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Myths and assumptions about human-wildlife conflict and coexistence

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Abstract: Recent extinctions often resulted from humans retaliating against wildlife that threatened people's interests or were perceived to threaten current or future interests. Today's subfield of human-wildlife conflict and coexistence (HWCC) grew out of an original anthropocentric concern with such real or perceived threats and then, starting in the mid-1990s, with protecting valued species from people. Recent work in ethics and law has shifted priorities toward coexistence between people and wild animals. To spur scientific progress and more effective practice, we examined 4 widespread assumptions about HWCC that need to be tested rigorously: scientists are neutral and objective about HWCC; current participatory, consensus-based decisions provide just and fair means to overcome challenges in HWCC; wildlife threats to human interests are getting worse; and wildlife damage to human interests is additive to other sources of damage. The first 2 assumptions are clearly testable, but if they are entangled can become a wicked problem and may need debunking as myths if they cannot be disentangled. Some assumptions have seldom or never been tested and those that have been tested appear dubious, yet the use of the assumptions continues in the practice and scholarship of HWCC. We call for tests of assumptions and debunking of myths in the scholarship of HWCC. Adherence to the principles of scientific integrity and application of standards of evidence can help advance our call. We also call for practitioners and interest groups to improve the constitutive process prior to decision making about wildlife. We predict these steps will hasten scientific progress toward evidence-based interventions and improve the fairness, ethics, and legality of coexistence strategies.

Keywords: animal damage, bias, biodiversity conservation, implicit value judgments, interventions, planning, policy

Mitos y Suposiciones sobre el Conflicto y la Coexistencia entre el Humano y la Fauna

Resumen: Casi todas las extinciones recientes han resultado de las represalias que los humanos han realizado en contra de la fauna que amenaza o que ha sido percibida como una amenaza para intereses humanos actuales o futuros. Hoy en día, la disciplina de conflicto y coexistencia humano – fauna (HWCC, en inglés), surgió de la original preocupación antropocéntrica por las amenazas reales o percibidas y después, a partir de mediados de la década de 1990, por la preocupación de proteger a las especies valoradas por el los humanos. Trabajos recientes de ética y leyes han modificado sus prioridades hacia la coexistencia entre las personas y la fauna silvestre. Para estimular el progreso científico y una práctica más efectiva, examinamos cuatro suposiciones generalizadas sobre el HWCC que necesitan ser evaluadas rigurosamente: los científicos son neutrales y objetivos con el HWCC; las decisiones participativas actuales basadas en consensos proporcionan medios justos y razonables para sobreponerse a los retos del HWCC; las amenazas de la fauna hacia los intereses humanos cada vez son peores; y el daño causado por la fauna a los intereses humanos es aditivo a otras fuentes de daño. Las primeras dos suposiciones son claramente evaluables, pero si se entrelazan, pueden convertirse en un serio problema y necesitarían ser desacreditadas como mitos si no se pueden desenlazar. Algunas suposiciones nunca o rara vez han sido evaluadas y aquellas que sí lo han sido parecen ser dudosas. A pesar de esto, el uso de las suposiciones continua en la práctica y en la academia del HWCC. La adhesión a los principios de integridad científica y la aplicación de estándares de evidencia pueden ayudar a promover nuestra petición. También hacemos un llamado a los practicantes y a los grupos de interés para

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que mejoren el proceso constitutivo previo a la toma de decisiones sobre la fauna. Pronosticamos que estos pasos a seguir apresurarán el progreso científico hacia intervenciones basadas en evidencia y mejorarán la imparcialidad, ética y legalidad de las estrategias de coexistencia.

Palabras Clave: conservación de la biodiversidad, daño animal, intervenciones, juicios de valor implícito, políticas de planeación, sesgo

摘要: 近代发生的物种灭绝许多是因为人类对威胁其利益, 或是主观认为会威胁其当下或未来利益的野生动物进行的报复。目前人兽冲突与共存 (human-wildlife conflict and coexistence, HWCC) 子领域起源于最初以人类为中心对这些真实或感知中的威胁的关注, 随后自二十世纪九十年代中期起, 开始考虑保护有价值的物种不受人类威胁。近期伦理学和法律方面的工作已将重点转向人与野生动物的共存。为了促进科学进步和更有效的实践, 我们检验了四个有关 HWCC 普遍流传但需要严格检验的假设: 科学家对 HWCC 持客观中立的态度; 目前参与性的、基于共识的决策为克服 HWCC 中的挑战提供了公正公平的手段; 野生动物对人类利益的威胁越来越严重; 野生动物对人类利益的损害可以与其它来源的损害累加。最后两个假设明显可以检验, 但它们如果相互关联就可能成为一个棘手难题, 不能彼此理清的话则会发展为谬见, 需要得到揭露。还有一些假设很少或从未被检验过, 而那些已经被检验过的假设也显得可疑, 但 HWCC 的实践和学术研究中仍然在使用这些假设。我们呼吁在 HWCC 的学术研究中检验假设、消除谬见。而坚持科学诚信的原则和证据标准的应用有助于推动我们的呼吁。我们还呼吁实践者和利益团体在改进流程后再进行有关野生动物的决策。我们预计这些做法将推动以证据为基础的干预措施的科学进展, 并提高共存策略的公平性、道德性和合法性。 **【 翻译: 胡怡思; 审校: 聂永刚 】**

