

REVIEW

Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict

A. J. Dickman

Department of Zoology, Wildlife Conservation Research Unit, The Recanati-Kaplan Centre, University of Oxford, Tubney, Oxfordshire, UK

Keywords

conflict resolution; human–wildlife conflict; mitigation; social factors.

Correspondence

Amy J. Dickman, Department of Zoology, Wildlife Conservation Research Unit, The Recanati-Kaplan Centre, University of Oxford, Tubney House, Abingdon Road, Tubney, Oxfordshire OX13 5QL. Tel: +44 1865 393100; Fax: +44 1865 393101
Email: amy.dickman@zoo.ox.ac.uk

Received 16 October 2009; accepted 5 March 2010

doi:10.1111/j.1469-1795.2010.00368.x

Abstract

Human–wildlife conflict is one of the most critical threats facing many wildlife species today, and the topic is receiving increasing attention from conservation biologists. Direct wildlife damage is commonly cited as the main driver of conflict, and many tools exist for reducing such damage. However, significant conflict often remains even after damage has been reduced, suggesting that conflict requires novel, comprehensive approaches for long-term resolution. Although most mitigation studies investigate only the technical aspects of conflict reduction, peoples' attitudes towards wildlife are complex, with social factors as diverse as religious affiliation, ethnicity and cultural beliefs all shaping conflict intensity. Moreover, human–wildlife conflicts are often manifestations of underlying human–human conflicts, such as between authorities and local people, or between people of different cultural backgrounds. Despite evidence that social factors can be more important in driving conflict than wildlife damage incurred, they are often ignored in conflict studies. Developing a broader awareness of conflict drivers will advance understanding of the patterns and underlying processes behind this critical conservation issue. In this paper, I review a wide variety of case studies to show how social factors strongly influence perceptions of human–wildlife conflict, and highlight how mitigation approaches should become increasingly innovative and interdisciplinary in order to enable people to move from conflict towards coexistence.

Human–wildlife conflict: a growing challenge in a changing world

Conflict between humans and wildlife is one of the most widespread and intractable issues facing conservation biologists today. This issue encompasses a huge diversity of situations and species, from grain-eating rodents to man-eating tigers *Panthera tigris* (Pimentel, Zuniga & Morrison, 2005; Barlow, 2009). Living alongside such species can impose a variety of significant costs upon local people, including depredation upon livestock or game (Thirgood, Woodroffe & Rabinowitz, 2005), crop-raiding or destruction of stored food (Pimentel *et al.*, 2005; Perez & Pacheco, 2006), attacks upon humans (Loe & Roskaft, 2004; Packer *et al.*, 2005), disease transmission to stock or humans (Thirgood *et al.*, 2005) and opportunity costs, where people forgo economic or lifestyle choices due to impositions placed upon them by the presence of wild animals or conservation areas (Woodroffe, Thirgood & Rabinowitz, 2005).

The response to these costs is often lethal control, and human–wildlife conflict poses a significant threat to species

as varied as the crowned eagle *Harpyhaliaetus coronatus*, the lion *Panthera leo* and the recently discovered Arunachal macaque *Macaca munzala* (Frank *et al.*, 2006; Sarasola & Maceda, 2006; Kumar *et al.*, 2008). In many places, human–wildlife conflicts are increasing, as burgeoning human populations move further into previously uninhabited areas, and as some species recolonize parts of their range (Woodroffe *et al.*, 2005; Skogen, Mauz & Krangle, 2008). Concomitantly, interest in this subject has increased among conservation biologists, with a significant rise ($r = 0.812$, $n = 21$, $P < 0.001$) in the number of scientific articles published about human–wildlife conflict between 1998 and 2008, as judged by citations in BIOSIS (Fig. 1).

Mitigating conflict

Effective mitigation strategies are urgently needed in order to resolve this issue, and a wide range of technical approaches exist for damage limitation (Breitenmoser *et al.*, 2005; Thirgood *et al.*, 2005) (Table 1). These techniques can undoubtedly help lessen conflict, as they can significantly

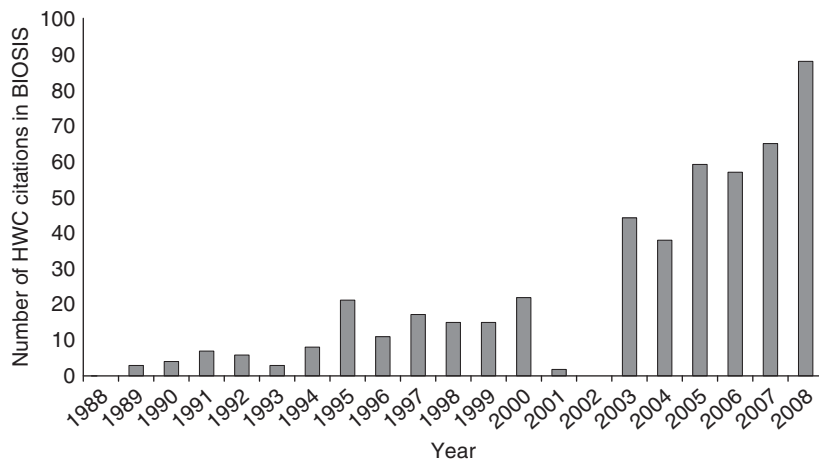


Figure 1 Number of BIOSIS citations from 1998 to 2008, containing the keywords 'human–wildlife conflict'.

