the return of a maligned charismatic carnivore (Marvin 2012) but contested by others as the imposition of a dangerous killer on rural communities by powerful outsiders (Skogen & Krangle 2003; Buller 2008; von Essen et al. 2014).

When conflicts are directly about predator impacts on people, it is useful to discover how predators and attacks by predators are perceived. Are predators seen as natural, magical, owned, or all three. If they are regarded as controlled or owned, who controls or owns them? Framing interrelations between humans and predators as conflicts can result in these animals being portrayed as the possessions, responsibilities or allies of one or other of the parties involved in a conservation conflict. How predators are viewed and the causality attributed to attacks (e.g., normal species behavior, metaphysical justice, or bewitchment) influence who is held responsible for conflicts and for resolving them (Álvarez et al. 2011; von Essen et al. 2014). In 2013 researchers working in Sava Region, Madagascar, reported they could find no "logical . . . explanations of [crocodile] attacks from locals" because locals believed "the persons killed or injured . . . [had] done something bad" (CITES 2013, p. 46). This makes attributing causality and involving locals in mitigation measures challenging.

Different social groups may also have different perceptions of predators because they have differing resilience to predator attacks—a wealthy cattle farmer can better cope with lion attacks than a subsistence pastoralist. Certain groups within communities (defined by class, gender, caste, or ethnicity) are more or less likely to experience predator attacks (Gore & Kahler 2012).

The diverse ways in which particular societies, communities, or individuals think about and respond to such culturally important animals cannot be explained solely through quantitative social sciences approaches focusing on measuring attitudes and behavior. These approaches typically disaggregate people into socioeconomic groups such as commercial farmers, communal farmers, pastoralists, agriculturalists, hunters, and other livelihood-oriented descriptions. This lumping by livelihood group results in analyses that miss some striking cultural differences, for example between people from different ethnic

groups (Kansky & Knight 2014; Zimmermann 2014; Dickman & Hazzah 2016).

In a study of jaguar conflicts across the Americas, Zimmermann (2014) found a wide diversity of attitudes to jaguars and disparities between their attitudes and their behavior toward jaguars. Seventeen case studies across 7 jaguar-range countries revealed that no socioeconomic factors could accurately predict how farmers perceived and dealt with jaguars. Similarly, peoples' responses to living alongside lions vary greatly across their range. Although lions (*Panthera leo*) are frequently killed by pastoralists and farmers across Africa (Loveridge et al. 2010), local farmers in the Greater Gir Landscape in Western India are remarkably tolerant of the Asiatic lions (*Panthera leo persica*) that roam outside of protected areas, despite occasional predation (Banerjee et al. 2013).

What comes up over and over again is the importance of the particular relationships that have developed between predators and prey and people in specific places (Peterhans & Gnoske 2001; Kruuk 2002; Baynes-Rock 2013). The fact that large predators survive at all in some regions outside of protected areas is down to a measure of tolerance by locals that can have as much to do with local cultures as economic calculation, legal enforcement, or the social engineering of behavior by conservationists. This is not to deny the effectiveness, if not always the justice, of the latter measures in some contexts. Here, locals' apparent tolerance may actually result from their incapacity to act.

Alongside stories about the persecution of predators, there are remarkable tales of long-standing tolerance of predators. Spotted hyenas (*Crocuta crocuta*) are tolerated and valued in Harar, Ethiopia, because they scavenge on diseased carcasses and are believed to kill and eat dangerous spirits called *jinn*s (Baynes-Rock 2013). In Australia when an Aboriginal woman of the Dhalinbuy community was killed by a saltwater crocodile (*C. porosus*) in Arnhem Land in 1980, the community requested that the crocodile not be killed. Eight years later when a man was killed by a crocodile in the same river, the Aboriginal community again chose not to have the animal killed (Webb & Manolis 1998).

However, cultures and beliefs are not static. Although the Maasai are often thought of as relatively tolerant of lions and traditionally hold some positive views toward them (Goldman et al. 2010), the popularity of relatively new evangelical churches has been associated with more negative attitudes toward carnivores in both Kenya and Tanzania (Dickman et al. 2014).