关键词: 动物造成的损失, 偏差, 生物多样性保护, 干预, 规划, 政策, 隐形价值判断

Introduction

Recent extinctions often resulted from humans retaliating against wildlife that posed real or perceived threats to people's current or claimed interests (Woodroffe & Ginsberg 1998; Treves & Karanth 2003*a*). The field of human-wildlife conflict grew out of an anthropocentric concern with real or perceived wildlife threats to human interests, often called animal damage management (Newby & Brown 1958; Jorgensen et al. 1978; Esterhuizen & Norton 1985; Robinson 2005). But in the 1990s, research and practice began to articulate more of a concern for protecting valued species from retaliation and competition with people (Jackson et al. 1996; Mace & Waller 1996; Naughton-Treves 1999). By the 2000s, coexistence was added to the scholarship and practice (Fascione et al. 2004; Woodroffe et al. 2005) and the focus became human-wildlife conflict and coexistence (HWCC). In the last few years, new initiatives in ethics and law combined with growing scientific rigor in the field of HWCC have begun to shift how coexistence and conflicts between people and wild animals are understood, managed, and prioritized. As evidence of the shift, we examined 4 widespread assumptions about HWCC that either need to be opposed by alternative hypotheses (Chamberlin 1890) and then tested with strong inference (Platt 1964) or, if they prove unfalsifiable by that standard, these assumptions should be viewed as unscientific and debunked as myths.

We examined the following assumptions in order from global to specific: governments and scholars are neutral and objective about HWCC; participatory, consensus-based decisions provide just and fair means to overcome challenges in HWCC; wildlife threats to human interests are getting worse; and wildlife damage to human interests is additive to other sources of damage.

We define *human interests* broadly to include people and their property including domesticates (plants and animals) and claims to future interests not yet in possession, such as wild prey people might want. By *wildlife*, we refer to free-ranging vertebrate animals, but generally focus on the larger-bodied animals that prey on domestic animals or frighten people. By *conflict*, we refer to any encounter between wildlife and humans or their property that results in contest or interference competition. Therefore, conflict includes humans harming animals or animals harming humans or their property claims, and the harm may be motivated by any reason (intention is irrelevant). We acknowledge that many human activities and land uses harm animals, so conflict might seem ubiquitous, but for our purposes we restrict our definition of *conflict* to direct competition; therefore, we excluded all incidental human-induced transformations of ecosystems that cause other indirect competition (scramble or scrounge competition). By *coexistence*, we refer to sharing a landscape (not necessarily close in space or time), even if encounters seldom occur. By our definition, the coexistence in HWCC can persist despite dyadic lethal interactions among individuals up to the point that zero individuals of a given species is left on a landscape (eradication) when coexistence has failed. By practitioners, we mean staff of government management agencies or private organizations. We refer to scholars or scientists interchangeably to mean people engaged in systematic, formal research. Because scientific integrity demands that we support our assertions with citations, we cite ourselves repeatedly in numerous places, as a way to call for change without antagonizing our colleagues.

Myth or Testable Assumption

GOVERNMENTS AND SCHOLARS ARE NEUTRAL AND OBJECTIVE ABOUT HWCC

Neutrality in our context means having no devotion to any side of an issue. The *Oxford English Dictionary* offers the following definition of *neutral* as "not taking part in a war . . . , not taking sides in a dispute . . . " and of *objective* as " . . . not influenced by personal feelings or opinions in considering and representing facts; impartial, detached." We view neutrality as a characteristic of actions or words after scientific research is conducted (objectively or not). Therefore, our comments relate to scientific questions, data collection, and interpretation of results in which objectivity is more relevant, followed by scientific communications in which neutrality is more relevant. Our summary of the development of the HWCC field in the Introduction has important implications for how objectively and neutrally today's scholars and practitioners address HWCC. For example, a focus on "animal damage management" that shifted to "conflict with wildlife" is not neutral because it shifts attention away from responsibility for domestic animals to place negative attention on wildlife. Addition of *coexistence* to the shorthand HWCC presents a more objective, balanced approach. However, those who might omit *conflict* entirely from their communications to emphasize coexistence express an alternative non-neutral position. Words have power; hence, our attention to them.

