Responsibility, equity, justice, and inclusion in dynamic human–wildlife interactions

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In an era of rapid environmental change, human–wildlife interactions (HWIs) are increasingly complex and pervasive across ecosystems. Negative outcomes from such interactions continue to warrant much attention, given their implications for conservation and human livelihoods. However, framing HWIs solely along a coexistence–conflict continuum is overly simplistic because coexistence is not devoid of conflict and negates the temporal dynamics of potential outcomes. Furthermore, without thorough consideration of governing principles, HWIs will persistently result in negative outcomes and a skewed perspective within the scientific community and among the public. Here we argue that incorporating the principles of responsibility, equity, justice, and inclusion (REJI) into conservation-oriented activities can influence the intensity, severity, and duration of negative outcomes throughout the HWI life cycle. The conceptual framework we present both complements and expands assessment and anticipation of HWI outcomes, which are inherently contingent on scientific practice, cultural sensitivity, and interdisciplinary approaches.

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Human–wildlife interactions (HWIs) have become increasingly prevalent in a rapidly changing world (Soga and Gaston 2022). Research on these encounters has predominantly featured human–wildlife conflicts (HWCs) rather than positive interactions (Lozano *et al.* 2019; Bhatia *et al.* 2020).

In a nutshell:

- Human–wildlife interactions (HWIs) are pervasive, and future global change will exacerbate negative outcomes
- Traditionally, HWIs have been framed as occurring along a conflict–coexistence continuum, where win–win scenarios are sought
- HWIs should rather be considered as a life cycle, to incorporate the plethora of outcomes – where interactions could be positive, negative, or neutral for one partner in the dyad – that vary in importance and over time
- Integrating responsibility, equity, justice, and inclusion as governing principles into the development and practice of conservation activities can reduce conflicts between humans and wildlife
- If left unmitigated, negative outcomes from HWIs challenge the sustainability of human livelihoods and reduce community support for conservation, impacting the long-term survival of species

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Interactions with wildlife can yield psychological benefits for people, reflecting cultural and spiritual values that contribute to human well-being (Buijs and Jacobs 2021). In addition, wildlife provide recreational opportunities, serve as food or furnish other resources, and generate revenues that contribute to local and national economies (Mace *et al.* 2012). Reciprocal benefits also exist, as humans buffer or shield against competitive pressures from more dominant sympatric species to promote species coexistence (eg Gámez and Harris 2021). However, the pervasiveness of negative outcomes from HWIs is undeniable, often occurring when wildlife injure or exploit shared human resources (eg domestic animals, fisheries), damage crops, or endanger human lives through direct mortality or public health pathways (Figure 1) (König *et al.* 2020; Gulati *et al.* 2021).

Due to the wide-ranging impacts of reciprocal processes between humans and wildlife across spatial and temporal scales, HWC is one of the most urgent and complicated issues facing conservation and sustainability today (Gross *et al.* 2021). One important global driver of HWCs is land-use change, as humans encroach into wildlife habitat with development, settlements, or agrarian areas (König *et al.* 2020). As wildlife populations have increased due to effective conservation efforts so too have HWCs, through greater competition and more frequent encounters with humans (eg Jhala *et al.* 2021). Proximity among dense human, livestock, and wildlife populations may further exacerbate HWCs, highlighting that the efficacy of interventions requires spatial and social considerations (Lischka *et al.* 2018; Soga and Gaston 2022).