reduce the magnitude of wildlife damage incurred (Breitenmoser *et al.*, 2005; Marker, Dickman & Macdonald, 2005; Woodroffe *et al.*, 2007). On the face of it, conflict resolution should be a relatively simple endeavour, with the expectation that once the appropriate strategies have been put in place to deal with the reported issue, animosity towards the species concerned should abate. Unfortunately, evidence suggests that complete, long-term conflict resolution is rare, even where such strategies have been implemented (Marker, 2002; Webber, Hill & Reynolds, 2007). This suggests that despite most people citing direct wildlife damage as the reason for their antagonism towards wildlife (Sillero-Zubiri & Laurenson, 2001), the causes of conflict are often complex and deep-seated, and a broader approach must be utilized in order to ameliorate such conflict fully in the long term.

Considering the complexities of conflict

There are numerous reasons why conflict mitigation efforts might fail to achieve the desired long-term results, and the likely issues will vary substantially according to local conditions. Conservation biologists often make important assumptions about human attitudes and behaviour when deciding how to tackle conflict, but often the mismatch between assumed and actual behaviour is startling. A common, and perfectly rational, conceptualization of the conflict process is depicted in Fig. 2.

This conceptualization involves three important, but often not critically assessed, assumptions. These include: (A) that the level of wildlife damage is directly related to the level of conflict engendered; (B) that the level of conflict elicits a proportionate response; (C) that altering the response to conflict will have proportionate conservation effects. However, in reality there are important attitudinal factors that influence the relationships between all of these components (Fig. 3).

Differences in these attitudinal factors can lead to significant departures from the expected model, and failing to consider such departures can have critical implications for the success or failure of a conflict mitigation project.

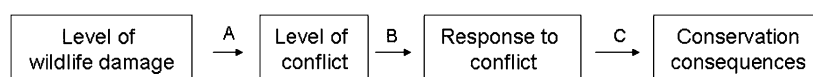
Peoples' responses to events vary significantly, and several factors need to be considered, including: (i) how accurately the level of damage is assessed, and how severe such damage is considered to be, both of which affect the perceived level of conflict; (ii) the intensity of an individual or group's response to that conflict; (iii) whether or not their management of that species is directly linked to the reported conflict. I define three key factors, which particularly influence the mismatch between common assumptions and actual behaviour, namely perceptions of risk, disproportionate responses and social influences. Conservation biologists should examine their local situations in-depth and carefully consider which of these factors might influence conflict, before deciding which mitigation strategies are likely to be most successful under those conditions.

Perceptions of risk

It is commonly assumed that people are reasonably aware of the actual risk posed by wildlife, but this is often untrue. Understanding how people perceive risks is usually of interest mainly to policy makers dealing with safety issues, but such studies can also be valuable in examining the complex nature of human–wildlife interactions and can help inform our understanding of conflict. The concept and understanding of risk, as well as the reactions to it, are heavily influenced by social and cultural perceptions, values, history and ideology, particularly with regard to ideas of what the world 'should' be like (Boholm, 1998; Sjöberg, Moen & Rundmo, 2004). A seminal study by Starr (1969), on how people perceive, tolerate and accept risks, revealed that people were on average 1000 times more likely to accept risks they undertake voluntarily as opposed to risks imposed externally. This can be of great importance in human–wildlife conflict scenarios, where people may blame external agencies for imposing wildlife and its attendant risks upon them: for instance, in France and Norway, many farmers suspect that 'naturally recolonizing' wolves *Canis lupus* were actually secretly bred and reintroduced (Skogen *et al.*, 2008). Meanwhile, research around Uganda's Kibale National Park revealed that although domestic stock inflicted twice