Everyone carries a bias or slant arising from their viewpoint. We have in varied ways over the years and continue to carry viewpoints. No one is perfectly objective because there is no view from nowhere, to paraphrase Lynn (2018). As a result of an inevitable bias, no one can be said to be perfectly objective or neutral. However, we do not agree with the notion that everything is subjective and partisan. Rather, we see a clear middle road characterized by transparency, deliberation between, and open-mindedness to other viewpoints and differing biases. Take for example the perspective of well-trained scientists acting with integrity. Scientists ask questions that arise from their curiosity or perhaps from the priorities of society or donors who pay for the research. Curiosity and priorities reflect worldviews, presuppositions, and value-laden priorities (whether moral, ethical, personal, or professional). If the questions to which one seeks answers are influenced by one's worldviews, then surely the ways one answers those questions (methods, assumptions, interpretations, etc.) (Bernstein 1991) are also influenced by the paradigms and practices of the times and one's preferences and technical specialties. In short, even scientists held up as objective will approach the research process, from start to finish, with a particular slant. In scientific terms, these starting points, preferences, and slants are biases. Whether the biases overwhelm the objectivity of research cannot be judged prematurely. Only a close reading of methods, results, and interpretations can reveal an overwhelming bias (e.g., Treves et al. 2016).

We are not making a simplistic (and wrong in our view) argument that everyone is equally biased nor are we advancing a relativist perspective. Scientists are trained to identify and redress a bias as much as possible, especially in measuring precisely, accurately, and reproducibly and, it is hoped, in analyzing and interpreting information fairly, objectively, and transparently. It may be fair to generalize that scientists can be more objective than most in a world filled with individual biases, but individual scientists vary.

We believe that cautious scholars can overcome a personal bias partially to render more objective conclusions than most other actors, when the scholars act transparently and aim for reproducibility of their inferences. This is a difficult challenge. In particular, we want to sound a note of caution about animal researchers, whether from the disciplines of humanities, social science, biology, or any other realm of scholarship. Animal research has long been particularly vulnerable to paradigmatic (worldview) biases about nonhumans (Midgley 1995), and, currently, animal research continues in this vein (Treves et al. 2018*b*).

The major, common paradigmatic bias is anthropocentrism. A paradigm is a fundamental worldview that typically goes unstated, unlike assumptions disclosed by transparent scientists. It is often shared by coauthors, independent reviewers, editors, and many readers; hence, the holders of the worldview are rarely challenged by someone with a different worldview, and yet the worldview can insidiously reduce the objectivity of the science itself or the neutrality of the scientific communications that ensue. A brief recounting of A.T.'s shift closer to neutrality in communicating his work should suffice to exemplify the clash of worldviews that concern us here.

A.T. was trained in a weakly anthropocentric tradition from 1992 to 2010, in which wildlife conservation aimed to protect populations (not individual animals) for the benefits of at least local communities or at most the nations and international communities concerned with biodiversity (not future generations of all life), and the interventions deployed to protect biodiversity would be chosen by a few representatives of interest groups having a stake in wildlife range (not by youth, representatives of nonhumans, distant publics, etc.) (e.g., Treves et al. 2002, 2006). This worldview was common then and remains so now (López-Bao et al. 2017). Under various pressures, benign and otherwise from 2011 to 2015, A.T.'s position shifted to rejecting the tyranny of local interests and stakeholder decision making over wildlife that ostensibly belonged to the broad public and future generations, which is common to the majority of nations (Treves et al. 2018*a*), and replacing the dominant

paradigm of wise use underlying conservation with a paradigm of preservation for the future (Treves et al. 2017). At the latter point, A.T.'s worldview had become weakly anthropocentric because people retained priority over nonhumans in most cases, but the prior emphasis on sustainable use for local interests had all but vanished with a realization that many trivial human uses of wildlife were inappropriate or illegal because many more people than locals had a right to say how wildlife were treated (Treves et al. 2018*a*). Finally, bringing us to the present, A.T.'s worldview underwent a change to accepting the ethical obligation to consider individual nonhumans equitably before intervening in their lives (Santiago-Ávila et al. 2018), the legal obligation to act as a trustee for nonhumans before society or its government takes decisions that adversely affect nature, and redefining the priority of preservation for futurity of all life on the Earth (Treves et al. 2018*b*). Although we acknowledge one paradigm is only replaced by another rather than resulting in no paradigms, we encourage readers to engage with and evaluate their own paradigms objectively also. Not all paradigms are equal by criteria of morality, legality, or scientific validity. Furthermore, even if scholars expose their own worldviews transparently as above, practitioners may encounter practical hurdles to doing so.