The coupled socioecological feedbacks within HWIs – in an era of rapid environmental change – require broadening approaches, interpretations, and partners for projects that extend beyond only considering human and animal behaviors separately (Varghese and Crawford 2021). Furthermore, attempts at identifying solutions are often constrained by a

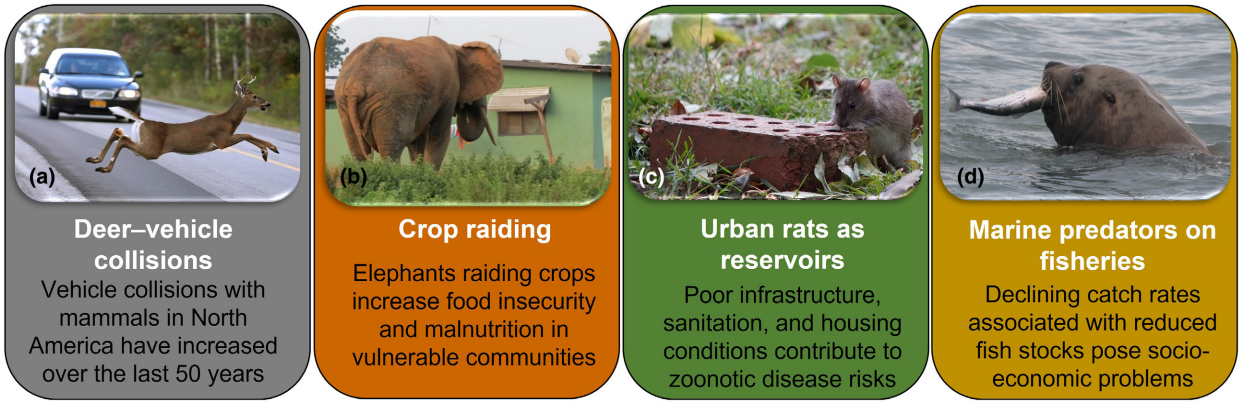

Figure 1. Examples of negative human–wildlife interactions in mammal communities. (a) Vehicle collisions (Hill *et al.* 2020b); (b) crop raiding (Barua *et al.* 2013); (c) disease risks (Himsworth *et al.* 2013); (d) depredation (Tixier *et al.* 2021). Image credits: (a) deer (Associated Press); (b) African elephant (NC Harris/Applied Wildlife Ecology Lab); (c) rat (Air wolfhound/CC BY-SA 2.0); (d) sea lion (W Osborne/USFWS Alaska).

narrow focus on managing wildlife while ignoring the social and economic impacts of these interactions (Lischka *et al.* 2018). It remains problematic to concentrate solely on maximizing wildlife populations by improving tolerance and leveraging compassion in human populations because this frames HWIs as political rather than ecological issues (Jordan *et al.* 2020; Coghlan and Cardilini 2022). In addition, practices that rely on transferring mitigation strategies from the "Global North" to the "Global South" can prove exclusionary and ineffective because of the lack of cultural sensitivity and broader knowledge systems (eg Browne-Nuñez and Jonker 2008). When relying on social-science approaches to study HWIs, researchers may introduce bias by using leading questions that explicitly identify HWIs as conflict; instead, to lessen their position and power, investigators should ask exploratory open-ended questions (Buijs and Jacobs 2021).

The limitations presented above, along with an array of emerging interdisciplinary research, underscore the need to improve inquiry into HWCs, particularly with regard to the importance of scrutinizing HWCs through lenses of morals and human culture that examine perceptions, historical contexts, and human–human conflicts (Nyhus 2016; Pooley *et al.* 2021). Here, using illustrative examples across systems, we advance these conversations by considering the dynamism of HWIs and assert that their outcomes are governed by principles that capture human dimensions. Specifically, we propose that HWIs occur within a life cycle and that incorporating principles of responsibility, equity, justice, and inclusion (REJI) can reduce HWCs.

Human–wildlife interactions: from a continuum to a life cycle

The dominant paradigm casts HWIs along a continuum from conflict to coexistence, with coexistence being the desired state (eg Nyhus 2016; König *et al.* 2020). Historically, coexistence was synonymous with a win–win scenario absent of conflict, whereas conflict was framed as humans suffering for the benefit of wildlife or vice versa (Pooley *et al.* 2021). However, coexistence is not devoid of wildlife doing harm, but rather that harm is negligible or occurs at a level deemed acceptable by those afflicted. In recent times, a more progressive and transformative approach has emerged, one that illuminates important nuances and the multidimensional, iterative nature of HWIs across space and time through consideration of such elements as human–human conflicts, cultural factors, and HWI nonlinearity (Figure 2) (Hill 2021).