Table 1 Summary of technical measures used to mitigate human–wildlife conflict

Conflict mitigation approach	Techniques	Examples
Physical separation of conflicting species and resources	Fencing/enclosing resource	Livestock enclosures; placing fences, electric fences, trenches, fladry, trenches, netting or other defence structures around resource
	Repellents/deterrents and scaring devices	Visual repellents, acoustic repellents, chemical repellents (including odour and taste repellents), rubber bullets or other projectile deterrents, radio-activated guard boxes
Guarding assets	Fencing protected areas	Electric fencing or other fencing around boundaries of protected area
	Guarding and warning animals	Specialized livestock guarding dogs, other guardian animals such as donkeys and llamas, local dogs to warn of predator presence
	Human guardians	Human guarding of resources, for example staying in crop fields to scare away herbivores, herders going out with stock or staying in/around enclosures to protect from carnivores
Habitat use and modification	Physical devices on livestock	Protection collars, king collars, cyanide collars
	Habitat manipulation to reduce conflicts	Mowing vegetation around airports to reduce bird strikes, increasing heather on grouse moors to reduce grouse predation, burning vegetation to reduce cover for wild animals
Behaviour modification of conflict-causing species	Habitat zoning	Demarcate habitat into different land use zones to prioritize human or wildlife use
	Physical aversion	Electric collars on conflict-causing animals to avert them from approaching resource
	Conditioned taste aversion	Lithium chloride and other chemicals applied to resource, to cause discomfort and aversion after consumption
Behaviour modification of humans responsible for resource	Livestock management	Synchronizing breeding, more conscientious herding, guarding, enclosing stock, carcass disposal and avoidance of conflict hotspots
	Relocation of people	Local people encouraged or made to move out of wildlife areas
	Education and awareness	Reducing own risk factors, e.g. reducing driving speed to avert deer-vehicle conditions, increasing knowledge of the ecology of conflict-causing species and the best techniques for reducing conflict, use of conflict verification teams to help people correctly identify species causing conflict
Use of buffer resources	Buffer crops	Planting of buffer crops to reduce consumption of important resources
	Artificial provision of alternative food sources	Diversionary feeding for conflict-causing species
	Maintenance of alternative food sources	Maintenance of wild prey for carnivores, maintenance of wild crops for herbivores to avoid consumption of human resources
Lethal control of conflict-causing species	Population control	Widespread killing of conflict-causing species to avoid conflict, selective culling to limit population growth
	Retaliatory killing	Killing of conflict-causing species as a response to ongoing conflict
	Problem animal control	Targeted lethal control of ‘problem animals’
Non-lethal control of conflict-causing species	Sterilization	Contraception, physical sterilization of conflict-causing animals
	Removal of problem animals	Translocation, relocation, placement of wild conflict-causing animals into captivity
Reducing costs of conflict	Alleviating economic costs of conflict	Compensation schemes for wildlife losses, insurance cover for resources
	Economic incentives to maintain conflict-causing species	Direct payments for conservation of conflict-causing species
	Alternative income generation	Diversifying income sources away from pure dependence upon resource under competition
	Increasing benefits of wildlife	Increasing economic benefits of wildlife, e.g. through tourism, revenue-sharing schemes or wildlife-related employment, and/or increasing lifestyle benefits, e.g. providing recreation opportunities through activities such as wildlife viewing or hunting, or provision of meat from wildlife hunting

**Figure 2** Rational conceptualization of the human–wildlife conflict process.

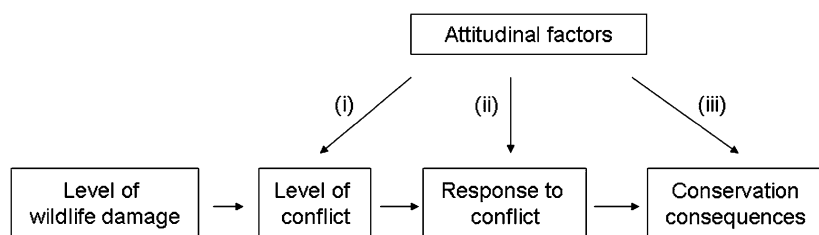


Figure 3 Impact of attitudinal factors on the perceptions and consequences of conflict.

as much crop damage as wild animals, local peoples' resentment was much higher towards wildlife, as they were perceived to be the state's property and imposed upon local people by external authorities rather than voluntarily tolerated (Naughton-Treves & Treves, 2005).

In 1978, a study by Fischhoff *et al.* revealed that the most important drivers of risk perception and tolerance were the level of intrinsic dread – that is whether the threat could be calmly considered or whether it instilled an intrinsic sense of dread – and the novelty of the risk. These results are corroborated in studies of perceived danger posed by wildlife: inherent, deep-seated dread and fear is a key driver of hostility towards wildlife (Prokop, Fancovicova & Kubiato, 2009), while people who have experience of living alongside wild animals tend to be less fearful of them (Røskaft *et al.*, 2003).

There is much evidence for a significant mismatch between perceptions of risk and actual degree of risk in many human–wildlife conflicts. One widely maligned species is the black-tailed prairie dog *Cynomys ludovicianus* which has been decimated due to conflict with ranchers: extermination programmes meant that by 1998, the prairie dog was thought to inhabit only 1% of the area in the USA that it did in 1900 (Reading *et al.*, 2005). Ranchers often believe that prairie dogs reduce the carrying capacity of land for livestock, even though studies show they improve grassland and forage quality (Reading *et al.*, 2005). Similarly, the endangered Zanzibar red colobus *Procolobus kirkii* relies heavily upon agricultural areas, where it conflicts with farmers over its perceived detrimental effects upon coconut *Cocos nucifera* harvests (Siex & Struhsaker, 1999). However, contrary to expectations, studies revealed that red colobus coconut consumption was positively correlated with final coconut harvests, possibly due to pruning, so the species actually had a beneficial effect on crop production (Siex & Struhsaker, 1999). Large, highly visible and potentially dangerous species are particularly likely to generate disproportionate antagonism – for instance, baboons *Papio* spp. and elephants *Loxodonta africana* elicit particular hostility for their detrimental effects on crops, even though rodents and invertebrates are likely to cause more damage (Naughton-Treves & Treves, 2005).

A 'hyper-awareness' of risk can emerge at a variety of scales – both at the individual level, where respondents intentionally or unintentionally exaggerate the losses they suffer due to wildlife, and at the community level, where damage sustained by one person elevates the fear of damage in other people, even if they have never personally experi-

enced it. Rare, devastating events can have a significant and widespread effect on risk perceptions: for instance, an incident where a bear killed seven people in Hokkaido in 1915 is still commonly mentioned in Japan, and engendered a nationwide perception of bears as bloodthirsty killers, which persists to this day (Knight, 2000a). Similarly, stories of wolves attacking humans are common in Norway, and 48% of Norwegians surveyed said they were very afraid of wolves, despite the last documented wolf attack having occurred >200 years previously (Linnell *et al.*, 2003). These perceptions of 'risky' species are commonly disseminated through popular culture – for example the movie *Jaws* was responsible for escalating fear of sharks, and hyper-awareness of shark attacks, in millions of people across the globe, with some viewers refusing to enter the ocean even 20 years later, even though the actual risk of shark attack is tiny (Harrison & Cantor, 1999; Loe & Røskaft, 2004).