Among the practical obstacles, governments are commonly more narrowly focused in their worldviews than scholars, if they prioritize their constituents, likely voters, donors to their campaigns or agencies, or interests that remunerate them individually. It need not be so, even for elected officials. For example, the U.S. president is sworn to uphold the Constitution, not the president's voters or donors. The U.S. Constitution's preamble makes clear that the beneficiaries are "ourselves and our posterity." At the very least, this preamble puts current U.S. public and future generations of the U.S. public on an equal footing. In short, our governments can be captured by narrower interests than their constitutional duties would have them serve. Therefore, the interests that lie behind government staff and scholars alike can be powerful, hard to set aside, and difficult to balance for a more objective look at HWCC.

Having established a fundamental and widespread bias among scholars (anthropocentrism) and the constraints acting on practitioners that can lead to even narrower interests than humanity itself, consider a study of an implicit cognitive bias among scholars. In an HWCC situation, researchers posing the same question to 593 scientific experts found their recommendations on whether grizzly bears (*Ursus arctos*) should receive or lose protection were significantly associated with their institutional and social backgrounds (Karns et al. 2018). The key question involved a complex ethical and scientific judgment (Should grizzly bears be delisted or remain listed under the U.S. Endangered Species Act?). Answering it required the integration of scientific conclusions about the current level of threat to grizzly bears and predictions about future threats after the removal of protections (observations and inferences about what is), combined with an ethical judgment about whether grizzly bears should continue to be protected (value judgments about what ought to be). Experts from natural resource agencies or those with affiliations to groups with utilitarian worldviews of wildlife differed significantly from experts from academic institutions or those with affiliations with animal rights groups, respectively (Karns et al. 2018). That variability among experts undermines the assumption that experts provide neutrality on decisions relevant to HWCC.

The title of Karns et al. (2018) is "Should Grizzly Bears Be Hunted or Protected? Social and Organizational Affiliations Influence Scientific Judgments." This title makes clear that a normative conclusion (should one do *x*?) was sought from experts who were also asked a whole series of scientific judgments (is *y* true now or will it be?). Should scientists be asked to make ethical judgments if they are not trained to do so? And, how would anyone respond when scientific judgments are not clearly disentangled from ethical judgments? The Endangered Species Act (ESA) itself contains a tangle of scientific judgments and ethical judgments in that it requires determinations about delisting (i.e., protection) be based "solely on the basis of the best available scientific and commercial data" (16 USC § 1531 Sec.4[b][1][A]). Basing a policy solely on best available science may be impossible given that data do not indicate how one ought to behave (Lynn 2006). Because few experts in HWCC are also equipped to handle ethical questions, as pointed out for Europe (Zemanova 2017) and implicit for the U.S. Fish & Wildlife Service's recent ethical review (Lynn 2018), we see a problem. Part of the problem is the assumption of neutrality or objectivity that permeates how experts are asked to make recommendations on HWCC.

We understand and empathize with the wish by decision makers to get a clear signal about evidence with a recommendation about how decision makers should act, but the shortcut of treating policy questions as if they were only scientific, devoid of ethical judgments (Lynn 2018), seems an illusion. Is the dividing line between scientific inferences and perceptions of what one ought to do made clear by questioner and respondent? And, are the experts wholly transparent about the limits to their own scientific inferences? No matter how expert one might be in grizzly bear poaching, for instance, that does not make one an expert on whether the government ought to expose grizzly bears to higher levels of legal killing and poaching, just as we are not experts on unrelated scientific topics.

We perceive that experts are asked to go far beyond their often-narrow expertise about a species to address a complex problem involving both humans and wildlife and then to make a recommendation that is at least partially an ethical one. Those who like the recommendation

may call it objective science, or a neutral recommendation, and defend the process, which can enshrine expert opinion in an unwarranted position; whereas opponents of the decision will view the expert with skepticism or suspect the motives of the decision maker who accepted the expert opinion. In this way, the assumption of neutral objectivity becomes an invidious one that sows mistrust.

Although the assumption of neutrality can be tested as in the grizzly bear study, we do see a wicked problem in fixing it. "Wickedness in public policy is not an issue of evil. Rather it reflects policy debates rooted in a strong divergence of outlook, values, and goals, and over which there are no technical solutions that solve the problem outright" (Lynn 2018:224). The wicked problem arises in the grizzly bear study because Karns et al. (2018) seem to agree there is no technical easy fix because they recommend that informing decision makers about biases among their experts and then constituting decision-making bodies that hold diverse biases is the best safeguard against a distorting effect of shared biases. Of course, we agree that transparency is good, but we are less sanguine that decision makers will ever give up their own implicit biases and we are also dubious that consensus processes can deliver the balanced recommendations envisioned by Karns et al. (2018). Indeed, we fear they have introduced a new assumption in their proposed fix, that multiple biases cancel each other out.

PARTICIPATORY, CONSENSUS-BASED DECISIONS PROVIDE JUST AND FAIR MEANS TO OVERCOME CHALLENGES IN HWCC

Why should one assume that participatory, consensus-based processes will overcome bias? Given a longstanding critique of the myth of consensus in this very journal (Peterson et al. 2005), it seems important to ask whether the assumption of participatory consensus is valid.