When considering HWCs, every interaction – apart from mutualism – would yield some form of conflict that results in a negative outcome for one actor, suggesting that, from a probability perspective, coexistence should rarely be expected. However, even when outcomes are negative, HWIs are more complex than this initial framing implies, given the multiple scenarios that could cause one partner in the human–wildlife dyad to suffer or tolerate the interaction. Ultimately, HWIs can include positive, negative, or neutral effects on one partner that vary in duration and consequence.

Arguably, a more realistic conceptual framework would be to consider the life cycle of HWIs (Figure 2). In considering one partner, the interaction may start neutral with little consequence for either party, which could be classified as coexistence. Then, the interaction becomes positive for wildlife exploiting some shared resource where humans suffer from the encounter. In this scenario, determining whether the level of harm exceeds a tolerable threshold is necessary to categorize the HWI as conflict or coexistence. Next, through a management intervention or retaliatory behavior, the feedback pathway results in negative outcomes for the wildlife while effects on humans are either positive (if some form of utilization occurs: for instance, obtaining meat, skin, bones, and so on) or neutral. However, humans may still experience a cost through mitigation action because of energy expended, financial loss, and emotional distress (Barua *et al.* 2013; Thondhlana

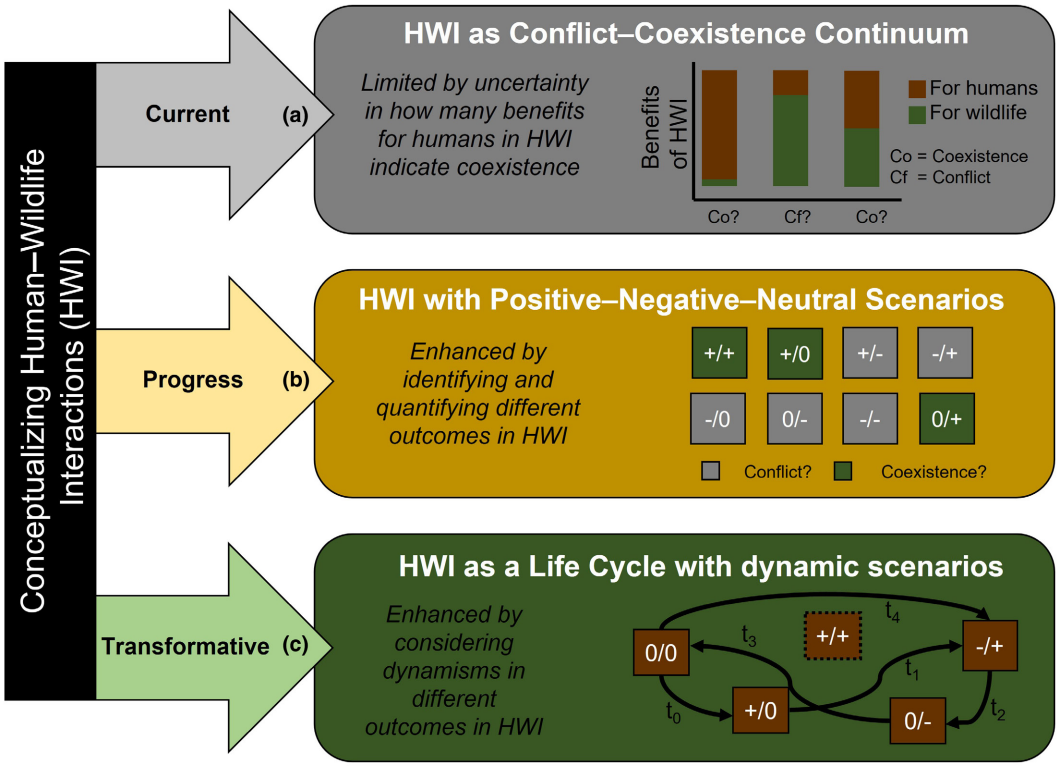

Figure 2. Different ideologies to conceptualize human–wildlife interactions (HWIs). (a) Current state: cast as a conflict–coexistence continuum; (b) progress: recognizes multiple scenarios that can be positive, negative, or neutral; and (c) transformation: introduces a temporal scale, with outcomes occurring within a life cycle. Dashed box indicates that the scenario of benefits for both humans and wildlife may not be achieved during the life cycle.

et al. 2020). In the US, the potential relisting of gray wolves (*Canis lupus*) in the Northern Rocky Mountains under the Endangered Species Act is a salient example of an HWI life cycle, where hunting incited restrictions on harvesting, and the subsequent population recovery led to livelihood concerns, resulting in culling to the point where the species is once again vulnerable (Kareiva *et al.