People who are dependent upon a single livelihood strategy tend to be particularly antagonistic towards dangerous animals, as the potential consequences of resource destruction are intensified by a lack of alternative assets or income strategies. This is due to the fact that being at risk from a threat is not necessarily the same as being vulnerable to it. If predator attacks are more likely in areas close to forests, for example, as has been seen with puma *Puma concolor* and jaguar *Panthera onca* attacks in Brazil (Palmeira *et al.*, 2008), then someone grazing stock in forest-adjacent land is more at risk than average. However, if that person is wealthy, has alternative sources of income and/or engages in social reciprocity with their family and community, then they could actually be less vulnerable than other people (Naughton-Treves & Treves, 2005). Having adequate coping strategies is therefore a key part of reducing vulnerability, and these tactics are integral to traditional communities who regularly face environmental hazards (Butt, Shortridge & WinklerPrins, 2009).

Disproportionate responses

Another often-erroneous assumption is that people respond proportionately to the level of wildlife damage suffered, and this supposition provides the basis for thinking that if wildlife damage is mitigated, the response will decline concomitantly. Unfortunately, however, the response to conflict often appears disproportionate, and even a small level of wildlife damage can still elicit harsh responses. A 1966 'bear alert' in Hokkaido resulted in the deployment of over 300 hunters and Japanese troops in vehicles and helicopters,

who proceeded to kill 39 bears (Knight, 2000a), while persecution of cheetahs *Acinonyx jubatus* to protect stock resulted in at least 7000 Namibian cheetah deaths in the 1980s, even though they rarely kill livestock (Marker, 2002).

Moreover, there is disquieting evidence that reducing wildlife damage, even to zero, may not reduce the consequences to zero as well. For instance, numerous measures were implemented in Namibia to reduce cheetah depredation, and although these measures were successful, follow-up research revealed that over 40% of farmers who no longer had a cheetah problem still removed the cats from their land (Marker, 2002). In reality, antagonism often remains robust over time, regardless of personal experiences (Dickman, 2008), suggesting that although people commonly cite direct wildlife damage as the main reason for hostility, other, more deep-seated factors also influence perceptions of conflict, as discussed further below.

Social influences

In reality, people base their perceptions and attitudes not only upon facts and personal experiences, but also upon a myriad of factors such as wider societal experiences, cultural norms, expectations and beliefs. These social factors can play an extremely important role in human–wildlife conflict, yet are relatively rarely considered. Animals play important roles in folk-lore in almost all cultures, and attitudes towards species can be substantially influenced by such means: for instance, mythology about vampirism is related to negative attitudes towards bats (Prokop *et al.*, 2009), while beliefs that the aye-aye *Daubentonia madagascarensis* is a harbinger of doom mean it is often killed on sight, with some people believing that the entire village should be burned down and abandoned if an aye-aye is seen nearby (Glaw, Vences & Randrianiana, 2008). These perceptions of certain species as innately evil or harmful mean that even if wildlife damage is entirely mitigated, residual fear and antagonism can lead to continued persecution nonetheless. Education can help lessen hostility (Prokop *et al.*, 2009), but such deep-seated preconceptions tend to be hard to overcome and must be considered in conflict studies.

In another complex twist, human–wildlife conflicts can also represent social conflicts, so attitudes towards species may fluctuate more with societal changes than with rates of actual wildlife damage. In Tanzania, spotted hyaenas *Crocuta crocuta* elicit intense conflict due to beliefs that certain ethnic groups bewitch and ‘train’ them to kill other peoples’ livestock, so tensions over hyaena depredation are heightened by these inter-group suspicions (Dickman, 2008). In Mozambique, there is a belief that people can use sorcery to transform *dimika* tree twigs into ‘spirit-lions’, which can then be used to attack the sorcerer’s enemies (West, 2001), so lions are commonly killed when they are encountered. An externally enforced villagization process increased social conflict in Mozambique, thereby increasing fears of ‘spirit-lions’, and intensifying human–lion conflict (West, 2001). Such perceptions of people bewitching animals or shape-shifting into animal form are found across a broad range of

cultures, and involve species as diverse as elephants, chimpanzees *Pan troglodytes* and bearded pigs *Sus barbatus* (Knight, 2000b), and in such cases recognizing and easing underlying social tensions is fundamental to effective conflict mitigation.

Even in developed nations where concepts of spirits and sorcery seem far-fetched, human–wildlife conflict can be significantly affected by inter-group hostility. For example, a pigeon *Columba livia* shoot used to be held annually in Hegins, Pennsylvania, allegedly for reasons of ‘pest control’ (Hoon Song, 2000). However, closer examination reveals that the pigeons did not cause significant local damage and, furthermore, that pigeons were actually imported specifically for the shoot (Hoon Song, 2000). Much of the antagonism towards the birds actually stemmed from their association with urban areas, and therefore their connotations with urban values and external threats to the rural Hegins community. People judged the pigeons as being associated with urban moral decay and specifically with homosexuality, HIV and drug-taking: in fact, the official 1990 shoot T-shirt bore the logo ‘Shoot pigeons, not drugs’ (Hoon Song, 2000). Therefore, certain species can be imbued with human characteristics that elicit far more hostility than their actual actions do, highlighting again the complexities of human attitudes towards animals.