The common practice worldwide is to convene several representatives of interest groups (e.g., wildlife conservation organizations, local residents often represented by elected officials, resource user groups, animal welfare organizations less frequently, and representatives of higher jurisdictions such as national governments). As outlined above, none of these are neutral actors (by definition they have a perspective or an interest), and even so-called neutral facilitators are not neutral if they are beholden to whomever pays them or hosts them. Participatory, consensus-based processes are defined in López-Bao et al. (2017) and lengthier treatments of the biases that emerge from these are discussed in other studies (Treves et al. 2017, 2018*b*; Santiago-Ávila et al. 2018).

We restricted ourselves to those processes for deciding on the use or preservation of nature, such as setting quotas or population targets, setting aside land or water for protection, and listing or delisting (as in Karns et al. [2018]). We do not refer to participation in evaluating outcomes of HWCC interventions or forums designed to share interest-group views because the former 2 processes do not usually lead directly to decisions about use or preservation. We are not opposed to participation and deliberation in governance; on the contrary, we endorse it. We are concerned with how such groups are constituted (Clark & Milloy 2014) and whether they are advisory or determinative on decisions to preserve nature or use it. Determinations and decisions to preserve or use nature should not be simply participatory in our view but rather based on trusteeship (Sand 2014; Wood 2014; Treves et al. 2017, 2018*a*, 2018*b*). The following are essential attributes of trustees: personal disinterest and neutrality toward diverse beneficiaries.

The criterion of fairness has been defined ethically and judicially to connote treating everyone equally or equitably. Equitable is distinct from equal because the affected individuals receive their due (not the same outcome) because their differing capacities, capabilities, and relationships are considered, such that different interests do not receive the same treatment. Given the preceding definitions, we hypothesize that few (if any) such decision processes in the use or preservation of nature are fair anywhere in the world because they do not include a legitimate representative of nonhumans or even a legitimate representative of future humans.

We are not arguing that an array of interest groups cannot express some care and interest in future humans or nonhumans. They often do. However, they are either unable or unwilling to set aside self-interest so as to be neutral in decisions or objective about evidence. For example, the nearly ubiquitous anthropocentric worldview will tend to favor humans over nonhumans, and current self-interest virtually always exerts more power than future human interests. A widespread example of this lack of consideration and fairness involves risk.

Humans typically attempt to minimize or preclude any risk from animals, and may reflect little to no tolerance for it (Treves & Bruskotter 2014), while ignoring the multitude of risks imposed by humans on animals (e.g., increased mortality through collisions or poaching, lack of natural prey or habitat destruction), many of which are invisible (Santiago-Avila et al. 2018; Finn & Stephens 2019). Acceptance of some risk without resorting to lethal management if the risk materializes and equitable mitigation of negative effects are as essential for fairness in human-wildlife relationships as they are in human-human relationships, perhaps even more so given the power asymmetry. Might does not make right in HWCC or most other ethical questions.

To promote fairness and equitable consideration in HWCC would require training as a trustee and a level playing field in which all legitimate interests of all humans and nonhumans are represented equitably. The outlines of such a system are described in Treves et al. (2018*b*). In brief, we recommend at least 3 authentic advocates to represent all current users, futurity, and nonhumans.

These ≥3 advocates would argue their beneficiaries' interests in front of the trustees (e.g., a constitutional court) and rebut each other's arguments, respond to questions from the trustees, and then wait for a decision based on evidence, the law, nonanthropocentric ethics, and competing claims. By its nature of advocacy, argument, and rebuttal in front of an arbiter bound by constitutional law and legal process, there is participation but little or no consensus building in our scheme. Our scheme counters the injustice of building consensus among current human adults who share an anthropocentric bias.

We can imagine a rigorous test of the assumption that consensus-based participatory decision processes are fair or unfair. However, that evaluation might require the assumption that the evidence or facts used by evaluators were generated objectively and that the evaluators themselves are neutral. Karns et al. (2018) falsified the assumption of neutrality in the grizzly bear study and then relied on another assumption (diverse participatory consensus-based decision making) to remedy the competing biases among experts. If the solution to biased experts is participation, but the solution to biased participation is neutral trustees, then we see the makings of a wicked problem that appears insoluble. Perhaps the solution lies in a clearer division between the evidence and the values-based ethical and legal decision making?