* 2021). This example demonstrates the oversimplification of defining HWIs along the coexistence–conflict continuum, and how doing so ignores the complexity of socioecological drivers influencing outcomes (Pooley *et al.* 2021). Although HWI approaches that apply positive, negative, and neutral outcomes represent progress, it is imperative to acknowledge the dynamism and fragility of these interactions across scales, and the possibility that coexistence and conflict can co-occur. Such a framing enhances our capacity to anticipate outcomes and buffer effects that also influence outcomes, which may include building resiliency into ecosystems and incorporating social justice principles (Cooke *et al.* 2022).

Governing principles

We contend that, when integrated into the HWI life cycle, four governing principles (at a minimum) influence the frequency and possibly the duration of actual conflict. Considerations of REJI may be enough of an intervention in coupled ecosystems for reversal where HWIs skew toward negative outcomes (Figure 3). We define these principles as: (1) *responsibility* – the state of being accountable for outcomes (Tan 2021); (2) *equity* – the distribution of costs or benefits at parity between individuals or groups of people (McDermott *et al.* 2013); (3) *justice* – the systemic fair treatment of people in conservation, where values and livelihoods are protected (Vucetich *et al.* 2018); and (4) *inclusion* – the action or state of including or of being included within a group or structure, involving authentic and empowered participation and a sense of belonging (Jones and Solomon 2019).

Although we discuss these principles in isolation, more effective conservation practice and positive outcomes throughout the HWI life cycle stem from their integration. Equity can involve access to justice, and inclusivity requires shared responsibility (Zafra-Calvo *et al.* 2017). For instance, by reducing negative outcomes of sheep depredation by gray wolves through collaboration with the ranching community, the Wood River Wolf Project in Idaho highlights interactions among these principles (Martin 2021). In this case, responsibility was distributed and inclusivity was enhanced by specific actions, including: (1) reconnaissance to transmit wolf location data to ranchers, (2) livestock husbandry and use of guardian dogs, and (3) adoption of predator deterrents such as mechanical tools and hazing techniques. This example explicitly highlights how scientists influence the HWI life cycle through