Priorities for conflict mitigation in a complex world

These examples demonstrate just a fraction of the complexity involved in human–wildlife conflict, and show that reducing wildlife damage alone will often fail to produce long-term conflict resolution. Therefore, it is vital for conflict professionals to consider the assumptions they are working under, and test their veracity in the site concerned. When examined in-depth, conflict scenarios are rarely simple, and the particular dynamics of any situation must be carefully considered and assessed in order to develop the most effective mitigation strategies. Rather than the simplistic conceptual framework often assumed (Fig. 2), complexities of the human–nature relationship means that there are usually many different elements affecting the extent of negative interactions between humans and wildlife, the perceived and actual costs of those interactions, the human responses to those costs, and the consequences for wildlife of those responses. Examples of some of the elements which can affect the intensity of human–wildlife conflict (Fig. 4) are discussed below.

Environmental risk factors

There are many factors specific to a particular environment that are likely to affect the intensity of damage caused by wildlife. These can include characteristics of the physical environment – for instance, crops situated near forest edges are more likely to suffer raiding by animals such as wild boar *Sus scrofa* (Linkie *et al.*, 2007), and wildlife damage often increases when alternative food sources in the environment

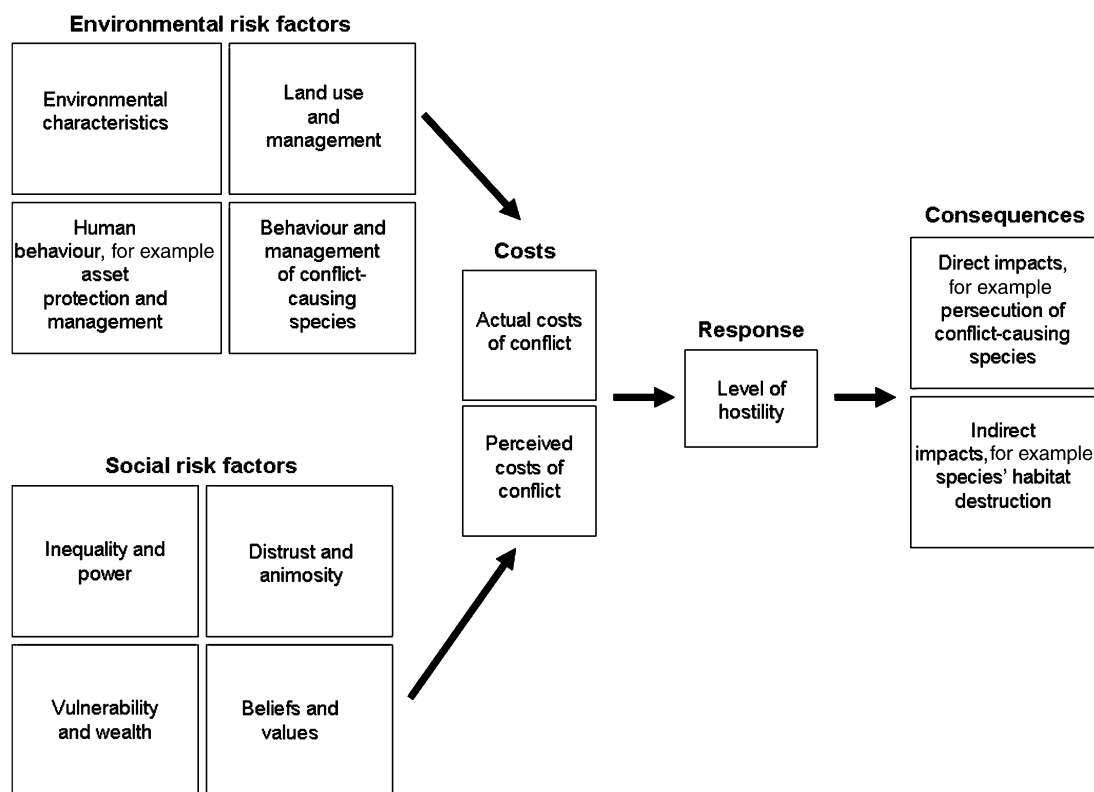


Figure 4 Conceptual framework of some of the factors likely to affect the intensity of human–wildlife conflict.

become scarce (Tweheyo, Hill & Obua, 2005). Methods of land use and management can also substantially alter the likelihood of conflict – for instance, switching from growing maize to cultivating chilli, which is less palatable to crop-raiding species such as elephants, can improve local livelihood security and reduce conflicts with wildlife (Parker & Osborn, 2006).

The behaviour of both humans and wildlife within a particular environment obviously has important implications for the magnitude of wildlife damage experienced. Humans can effectively decrease the risk of wildlife damage by better protecting their assets, for instance by using dogs, herders and enclosures to protect livestock from predators (Woodroffe *et al.*, 2007). Meanwhile, patterns of animal behaviour often affect conflict intensity – for instance, in Luxembourg, the territorial behaviour of stone martens *Martes foina* results in increased incidences of them damaging car engines, which is a common source of human–wildlife conflict in central Europe (Herr, Schley & Roper, 2009). All these environmental factors can play a major role in determining the actual level of wildlife damage caused, and therefore the costs of conflict to local people.