Examples of tolerance toward predators arise not only from the beliefs and behaviors of humans but also from animal behavior. This suggests a different kind of focus on animal behavior (i.e., how individual animals and societies of animals have adapted to the human societies they interact with). On the one hand, there are areas where certain predators such as crocodylians, hyenas, leopards

(*Panthera pardus*), and pumas (*Puma concolor*), for example, have learned to live alongside humans with few problematic encounters. On the other hand, certain places have long been notorious for so-called man-eating predators, for example Nile crocodiles along stretches of the lower Zambezi or the Chobe in Namibia (Livingstone 1858; Stevenson-Hamilton 1917; Aust et al. 2009; Wallace et al. 2011) and lions in the Rufiji River basin of southern Tanzania (Packer et al. 2005).

There is speculation that predators in some of these places have developed cultures of preying on humans as a result of conjunctions of human and animal behavior and environmental conditions. Packer et al. (2005) found that habitat destruction and prey depletion are associated with an increase in lion attacks on humans in southern Tanzania and that lions had learned to prey on humans after following bushpigs (*Potamochoerus larvatus*) into human settlements and agricultural areas. Behavioral studies strongly suggest that some species have culture in the sense of learned behavior passed on from parents to offspring (Berger 2008). Examples where this has been attributed to predators preying on humans include Nile crocodiles at Shesheke (Stevenson-Hamilton 1917), tigers (*Panthera tigris*) in the Sundarbans (Kruuk 2002), and lions at Tsavo (Peterhans & Gnoske 2001).

Cosmopolitan Natures

In addition to specific local relationships between animals and people, another type of relationship is becoming increasingly important—the globalized, urbanized, Western view of wildlife. The concept of cosmopolitan natures is useful for understanding these changed relations between humans and a small number of popular images of charismatic animals that circulate in global media for the purposes of both entertainment and conservation campaigns (Barua 2014b). As safari hunting gave way to photographic safaris and wildlife films, so a select group of animals ceased to be parochial and became prominent internationally through networks of trade, science, and entertainment (Mackenzie 1988; Beinart & Schafer 2013; Macdonald et al. 2015). These are the culturally defined wild animals that many urban people encounter in their lives and come to care for. Conservationists need to understand how the cosmopolitan natures of these cultural animals shape the economics and politics of conflict.

Conservation has become reliant on the commodification of a small number of flagship species that appear in advertising and on film and are encountered face-to-face through ecotourism (Lorimer 2015). Through these processes, money is raised to save tigers, elephants, and lions and their habitats. But the globally circulating images of predators rarely include the experiences and conceptualizations of the people who live alongside these animals. For example, the killing of Cecil the Lion by a trophy

hunter outside Hwange National Park, Zimbabwe, in July 2015 elicited very different responses from Zimbabweans living in areas where lions prey on their livestock than it did from animal lovers in the United States. Some Zimbabweans interpreted the media frenzy and resulting donations to lion conservation as evidence that “Americans care more about African animals than about African people” (Nzou 2015). Similarly, reports overlooked the social, ecological, and economic complexity of the trophy-hunting industry in East and southern Africa, and the media frenzy led to political campaigns that may negatively affect lion populations.

The global institutions and agencies that mobilize charismatic species for funding and international or national legitimacy can direct local outcomes from afar but may have limited local legitimacy. In understanding and mitigating conflicts involving predators it is important to recognize the multiple natural knowledges that come into contact and their potentially conflicting natures in the globalizing networks of conservation (Lorimer 2015).

Implications for Research and Management Practice

Research

We have examined some important ways in which conceptualizations of predators and human–predator interrelations are plural and shifting and how this plurality impacts responses to conflict. But how can this new understanding change research practices? First, the research approach must be interdisciplinary, requiring researchers from relevant disciplines to collaborate on planning, method selection and development, and analyses (Pooley et al. 2014).

Approaches currently prevalent in conservation research often do not adequately capture the complexities of human–predator interactions. Researchers are just beginning to think more rigorously about what *coexistence* and *coadaptation* actually mean (Carter & Linnell 2016). However, work in animal studies, anthropology, environmental history, and geography has sought to develop new ways of conceptualizing human–animal relationships and new approaches for studying them, which could usefully be applied in conservation (Gross & Valley 2012; Malone et al. 2014; Hodgetts & Lorimer 2015).

An example of such a useful research framework is human–animal geographies (Philo & Wilbert 2000; Lorimer & Srinivasan 2013). This entails considering the geographies of animals themselves and the ways in which geographies challenge (or confirm) human social orderings of space. Human geographies for animals include explicit territories and boundaries (e.g., protected areas, corridors, and fences) as well as more subtle mechanisms (e.g., lists of native species or IUCN Red List criteria) that frame how spaces for animals are imagined

and governed. Such territories and boundaries may not be recognized by, or determine, the movements and interaction of animals or the people living alongside them.