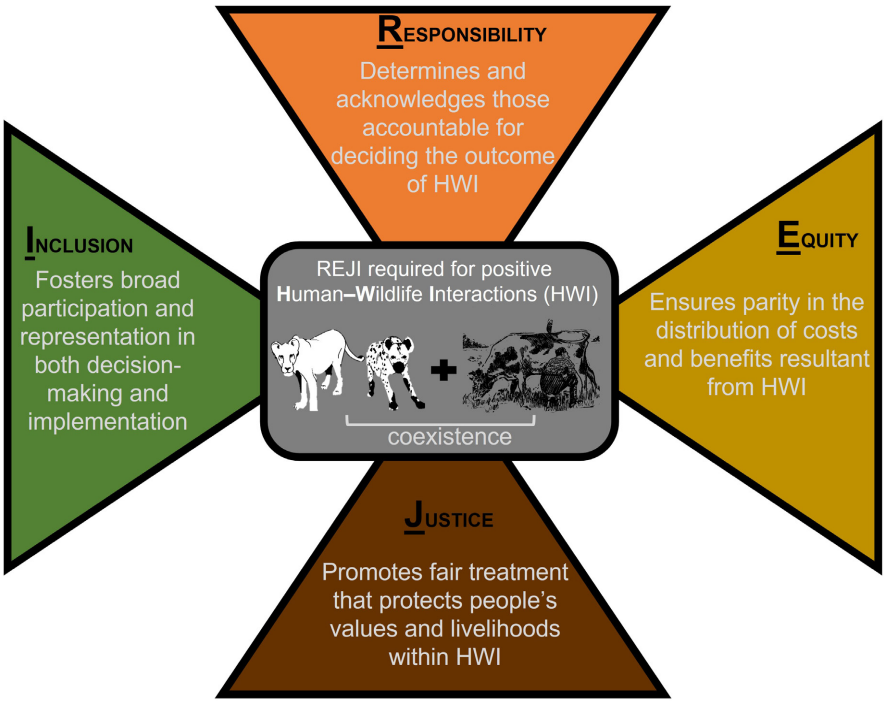

Figure 3. Governing principles to promote positive outcomes from human–wildlife interactions (HWIs). Carnivore illustrations by V Zakrzewski.

information transfer – a characteristic of responsible scientific practice.

Fundamentally, promoting positive HWIs requires addressing underlying human–human conflicts emergent from legacies of oppression, injustice, discrimination, and inequity (Lischka *et al.* 2018; Rudd *et al.* 2021). For example, many farmers (86% of respondents) in Catalonia, Spain, reported that the response of managing authorities to risks posed by vultures to livestock was ineffective (Oliva-Vidal *et al.* 2022). Across systems, such dissatisfaction emboldens afflicted communities to address wildlife conflicts themselves through retaliatory killings and poisoning as acts of resistance and management (Cooney *et al.* 2017). Therefore, we recognize the precursor to tackling HWCs is acknowledging the variations in values, attitudes, and behaviors within the human population (Thondhlana *et al.* 2020; Buijs and Jacobs 2021). In an ideal world, the burden of achieving positive outcomes would fall on the powerful actors who caused (and in many cases continue to cause) injustices underlying conflict. Applying an environmental justice framework, which strives to ensure equal environmental protection for all by combatting inequities and disparate impacts (Bullard 2001), can offer important lessons to HWI studies. Positioning antagonisms between humans and wildlife as an environmental justice issue can help powerful stakeholders (such as governments and industries) develop frameworks that pivot sole responsibility away from communities experiencing conflict (Dietsch *et al.* 2021). The conceptual framework we present both complements and expands how we approach assessing and anticipating HWI outcomes, which are inherently contingent on scientific practice, cultural sensitivity, and interdisciplinary approaches.

Responsibility

All of the many actors involved in HWIs (including natural resource managers, scientists, and the afflicted parties) are responsible for promoting positive outcomes. When both local communities and wildlife managers view the negative impacts of HWIs as a shared problem, the burden of formulating and implementing solutions can also be shared to improve relationships between parties despite seemingly disparate goals (Zafra-Calvo *et al.* 2017). Efforts that focus on promoting tolerance in one party or leveraging spiritual reverence alone, which shifts the burden to affected communities, are insufficient for mitigating HWCs, and arguably are unethical. In Delhi, India, for instance, human subsidies and ritualized feeding of black kites (*Milvus migrans*) result in a greater number of agonistic interactions with the public (Kumar *et al.* 2019). Furthermore, tolerance is a luxury not all can afford, especially when crop raiding and livestock depredation are so intricately linked to livelihoods (Soga and Gaston 2022). Divergent ideologies of valuations and omission of biocultural approaches further complicate considerations of responsibility in reducing human–wildlife antagonism and promoting environmental sustainability (Sterling *et al.* 2017; Lischka *et al.* 2018). A shared responsibility is particularly salient when oppressive and Western capitalist approaches to mitigation dominate over those employed by Indigenous communities (Fernández-Llamazares and Cabeza 2018; Brondízio *et al.* 2021).