Social risk factors

Despite the importance of the environmental factors in determining the level of actual damage, it is critical to realize that perceptions of that damage are often shaped by a

myriad of other factors. Antipathy over perceived inequalities and imbalances of power can play an important role here – for instance, rural communities often feel particularly aggrieved by damage caused by wildlife that they perceive as being protected or imposed by more powerful urban elites (Skogen *et al.*, 2008). Such issues are intensified by antagonism and distrust between groups, as demonstrated in Sierra Leone, where people feel that chimpanzee attacks on villagers are actually orchestrated by powerful external trading elites, who they suspect shape-shift into chimpanzees and kill local youths for their body parts (Richards, 2000). Vulnerability can play an important role as well – the perception of social vulnerability relative to other groups often inflames conflict, while lack of wealth also increases vulnerability and therefore the level of hostility to costs imposed by wildlife. Ultimately, it is the beliefs and values of any individual or group that will be most important in determining how wildlife damage is perceived. Religious beliefs can play an important role here: evangelical Christian beliefs have been linked to particular hostility towards wildlife (Hazzah, 2006), while Buddhist herders in Nepal can be remarkably accepting of snow leopard *Panthera uncia* depredation, interpreting it as a punishment from the mountain god rather than blaming the predator itself (Ale, 1998).

It is this complex interaction of cultural, social and personal factors that ultimately determines how costly conflict-causing species are perceived to be, and therefore the

level of hostility felt towards them. This hostility can have important consequences, either directly, by persecuting the species concerned, or indirectly, by altering habitats to reduce their suitability for such species, so it is vital that these social determinants of conflict are examined in-depth and better understood.

Moving forwards: delving deeper into conflict

Although it can be useful to do what is usually done in conflict studies, and select a couple of these factors and examine the relationship between them, such as between the reported level of hostility to a particular species and the degree of persecution of that species, achieving long-lasting conflict resolution will rely upon practitioners taking a much broader and more holistic approach. Although not all of these factors may be relevant in every conflict scenario (and in many scenarios there will be numerous other additional factors) these are the kinds of dynamics that should at least be considered and investigated by conflict researchers, in order to truly understand the nature of that specific situation and how it can best be addressed. Furthermore, there are substantial gaps in our understanding of the relationships between several of these different elements, which it would be very informative to explore further in any conflict scenario. These include:

(i) *Relationships between levels of wildlife damage and perceptions of conflict, at individual and community levels:* Limited time and resources mean that many researchers are only able to collect data on reported (and therefore perceived) conflict rather than ‘actual’ damage caused. However, information on the relationship between perceived and actual costs of wildlife could help mitigate conflict, as sensitive research and education programmes might help reduce antagonism towards species, if it can be demonstrated that they are not as damaging as previously thought. Identifying commonalities across different sites (such as a link between religious beliefs and heightened perceptions of conflict, or certain ecological characteristics) will help identify the most important factors affecting both wildlife damage and perceptions of conflict, and this could in turn help identify areas where conflict mitigation efforts should be prioritized. Furthermore, there are few, if any, studies which attempt to quantify how much, and for how long, wildlife damage has to be reduced across an entire community before individual perceptions of risk decline. More longitudinal studies will help inform managers about far removed, both in time and space, wildlife damage must be before people feel less threatened by it. It is also important to consider that in many situations, conflict studies are extremely hard to conduct in a way that does not risk inadvertently raising conflict, especially as researchers are rarely able to implement mitigation measures for everyone in an area. Therefore, locations with particularly intense reported conflicts are often targeted for mitigation, but the problem may only be displaced onto neighbours who have not had help in implementing mitigation measures. This

displacement of conflict, although it may decrease antagonism at the original target location, is likely to inflame tensions elsewhere, and may even raise overall levels of conflict across the wider community. In situations where wildlife and conservation organizations are already viewed negatively, this can be a difficult side effect of well-intentioned intervention. This is an important dynamic to be aware of, particularly where inter-group tensions already exist, but it has very rarely been examined in conflict resolution studies.

(ii) *Relationships between wildlife damage, human perceptions and retaliation:* Numerous studies detail hostility towards wildlife, but researchers are often constrained in their ability to independently quantify the effect such conflict has on wildlife at a population level. Studies that simultaneously measure conflict perceptions, independently quantify ‘actual’ wildlife damage and monitor rates and causes of wildlife mortality are rare, but would paint a far more complete picture of how significant a threat conflict really poses, both to communities and wildlife. Furthermore, examining the characteristics of the relationship between conflict and retaliation across different sites would reveal any key factors that frequently intensify retaliation levels, and therefore highlight the most important issues to address. Moreover, when examining the consequences of conflict on wildlife, most studies focus on direct persecution, but it would also be useful to investigate indirect consequences of conflict as well, such as the clearing or burning of habitat to make it less attractive to certain species, as over a wide scale that could also have significant consequences for wildlife conservation.

(iii) *Evidence-based examination of conflict mitigation’s conservation effects:* Numerous strategies have been implemented in order to reduce conflict, with the apparent assumption that reducing conflict will have a measurable conservation effect. However, the veracity of this assumption is rarely tested, and there is a need for rigorous studies examining the conservation effects of mitigation, both at a household and community level, and in terms of direct and indirect consequences of conflict. For instance, the displacement of conflict due to mitigation at a few locations, as mentioned above, could inflame community-wide perceptions of risk and fail to reduce overall conflict or retaliation. Furthermore, if work is mainly done with local elites (as is often the case), it may inadvertently heighten local jealousies and create more antagonism towards conservation groups and wildlife than is resolved. Lastly, ingrained attitudes may mean that people still kill conflict-causing species regardless of reduced problems with them, so a detailed examination of how often and under which circumstances different conflict mitigation strategies produce significant conservation benefits would be extremely useful for best directing future efforts.