If experts with inescapable bias can jointly use the tools of scientific integrity and standards of evidence to debate evidence fully, then they might expose the best available evidence by following rules for strong inference and presenting a final weight of evidence. Given the tools of the internet and social media, it may be possible to canvass hundreds of experts as Karns et al. (2018) did but to have them weigh evidence instead of making a normative judgment of what one should do. Then the authorities deliberating on ethics and law might take that best available evidence into consideration using consensus for some aspects, moral and ethical argumentation and deliberation for others, and the rule of law for yet other aspects of their decision. Without a clear separation of the weight of evidence from the burden of ethical reasoning, we fear the assumption that practitioners and scholars are neutral and objective, respectively, combines with the assumption that participatory, consensus-based decisions provide just and fair means to overcome challenges in HWCC, to create a myth. They are not separate, testable assumptions currently because the remedy to one invokes the other.

CONFLICTS ARE GETTING WORSE

It is common for scholars to describe an increase in conflict or something worsening about HWCC. We propose that this framing may be inaccurate. We cite as an example of Treves and Karanth (2003*b*) in a *Conservation Biology* special section on human-carnivore conflicts that has been cited 1154 times as of writing. This work deserves some blame for overheated rhetoric, although the authors attempted to specify what might be increasing about conflict, when the authors stated (p. 1489),

> Conservationists around the world are raising alarms over human-wildlife conflicts . . . This issue is playing an increasingly prominent role in conservation conferences . . . . There are at least three reasons for this alarm and attention. First, humans are increasingly entering and developing hitherto remote carnivore habitats. Second, many large-carnivore populations are recovering from past extirpation efforts and becoming involved in mutually threatening interactions with humans. Finally, the response of affected communities undermines urgently needed wildlife conservation action around the world.

Obviously when someone notes "increasingly prominent . . . alarms and attention," numerous criteria may apply. Given that humans and wildlife are involved and possibly domestic plants and animals too, one might be alarmed if the frequency of interactions increases for any of the actors and label that as worsening. Alternately, perhaps the severity of an interaction may have increased, even if the frequency declines or remains the same. Or, perhaps human perceptions of interactions have become negative, even if the physical manifestations have not changed. Finally, conflict between humans and wildlife has long been redefined from the narrow sense of wildlife causing damage to human interests to a more neutral definition that includes humans retaliating against wildlife or clearing habitat (Treves et al. 2006). Therefore, the inference that conflict has increased need not reflect any change in wildlife actions or human perceptions of those actions, but in the actor's behavioral reactions. Indeed, there might be very strong scientific reasons to conclude that conflict with wild animals has become less frequent or severe in aggregate because large, dangerous wildlife have been restricted to smaller and smaller areas of the globe and been replaced by smaller, less threatening animals (Naughton-Treves 1999; Ripple et al. 2014, 2016, 2017). Yet, common human responses of retaliation against dangerous animals may now have more serious consequences for coexistence. In any case, a precise and scientific evaluation of the specific interaction and its frequency, severity, or perception of the interaction may be required before we sound alarms. However, we cannot agree that scholarly attention to conflict by itself justifies a claim that the conflict is worsening.

Even if one finds that by some measures conflict has increased and by other measures it has decreased, it may (or may not) be strategic to emphasize the worst case. It may be tempting to sound an urgent alarm to allies, potential donors, or the media, but it raises expectations of solutions. As with the boy who cried wolf, those concerned about the conflicts and coexistence may

damage their credibility. Therefore, we conclude this is a testable assumption or claim but it may continue to be used rhetorically without a rigorous test if it serves the interests of the claimant. That should concern scholars of HWCC.

PREDATION ON DOMESTIC ANIMALS IS ADDITIVE

Allen and Sparkes (2001) offered an important insight about additive and compensatory mortality among domestic ungulates, which can be simply imagined as the predator killing a domestic animal that was at death's door from other causes. If domestic animals were poorly cared for or unguarded, the competing risk they face from any cause (weather, accidents, health, humans, traffic, etc.) may also rise and therefore predation may be the *coup de grace* or contributory but not causal in an animal's death. Blaming the predator or the other cause of death in such a case is often a value judgment.

When other causes of mortality and morbidity in domestic animals and cultivated plants are high, the additive effect of wildlife is likely to be small and could be as low as zero. Therefore, some wildlife damage to domesticates is compensatory, and its reduction or elimination may be correspondingly futile because the primary cause of morbidity or mortality may remain unchanged. Some interest groups are quick to argue that their killing of wildlife is compensatory, not additive, meaning the targeted animals would have died anyway of other causes, so the effects of their animal-killing are less important or even undetectable. The same might be said of human property facing multiple threats in addition to wildlife. Allen and Sparkes' (2001) early insight should have generated research into background rates of property loss rather than unsubstantiated claims of low rates of loss or unsubstantiated claims that domesticates were healthy before wildlife losses were measured (Linnell & Broseth 2003; Oakleaf et al. 2003). To our knowledge, few if any studies of background property loss have informed deliberations on HWCC, but see López-Bao et al. (2013).