One model to redistribute power structure and responsibility is to build alliances, which can also promote inclusivity. Rees *et al.* (2020) suggested that land management alliances between the conservation and agricultural sectors would optimize allocation of resources and co-benefits when managing invasive species in the Kati Thanda–Lake Eyre Basin of Australia, one of the largest internally draining river systems in the world. Although named after a 19th-century English explorer (Edward John Eyre), the health of the Kati Thanda–Lake Eyre Basin is connected to the Arabana and other Indigenous peoples, as the basin is located on their traditional lands. Building effective alliances is therefore contingent on responsible scholars being aware of the historical context and persistent legacies of the areas in which they are working to decolonize their work, identify relevant partners, and operate with principles of inclusivity (Tan 2021; Trisos *et al.* 2021; Yitbarek *et al.* 2021).

We propose that several of the negative outcomes throughout the HWI life cycle stem from inequitable distribution of

access to relevant technologies, data, and best practices induced by the scientific community (Trisos *et al.* 2021). It is the responsibility of researchers and their partners to broadly disseminate risks and mitigation strategies, particularly to vulnerable communities (Zafra-Calvo *et al.* 2017). When successful conservation efforts increase predator densities, as evident by tigers (*Panthera tigris*) across portions of their range, conflicts concurrently ensue both in the form of livestock depredation and direct human mortality (Jhala *et al.* 2021). Therefore, researchers and wildlife managers must conduct socioecological risk assessments and confirm community support prior to implementation, as well as ensure adaptive governance for addressing unintended consequences or changing attitudes (Gill *et al.* 2019; Niemiec *et al.* 2021). We also recognize knowledge transfer should never be unidirectional, and integrating the longitudinal knowledge and oral tradition of Indigenous communities can provide essential information for wildlife management from a historical context (Hill *et al.* 2020a; Varghese and Crawford 2021). As a result, scientists should explicitly incorporate traditional ecological knowledge (TEK) into their activities, because doing so will advance a more inclusive practice of science, signal an awareness of responsibility, and promote broader impacts (Molnár and Babai 2021).

Equity

Environmental degradation commonly disadvantages nonwhite communities and marginalized members of society, as evident in the inequitable distribution of resources, benefits, toxicants, and disease risks (Bullard 1999; Tessum *et al.* 2021). In addition, the poor and powerless often lack the resources for conflict prevention when managing interactions with sympatric wildlife. For example, countries that were wealthier contributed more to compensation programs to mitigate conflict with large carnivores in Europe (Bautista *et al.* 2019). Without broad access to forecasting services and the capacity to implement mitigation strategies, HWIs will continue to exacerbate consequences for vulnerable communities that rely on shared resources. For instance, Almuna *et al.* (2020) used risk modeling of farmer experiences and landscape variables to identify effective husbandry that supports coexistence between small-scale poultry operations and raptors in Chile. When recommendations to control negative outcomes differ among groups, distinctions are often most conspicuous between those affected versus those unaffected. As an example, for reducing HWCs, fishers in Tasmania subject to damage and loss from brown fur seals (*Arctocephalus pusillus*) supported seal culling efforts (Cummings *et al.* 2019), whereas the public and managers advocated for the use of non-lethal methods. A thoughtful consideration of equity throughout the HWI life cycle requires scrutinizing exposure probabilities, system dynamics, power imbalances, and governance infrastructure (Law *et al.* 2018; Dietsch *et al.* 2021). Efforts persistently underscore equity as a central principle for community-based work, recognizing that different social equity topologies affect conservation, which consequently could determine HWI outcomes and outcome durations in the HWI life cycle (eg Gill *et al.* 2019; Armitage *et al.* 2020).