(iv) *Broadening the approach: from species to societies:* Ultimately, effective conflict resolution will require a broad, multifaceted and truly interdisciplinary approach, and conservation biologists must move beyond examining species-based conflicts towards considering the wider

socio-economic, ecological and cultural conditions under which intense conflicts arise. As conservation biologists rarely have the training needed to adequately assess these anthropological factors, such studies would necessitate the involvement of numerous collaborators in order to ensure the best chance of success. Such collaboration would involve not only the individuals and communities affected by conflict, but also donors, fellow conflict researchers and professionals from other areas, such as anthropology, psychology and economics, in order to obtain the most complete picture of how humans interact with wildlife in that scenario. Although this conclusion is well-accepted among many conflict practitioners, examination of the published literature reveals relatively few cases where this kind of diverse, interdisciplinary conflict mitigation is attempted and critically assessed. Although some projects undoubtedly do take this approach (e.g. Hazzah, 2006), the increasing intensity and scope of conflict and the threat that it poses to both human and wildlife populations, highlights the pressing need for developing such projects, which are likely to produce the best chance for effectively resolving one of the most significant conservation problems in the modern world.

References

- Ale, S. (1998). Culture and conservation: the snow leopard in Nepal. *Int. Snow Leopard Trust Newslett.* **16**, 10.
- Barlow, A.C.D. (2009). *The Sundarbans Tiger: adaptation, population status, and conflict management*. PhD thesis, University of Minnesota, Minnesota.
- Boholm, A. (1998). Comparative studies of risk perception: a review of twenty years of research. *J. Risk Res.* **1**, 135–163.
- Breitenmoser, U., Angst, C., Landry, J.-M., Breitenmoser-Wursten, C., Linnell, J.D.C. & Weber, J.-M. (2005). Non-lethal techniques for reducing depredation. In *People and wildlife: conflict or coexistence?*: 49–61. Woodroffe, R., Thirgood, S. & Rabinowitz, A. (Eds). Cambridge: Cambridge University Press.
- Butt, B., Shortridge, A. & Winklerprins, A. (2009). Pastoral herd management, drought coping strategies, and cattle mobility in Southern Kenya. *Ann. Assoc. Amer. Geogr.* **99**, 309–334.
- Dickman, A.J. (2008). *Key determinants of conflict between people and wildlife, particularly large carnivores, around Ruaha National Park, Tanzania*. London: University College London.
- Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S. & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sci.* **9**, 127–152.
- Frank, L., Hemson, G., Kushnir, H. & Packer, C. (2006). Lions, conflict and conservation in Eastern and Southern Africa. In *Eastern and Southern African Lion Conservation Workshop*. Johannesburg: IUCN.
- Glaw, F., Vences, M. & Randrianiana, R.D. (2008). Killed aye-aye (*Daubentonia madagascariensis*) exposed on the gallows in northeastern Madagascar. *Lemur News* **13**, 6–7.
- Harrison, K. & Cantor, J. (1999). Tales from the screen: enduring fright reactions to scary media. *Media Psychol.* **1**, 97–116.
- Hazzah, L.N. (2006). *Living among lions (Panthera leo): coexistence or killing? Community attitudes towards conservation initiatives and the motivations behind lion killing in Kenyan Maasailand*. Madison: University of Wisconsin-Madison.
- Herr, J., Schley, L. & Roper, T. (2009). Stone martens (*Martes foina*) and cars: investigation of a common human–wildlife conflict. *Eur. J. Wild. Res.* **55**, 471–477.
- Hoon Song, S. (2000). The Great Pigeon Massacre in a deindustrializing American region. In: *Natural enemies: people–wildlife conflicts in anthropological perspective*: 212–228. Knight, J. (Ed.). London: Routledge.
- Knight, J. (2000a). Culling demons: the problem of bears in Japan. In *Natural enemies: people–wildlife conflicts in anthropological perspective*: 145–169. Knight, J. (Ed.). London: Routledge.
- Knight, J. (Ed.). (2000b). *Natural enemies: people–wildlife conflicts in anthropological perspective*. London: Routledge.
- Kumar, R.S., Gam, N., Raghunath, R., Sinha, A. & Mishra, C. (2008). In search of the *munzala*: distribution and conservation status of the newly-discovered Arunachal macaque *Macaca munzala*. *Oryx* **42**, 360–366.
- Linkie, M., Dinata, Y., Nofrianto, A. & Leader-Williams, N. (2007). Patterns and perceptions of wildlife crop raiding in and around Kerinci Seblat National Park, Sumatra. *Anim. Conserv.* **10**, 127–135.
- Linnell, J.D.C., Solberg, E.J., Brainerd, S., Liberg, O., Sand, H., Wabbaken, P. & Kojola, I. (2003). Is the fear of wolves justified? A Fennoscandian perspective. *Acta Zool. Lit.* **3**, 34–40.
- Loe, J. & Roskaft, E. (2004). Large carnivores and human safety – a review. *Ambio* **33**, 283–288.
- Marker, L. (2002). *Aspects of cheetah (Acinonyx jubatus) biology, ecology and conservation strategies on Namibian farmlands*. Oxford: University of Oxford.
- Marker, L.L., Dickman, A.J. & Macdonald, D.W. (2005). Perceived effectiveness of livestock guarding dogs placed on Namibian farms. *Range. Ecol. Mgmt.* **58**, 329–336.
- Naughton-Treves, L. & Treves, A. (2005). Socio-ecological factors shaping local support for wildlife: crop-raiding by elephants and other wildlife in Africa. In *People and wildlife: conflict or coexistence?*: 252–277. Woodroffe, R., Thirgood, S. & Rabinowitz, A. (Eds). Cambridge: Cambridge University Press.
- Packer, C., Ikanda, D., Kissui, B. & Kushnir, H. (2005). Lion attacks on humans in Tanzania. *Nature* **436**, 927–928.
- Palmeira, F.B.L., Crawshaw, P.G. Jr, Haddad, C.M., Ferraz, K.M. & Verdade, L.M. (2008). Cattle depredation by puma (*Puma concolor*) and jaguar (*Panthera onca*) in south-western Brazil. *Biol. Conserv.* **141**, 118–125.