Work on human geographies of animals helps identify where and when different animals are understood to be in or out of place and thus where conflicts occur. For example, research documents that synurbic species that flourish in urban ecosystems have both positive and negative relations with people (Francis & Chadwick 2012). Other work considers animal mobilities (the various forms and lived experiences of animal movement) to explore how animals shape their daily, seasonal, and life-cycle rhythms to adapt to human ecologies (Lorimer 2015). This research could fruitfully complement studies by conservation scientists on how particular predators and local communities interact in space and over time (e.g., Valeix et al. 2012; Elliot et al. 2014).

Multispecies ethnography uses methods from ethnography and ethology to document human and animal behaviors, sociabilities, and emotional states (Kirksey & Helmreich 2010). The novelty and utility of multispecies ethnography is its focus on uncovering the detailed and multifaceted interactions between humans and animals; the emphasis is on mutual influence rather than one-way relationships. There is great potential for developing this research through existing technologies for monitoring, tracking, and governing animal movements (e.g., Valeix et al. 2012; Kuiper et al. 2015). This could help inform creative technological interventions to deter and perhaps train animals to avoid conflict.

Environmental history places contemporary conflicts in their historic contexts to study the ways in which human and predator histories intersect. Beinart (2003) shows how black-backed jackals (*Canis mesomelas*) benefitted from the astronomical rise in numbers of sheep in the Cape, South Africa, from 1800 to 1930. The political power of sheep farmers enabled them to win state support for a bounty system, and poisoning, trapping, fencing, and hunting clubs controlled jackals to some degree from the 1920s to the 1970s. Now, however, with more protected areas, wildlife farming, and the removal of fences, jackals are making a comeback (Natrass et al. 2015). Historical perspectives can reveal these long-term shifts in balance between humans, livestock, and predators and the complex causes and outcomes of management interventions. They also illustrate that how conflict is handled changes in accordance with changes in management philosophy, land use, land ownership, cultural attitudes to predators, and where traditional management is eroded or disappears (Mackenzie 1988).

Researchers in the environmental humanities have examined the intertwined relations of wild animals and those who study them (Plumwood 2012; Van Dooren 2014). Plumwood (2012), Quammen (2003), and the environmental historians Ritvo (1989), Walker (2013),

and Pooley (2016) have investigated how humans relate to animals that prey on them, how this problematizes boundaries between humans and other animals, and how people understand and attribute agency to such animals when they think about their lives and histories. Their work encourages self-reflection on why and how those engaged in conservation study and relate to such animals.

Management

We have noted some exemplary interventions for mitigating instances of human–predator conflict (e.g., McManus et al. 2015). However, even interventions as apparently straightforward as the building of fences are socially complicated undertakings and can substantially restructure (or reinforce) historical and existing social and political relations (Evans & Adams 2016). They can exacerbate or reignite conflicts between local people and conservationists, with potentially adverse impacts on conservation outcomes. Clearly, there are still important gaps in understanding of and approaches to mitigating the more intractable conflict scenarios.

A notable example is the protracted conflict over the illegal killing of raptors in the U.K. uplands in the interests of reducing predation on commercially valuable Red Grouse (*Lagopus lagopus scotica*). Extensive ecological research and a number of technical solutions have all failed to mitigate this conflict. This has led to the insight that conflict mitigation on the ground requires a transdisciplinary approach involving researchers, managers, locals, and other stakeholders (Redpath et al. 2015). Such collaborations are challenging. The bitter conflict between game-shooting estate owners and conservationists over the impact of Hen Harriers (*Circus cyaneus*) on Red Grouse has not disposed either side to seek genuinely shared solutions to the problem (Thirgood & Redpath 2008).

The role of researchers is particularly fraught when moving from understanding to resolving conflicts. Should conservation scientists strive to educate people out of what they see as mistaken beliefs about animal behavior? Some cultural beliefs and traditions are harmful to wildlife and should be (respectfully) challenged (Dickman et al. 2015). For example, beliefs that certain animals (e.g., hyena) are evil or associated with witchcraft result in their persecution (Dickman & Hazzah 2016). The idea that supernatural agents are the instigators of attacks by predators may explain failures to implement sensible mitigation measures that could reduce attack incidence (Knight 2000; Pooley 2016). The use of lion and tiger bones in Chinese tiger wine, an alleged tonic, is another example of cultural beliefs that are harmful to predators (Williams et al. 2015).