To unpack and combat racism and bias in natural resource management to improve equity, we must first recognize that nature-based risks and benefits alike are mediated by culture and privilege that enable power inequities and skew the subset of beneficiaries (Dietsch *et al.* 2021; Nikolakis and Hotte 2022). Such inequities highlight disadvantages that emerge with respect to who are tasked with decision making (procedural equity), who are exposed to burdens (distributional equity), whose voices and values matter (recognitional equity), and who have the capacity to adapt or mitigate (contextual equity) (McDermott *et al.* 2013). However, simply disaggregating risks to more equitably harm a greater and more diverse human population does not promote positive HWIs. Furthermore, recommending alternative livelihoods that reduce reliance on natural resources disregards that utilitarian value may be tightly connected to heritage, traditional medicinal remedies, or spirituality (Thondhlana *et al.* 2020). Instead, participatory science and human perception studies that incorporate TEK prior to or in tandem with field ecological research would aid in anticipating conflicts, improve data interpretations, and elucidate interventions that could more effectively be adopted to align with the UN Declaration of the Rights of Indigenous Peoples (Redpath *et al.* 2013; Tauli-Corpuz *et al.* 2020; Molnár and Babai 2021). Ultimately, addressing inequities across governance, conservation practice, and scientific inquiry can promote positive HWIs.

Justice

Rules aimed at preserving biodiversity may simultaneously erode local culture, with foreign interests taking precedence in protected area management. As such, Indigenous communities with ancestral claims to land may unjustly no longer practice rituals that maintain their health, spirituality, and connection to the land (Tauli-Corpuz *et al.* 2020). For example, the traditional "fortress" conservation schema incites a diverse cadre of HWIs, but the displacement of people and restricted access to natural resources in protected areas cause many antagonisms (Zafra-Calvo *et al.* 2017; Yitbarek *et al.* 2021). Assets locked within national park boundaries, as top-down regulatory conservation infrastructure, cause competition among human users (Tauli-Corpuz *et al.* 2020). Such human–human conflicts highlight emergent cross-cultural differences that act as the proximate cause underlying many observed negative outcomes throughout the HWI life cycle (Redpath *et al.* 2013).

In recent years, nongovernmental organizations and other entities have attempted to address failings by implementing several measures as reparations, with debatable levels of success that represent attempts at procedural justice for resolution

(McDermott *et al.* 2013). Most popular approaches include compensation, provision of physical interventions, insurance, and facilitation of community-based conservation governance (Vucetich *et al.* 2018). These all still require explicit integration of REJI principles to promote positive outcomes from HWIs. Compensation for damage to livestock and crops, or for human lives lost, can be an impactful and tangible delivery of justice (Ravenelle and Nyhus 2017), but if done incorrectly can have drawbacks that lead to unsustainability (eg Braczkowski *et al.* 2020). Fiduciary responsibility through these compensation programs for wildlife-related damage is perhaps a start, but does not actually reduce exposure to risks, alter outcomes from encounters, or fully serve as a means for contextual justice (that is, the historical context that influences mitigation capacity) (McDermott *et al.* 2013; Oliva-Vidal *et al.* 2022). In India, Program Wild Seve was established to facilitate justice in the form of financial reparations for communities that were often excluded from receiving compensation – due in part from high rates of illiteracy – for livestock depredation by predators (Karanth and Vanamamalai 2020). Physical tools that deter wildlife can also prove insufficient and unsustainable because of the unpredictability of donations received by the provisioning organizations. Insurance programs are among the more promising community-based conservation initiatives that could be a self-sustaining avenue for justice (Wilson-Holt and Steele 2019). For example, work by African People and Wildlife in the Tarangire ecosystem of Tanzania integrates community buy-in for living walls for livestock enclosures with peer-to-peer training on wildlife monitoring, anti-conflict patrols, and environmentally friendly enterprise development (Lichtenfeld *et al.* 2015). However, one drawback to this model is that it relieves other responsible parties – often those with political power – of responsibility and again places the onus on afflicted communities.