One example of policy to address background rates of lost property was a compensation scheme that addressed the disappearances of cattle from pastures with a history of verified wolf predation (summarized in Treves et al. [2009]). Initially, the compensation paid for missing calves was discounted by the background level of calves expected to have died. Under pressure from farm interests, that discounting policy was abandoned. In general, the background rates of damage and loss of property are important points of comparison when considering the effects of wild animals, whether those damage crops or attack domestic animals. Additive or compensatory loss of property is a testable assumption. Yet, the lack of such a test long after publication of Allen and Sparkes (2001) seems to reemphasize our concerns about neutrality among governments (which fund most research) and scholarly neutrality when making scientific communications about HWCC.

Conclusions

We expect the scholarship of HWCC to progress more quickly if implicit assumptions are exposed to the light and tested rigorously, as predicted by Platt (1964), and if favored hypotheses are exposed rigorously to authentic alternatives as advocated by Chamberlin (1890), both of whom addressed progress in other fields of science. We predict the assumption of additive threats to property from wildlife is testable and will weaken implicit anthropocentric reasoning that wild animals pose major obstacles to human interests in many circumstances. We also predict the assumption that conflicts with wildlife are getting worse will be tested and give way to more scientific descriptions, although we expect practitioners to continue to sound alarms because doing so is both a duty and a self-interest. Coming to conclusions related to the assumptions that practitioners and scholars are neutral and objective, respectively, and that consensus-based processes can produce fair outcomes is more difficult.

If an assumption proves unfalsifiable, then it is more insidious by being unscientific (Popper 1959). Such assumptions are akin to myths that scientists should debunk. We identified 2 assumptions that are on their way or already myth.

The assumption of scientific objectivity has been undermined by evidence of a personal or professional bias among experts. The proposed remedy for variable biases among scholars is to build consensus by participatory deliberation. Yet, participatory, consensus-based decisions typically lead to debates over values that are almost always won by powerful, current interests over weaker, nonhuman, or future interests. If both assumptions within current practice are inaccurate or false, they may self-reinforce to create a wicked problem. Therefore, we propose an alternative to choosing scholars and drawing consensus from their recommendations on evidence. First, we recommend that scholars of HWCC only be asked to weigh evidence not to make normative recommendations. Second, we recommend that neutral trustees hear arguments about ethics, law, and values offered by legitimate advocates for at least 3 interest groups in an HWCC situation: current humans, nonhumans, and futurity of involved organisms.

We predict the wicked problem of the entanglement of value judgments and evidence will be very slow to disentangle without the alternative we recommended. We recommend the scientific community do its part by exposing value judgments and paradigms to scrutiny and objective testing. In turn, the practitioner community should ask the tough ethical and political questions of how decision processes are constituted (Clark & Milloy

2014) and then persuading and compelling authorities toward more fair and just processes that clearly separate evidence from ethical judgments.

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Literature Cited

Allen LR, Sparkes EC. 2001. The effect of dingo control on sheep and beef cattle in Queensland. Journal of Applied Ecology **38:**76–87.

Bernstein RJ. 1991. Beyond objectivism and relativism: science, hermeneutics and praxis. University of Pennsylvania Press, Philadelphia.

Chamberlin T. 1890. The method of multiple working hypotheses. Science **15:**92–96 (reprinted in 1965, volume 148, pp. 754–759).

Clark SG, Milloy C. 2014. The North American model of wildlife conservation: an analysis of challenges and adaptive options. Pages 289–324 in Clark SG, Rutherford MB, editors. Large carnivore conservation: integrating science and policy in the North American West. The University of Chicago Press, Chicago.

Esterhuizen WCN, Norton PM. 1985. The leopard as a problem animal in the Cape Province as determined by the permit system. Bontebok **4:**9–16.

Fascione N, Delach A, Smith ME, editors. 2004. People and predators: from conflict to coexistence. Island Press, Washington, D.C.

Finn HC, Stephens NS. 2019. The invisible harm: land clearing is an issue of animal welfare. Wildlife Research **44:**377–391.

Jackson RM, Ahlborn GG, Gurung M, Ale S. 1996. Reducing livestock depredation in the Nepalese Himalayas. Proceedings of the Vertebrate Pest Conference **17:**241–247.

Jorgensen CJ, Conley RH, Hamilton RJ, Sanders OT. 1978. Management of black bear depredation problems. Proceedings of the 4th Eastern Workshop on Black Bear Management and Research **4:**297–321.

Karns GR, Heeren A, Toman EL, Wilson RS, Szarek HK, JTB. 2018. Should grizzly bears be hunted or protected? Social and organizational affiliations influence scientific judgments. Canadian Wildlife Biology & Management **7:**18–30.

Linnell JDC, Broseth H. 2003. Compensation for large carnivore depredation of domestic sheep. Carnivore Damage Prevention News **6:**11–13.