However some beliefs, which researchers also regard as mistaken, may have positive impacts on the persistence

of predators. For example, there is a Nepalese taboo on killing snow leopards (*Panthera uncia*) (Ale 1998) and spotted hyenas are tolerated in Harar, Ethiopia, because they are believed to devour evil spirits (Baynes-Rock 2013). Might working with locals and their beliefs sometimes facilitate the coexistence of predators, humans, and their livestock outside protected areas? It is arguably at best inconsistent and at worst unethical to attempt to selectively convince people that some of their beliefs (those judged harmful to wildlife) are misconceived, whereas others (judged helpful) are true or justified. Furthermore, for some conservation scientists, this appears to compromise the integrity of their scientific method and suggests an element of moral relativism in elevating some cultural practices above rational criticism (Dickman et al. 2015). The situation may however not be this polarized. In many communities there will be individuals with enough education to straddle different understandings of nature.

In practice, it has proven possible to work with cultural beliefs to mitigate the killing of predators where conservationists have interacted creatively with locals whose belief systems are amenable to modification (Macdonald et al. 2010). The Lion Guardians scheme in Amboseli, Kenya, redirects the energies of young Maasai men who gained social status by killing lions into achieving this status through gaining skills and income from tracking and guarding lions. The men still fulfill their protective role in the community through awareness of where the lions are and predator-proofing of livestock enclosures (Hazzah et al. 2014).

Opinions about which ideas and beliefs about wild animals and human–predator relations are justified and constructive and which are not reflect particular epistemologies and value systems. To coproduce knowledge about the causes and consequences of conflicts, while avoiding a paralyzing relativism, all parties need to agree on what they will accept as good evidence, collaborate to develop processes and methods to mitigate conflicts, and decide how these can be monitored and evaluated (Redpath et al. 2015).

Researchers can now draw on a range of conceptual frameworks and qualitative and quantitative approaches to assess links between values, attitudes, and behavior. In particular, innovative approaches are being developed to study illegal behavior, conflicts, and the social impacts of conservation (St John et al. 2010; Jochum et al. 2014; Harrison et al. 2015).

Researchers can also learn from disciplines that have targeted analogous problems within the human realm, such as criminology and peace studies. Two recent adaptations of such approaches to improve conservation conflict mitigation are Redpath et al.'s (2013) framework for an adaptive conflict-mapping and management process and Madden and McQuinn's (2015) tripartite levels of conflict model derived from peace studies.

The Elusive Win-Win

Conservation science is one among many voices in conservation. Scientific arguments and evidence contribute to larger processes involving moral arguments (what ought to be done) and political arguments (what can be done). Ideally, research projects and conflict-resolution processes should reflect this and be shaped into transdisciplinary collaborations where progress is made through disciplined argument and cooperation rather than a zero-sum competition over power, influence, and resources.

The model of consensus-based conservation that came to prominence in the 1990s, linked to sustainable development, has proven unhelpful in resolving conservation conflicts (Peterson et al. 2013). The focus of conservation efforts—and importantly, funding—is now frequently on scenarios where conservation and development must benefit mutually from interventions. However, conservation and development often have different end goals and win-wins are rare. It is hard to defend protectionist conservation policies to a poverty-stricken pastoralist whose few livestock have been killed by a big cat or to argue against the right of a woman widowed by a predator to oppose scientifically sound conservation policies. It may be equally challenging to find mutually beneficial solutions in the face of unsustainable local uses of threatened species, although these are always the ideal solutions.

A desire for rapid, win-win solutions focuses energies on dispute resolution and technical fixes. This limited focus obscures important, deep, and long-running underlying drivers of conflicts and fundamental differences in power, vulnerabilities, and values without due cognizance of which well-intentioned efforts will fail.

Conclusion

Conservationists should widen their focus and admit the ideas, discourses, and perspectives of the many disciplines and players required to understand the drivers and consequences of what conservationists unhelpfully call human–predator conflicts (thus removing themselves from the equation). In the best traditions of the sciences and the humanities, we call for robust, inclusive and bounded debate in pursuit of better ways to think about and coexist with predators.

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