Inclusion

The exclusion of local communities from discussions concerning HWIs incites adversarial relations with wildlife managers, causes retaliatory behaviors that derail conservation goals, and perpetuates colonial practices (Bhatia *et al.* 2020; Trisos *et al.* 2021). Instead, assessing alignment of any newly enacted conservation measure with existing management practice by Indigenous communities promotes inclusion. For example, the commitment of the Kitasoo/Xai'xais First Nations in British Columbia, Canada, to marine conservation was more pronounced than Eurocentric approaches due to their embodiment of conservation measures in their worldview and everyday life practices (Ban *et al.* 2020). The need for local involvement in and endorsement of conservation practices has led to the establishment of such programs as integrated conservation and development, community-based conservation, and community-based natural resources management (Armitage *et al.* 2020; Tauli-Corpuz *et al.* 2020). The effective inclusion of local communities on issues relating to HWIs requires decision makers and wildlife managers to recognize and incorporate local community values, attitudes, and beliefs across demographic, cultural, and ethnic parties impacted by HWIs (Jordan *et al.* 2020; Yitbarek *et al.* 2021). Such practices will minimize those traditionally allowed to have a voice in influencing who gains and who loses from planned interventions. Furthermore, neglecting some parties can often incorrectly emphasize the successes of interventions because the participation did not truly reflect the diversity of the community (Gore and Kahler 2012).

Inclusion can be achieved when the values of the entire community are integrated into wildlife management; when the entire community has agency in the outcome of their interactions with wildlife; and, in cases where those HWIs are negative, when the entire community has access to justice. Efforts that broadly adopt an "ethical space" ideology for partnerships represent a promising approach to enhance conservation goals and promote positive outcomes throughout the HWI life cycle (Nikolakis and Hotte 2022). In Namibia, the establishment of conservancies to manage wildlife on community lands is an example of how including local communities in HWI issues can be achieved successfully (Boudreaux and Nelson 2011). These conservancies improved attitudes toward wildlife, likely resulting from the autonomy with which communities can gain tangible benefits that contribute to their livelihoods (Boudreaux and Nelson 2011; Störmer *et al.* 2019).

Conclusion

As HWIs continue to expand, recognizing the dynamism of potential outcomes becomes increasingly necessary for effective mitigation. Conservation efforts that promote lasting positive outcomes require explicit employment of REJI principles, ideally with interdisciplinary teams comprising expertise in conflict resolution, motivations and behaviors, and human conditioning (Figure 3). The objective of using REJI principles in conservation science is to harmonize nature conservation activities with human rights. Environmental justice work demonstrates that incorporating these principles is key for improved and equitable conservation, yet this has not explicitly been extended to most research on HWIs. However, key challenges and barriers persist to incorporating REJI into studies focusing on HWIs. Current conservation models carry a colonial legacy, which can cause well-meaning conservation interventions to exacerbate antagonisms and render mutualistic outcomes less attainable. Further exacerbating this problem, flawed funding structures and a constant sense of urgency limit both proper consultation and assessments for projects (Jordan *et al.* 2020). Fortunately, momentum exists to acknowledge environmental injustices, Indigenous sovereignty, and TEK, which could result in a more ethical and impactful scientific practice.

By highlighting multiple strategies, our work demonstrates that REJI principles are not only useful but also critical for ensuring positive outcomes throughout the HWI life cycle. Creating measurable REJI metrics tailored to specific projects could allow researchers to track progress toward meeting these goals in workplans. Future studies should investigate the extent to which incorporation of REJI principles influences the intensity, severity, and duration of negative outcomes across the HWI life cycle. Ultimately, unmitigated negative outcomes from HWIs challenge the sustainability of human livelihoods while lessening local support for conservation efforts, which affects the long-term survival of wildlife species.

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No data were collected for this study.

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