- Parker, G.E. & Osborn, F.V. (2006). Investigating the potential for chilli *Capsicum* spp. to reduce human–wildlife conflict in Zimbabwe. *Oryx* **40**, 343–346.
- Perez, E. & Pacheco, L.F. (2006). Damage by large mammals to subsistence crops within a protected area in a montane forest of Bolivia. *Crop Protect.* **25**, 933–939.
- Pimentel, D., Zuniga, R. & Morrison, D. (2005). Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecol. Econ.* **52**, 273–288.
- Prokop, P., Fancovicova, J. & Kubiato, M. (2009). Vampires are still alive: Slovakian students' attitudes toward bats. *Anthrozoos* **22**, 19–30.
- Reading, R.P., McCain, L., Clark, T.W. & Miller, B.J. (2005). Understanding and resolving the black-tailed prairie dog conservation challenge. In *People and wildlife: conflict or coexistence?*: 209–223. Woodroffe, R., Thirgood, S. & Rabinowitz, A. (Eds). Cambridge: Cambridge University Press.
- Richards, P. (2000). Chimpanzees as political animals in Sierra Leone. In *Natural enemies: people-wildlife conflict in anthropological perspective*: 78–103. Knight, J. (Ed.). London: Routledge.
- Røskaft, E., Bjerke, T., Kaltenborn, B., Linnell, J.D.C. & Anderson, R. (2003). Patterns of self-reported fear towards large carnivores among the Norwegian public. *Evol. Human Behav.* **24**, 184–198.
- Sarasola, J.H. & Maceda, J.J. (2006). Past and current evidence of persecution of the endangered crowned eagle *Harpyhaliaetus coronatus* in Argentina. *Oryx* **40**, 347–350.
- Siex, K.S. & Struhsaker, T.T. (1999). Colobus monkeys and coconuts: a study of perceived human–wildlife conflicts. *J. Appl. Ecol.* **36**, 1009–1020.
- Sillero-Zubiri, C. & Laurenson, M.K. (2001). Interactions between carnivores and local communities: conflict or co-existence? In *Carnivore conservation*: 282–312. Gittleman, J.L., Funk, S.M., Macdonald, D.W. & Wayne, R.K. (Eds). Cambridge: Cambridge University Press.
- Sjoberg, L., Moen, B.-E. & Rundmo, T. (2004). Explaining risk perception: an evaluation of the psychometric paradigm in risk perception research. *Rotunde* **84**, 1–39.
- Skogen, K., Mauz, I. & Krange, O. (2008). Cry wolf!: narratives of wolf recovery in France and Norway. *Rural Sociol.* **73**, 105–123.
- Starr, C. (1969). Social benefits vs. technological risks. *Science* **165**, 1232–1238.
- Thirgood, S., Woodroffe, R. & Rabinowitz, A. (2005). The impact of human–wildlife conflict on human lives and livelihoods. In *People and wildlife: conflict or coexistence?*: 13–26. Woodroffe, R., Thirgood, S. & Rabinowitz, A. (Eds). Cambridge: Cambridge University Press.
- Tweheyo, M., Hill, C.M. & Obua, J. (2005). Patterns of crop raiding by primates around the Budongo Forest reserve, Uganda. *Wildl. Biol.* **11**, 237–247.
- Webber, A.D., Hill, C.M. & Reynolds, V. (2007). Assessing the failure of a community-based human–wildlife conflict mitigation project in Budongo Forest Reserve, Uganda. *Oryx* **41**, 177–184.
- West, H. (2001). Sorcery of construction and socialist modernisation: ways of understanding power in postcolonial Mozambique. *Am. Ethnol.* **28**, 119–150.
- Woodroffe, R., Frank, L.G., Lindsey, P.A., Ole Ranah, S.M.K. & Romanach, S. (2007). Livestock husbandry as a tool for carnivore conservation in Africa's community rangelands: a case-control study. *Biodivers. Conserv.* **16**, 1245–1260.
- Woodroffe, R., Thirgood, S. & Rabinowitz, A. (Eds.) (2005). *People and wildlife: conflict or coexistence?* Cambridge: Cambridge University Press.