López-Bao JV, Chapron G, Treves A. 2017. The Achilles heel of participatory conservation. Biological Conservation **212:**139–143.

López-Bao JV, Sazatornil V, Llaneza L, Rodríguez A. 2013. Indirect effects on heathland conservation and wolf persistence of contradictory policies that threaten traditional free-ranging horse husbandry. Conservation Letters **6:**448-455.

Lynn WS. 2006. Between science and ethics: what science and the scientific method can and cannot contribute to conservation and sustainability. Pages 191–205 in Lavigne D, editor. Gaining ground: in pursuit of ecological sustainability. University of Limerick, Limerick.

Lynn WS. 2018. Bringing ethics to wild lives: public policy for barred and northern spotted owl. Society & Animals **26:**217–238.

Mace RD, Waller JS. 1996. Grizzly bear distribution and human conflicts in Jewel Basin Hiking Area, Swan Mountains, Montana. Wildlife Society Bulletin **24:**461–467.

Midgley M. 1995. Beast and man. Routledge, New York.

Naughton-Treves L. 1999. Whose animals? A history of property rights to wildlife in Toro, western Uganda. Land Degradation and Development **10:**311–328.

Newby F, Brown R. 1958. A new approach to predator management in Montana. Montana Wildlife **8:**22–27.

Oakleaf JK, Mack C, Murray DL. 2003. Effects of wolves on livestock calf survival and movements in central Idaho. Journal of Wildlife Management **67:**299–306.

Peterson MN, Peterson MJ, Peterson TR. 2005. Conservation and the myth of consensus. Conservation Biology **19:**765–767.

Platt JR. 1964. Strong inference. Science **146:**347–353.

Popper K. 1959. The logic of scientific discovery. Routledge, Abingdon-on-Thames, United Kingdom.

Ripple WJ, et al. 2014. Status and ecological effects of the world's largest carnivores. Science **343:**1241484.

Ripple WJ, et al. 2016. Saving the World's terrestrial megafauna, BioScience **66:**807–812.

Ripple WJ, et al. 2017. Conserving the World's megafauna and biodiversity: the fierce urgency of now. BioScience **67:**197–200.

Robinson M. 2005. Predatory bureaucracy. University of Colorado Press, Boulder.

Sand PH. 2014. The rise of public trusteeship in international environmental law. Environmental Policy and Law **44:**201–271.

Santiago-Avila FJ, Lynn WS, Treves A. 2018. Inappropriate consideration of animal interests in predator management: towards a comprehensive moral code. Pages 227–251 in Hovardos T, editor. Large carnivore conservation and management: human dimensions and governance. Taylor & Francis, New York.

Treves A, Artelle KA, Darimont CT, Lynn WS, Paquet PC, Santiago-Avila FJ, Shaw R, Wood MC. 2018*a*. Intergenerational equity can help to prevent climate change and extinction. Nature Ecology & Evolution **2:**204–207.

Treves A, Bruskotter JT. 2014. Tolerance for predatory wildlife. Science **344:**476–477.

Treves A, Chapron G, López-Bao JV, Shoemaker C, Goeckner A, Bruskotter JT. 2017. Predators and the public trust. Biological Reviews **92:**248–270.

Treves A, Jurewicz RL, Naughton-Treves L, Rose RA, Willging RC, Wydeven AP. 2002. Wolf depredation on domestic animals: control and compensation in Wisconsin, 1976–2000. Wildlife Society Bulletin **30:**231–241.

Treves A, Jurewicz RL, Naughton-Treves L, Wilcove D. 2009. The price of tolerance: wolf damage payments after recovery. Biodiversity and Conservation **18:**4003–4021.

Treves A, Karanth KU. 2003*a*. Human-carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology **17:**1491–1499.

Treves A, Karanth KU. 2003*b*. Human-carnivore conflict: local solutions with global applications. Conservation Biology **17:**1489–1490.

Treves A, Krofel M, McManus J. 2016. Predator control should not be a shot in the dark. Frontiers in Ecology and the Environment **14:**:380–388.

Treves A, Santiago-Ávila F, Lynn WS. 2018*b*. Just preservation. Biological Conservation **229:**134–141.

Treves A, Wallace RB, Naughton-Treves L, Morales A. 2006. Co-managing human-wildlife conflicts: a review. Human Dimensions of Wildlife **11:**1–14.

Wood MC. 2014. Nature's trust. Cambridge University Press, New York.

Woodroffe R, Ginsberg JR. 1998. Edge effects and the extinction of populations inside protected areas. Science **280:**2126–2128.

Woodroffe R, Thirgood S, Rabinowitz A, editors. 2005. People and wildlife, conflict or coexistence? Cambridge University Press, Cambridge.

Zemanova MA. 2017. More training in animal ethics needed for European biologists. BioScience **67:**301–305.