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Conservation through connection: Approaches to engaging communities in applied grizzly bear research

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Human-wildlife dynamics is a growing field and one of considerable importance to conservation. Wild spaces are in short supply, and consequently wildlife and people increasingly share the landscape, though not necessarily by choice. As a result, peoples' needs might not be prioritized over those of wildlife, even in cases of human-wildlife conflict. For wildlife conservation to be effective and human-wildlife coexistence possible, the needs of both wildlife and people must be simultaneously addressed. Rather than an afterthought or a sentence in the conservation/management implications section of a paper, community engagement should be addressed before, during, and after a research project. However, this can be a difficult and often complicated task, for multiple reasons. Building relationships founded on trust, respect and reciprocity with community members takes commitment, time, skill, and a willingness by researchers to be open-minded in terms of methodologies and new ideas. Different cultural norms, beliefs, perspectives and biases can further exacerbate these challenges. Here, we share three short case studies reflecting our own research experiences engaging with communities in the field of grizzly bear (*Ursus arctos*) ecology and conservation science. We conclude with guidelines for advancing effective community engagement and suggestions for tackling some common barriers. Overall, we offer considerations for a practical and more holistic approach to large carnivore conservation, established on a foundation of strong community support.

KEYWORDS

community, conservation, human-wildlife dynamics, grizzly bear, engagement, Alberta (Canada), human-bear conflict

Introduction

As a field of knowledge and research, wildlife management works to address the complex ways in which people and wildlife share the landscape. Humans and wildlife interact in a variety of ways and conservation scientists are becoming increasingly interested in understanding these dynamic relationships to inform management decisions (Hughes and Nielsen, 2019; Bhatia et al., 2020; Pooley et al., 2020). In a world with limited space, people and wildlife continually share landscapes, though not necessarily by choice. This can lead to human-wildlife conflict, which has contributed to the extinction of some species, changes in ecosystem structure and function, and loss of human life, crops, livestock, and property (Nyhus, 2016). Typically, classically trained wildlife scientists have approached these challenges from the perspective of understanding wildlife behaviors, habitat selection and population dynamics. However, understanding the human dimensions is equally important, if not arguably more so in some cases, to achieve conservation success (Hughes et al., 2020a; Morehouse et al., 2020; Sibanda et al., 2021a).

Indeed, over the past decade scholarly works have increasingly focused on the human side of human-wildlife dynamics, using quantitative and qualitative methods to better understand people's values, experiences and actions relative to conservation objectives and outcomes (e.g., Bennett et al., 2017; Margulies and Karanth, 2018; Bhatia et al., 2021; Pooley et al., 2022; Stern and Humphries, 2022). An essential part of understanding these dynamic relationships is recognizing the variation between people and communities, which is shaped by the different socio-cultural, political, economic and environmental factors (Redpath et al., 2017; Hughes and Nielsen, 2019; Hughes et al., 2020b; Hill, 2021; Kimaro and Hughes, 2021; Morehouse et al., 2021; Rust et al., 2021). While this research has been helpful in guiding the efforts of conservation scientists to date, we propose that there needs to be more direct community engagement in research efforts in order to recognize, incorporate and hopefully address the complexities of culture and policy contexts surrounding conservation science (Freitag and Pfeffer, 2013; Elmeligi et al., 2016; Hughes and Nielsen, 2019). This can range from simple conversations with individuals to strategic consultation and engagement programs with specific groups, or in-depth participatory methods with whole communities (Salvatori et al., 2021). Indeed, as human-wildlife studies have evolved, more attention has been given to the need for inclusive and collaborative approaches that recognize the different ways of knowing and understanding how people value, perceive, experience and ultimately live with different wildlife species (Hughes and Nielsen, 2019; Morehouse et al., 2020; Sibanda et al., 2020).

However, adopting and implementing these approaches is often a difficult and complicated task, and can generally result in

longer timelines and increased research costs. Some challenges include building mutual respect, trust, and reciprocity between researchers and communities, which takes time, effort, and a healthy dose of skill (i.e., listening, facilitation, public participation techniques, etc.; Morehouse et al., 2020; Hughes et al., 2021). Also, qualitative methods can be overlooked or underappreciated by the more traditionally trained quantitative conservation scientists (Rust et al., 2017). Challenges also relate to the quality, credibility, and reliability of data gathered by community members, calling into question whether research results and recommendations are valid (Catlin-Groves, 2012; Gollan et al., 2012). Additionally, the cultural norms, beliefs, perspectives and biases that are shared (or not) by different communities can exacerbate these challenges, or even shed light on how to address them (Hill, 2021). Finally, while some scientists may not have training or feel comfortable working with people, which itself can be a barrier to effective community engagement, others are skeptical or even reluctant to engage with communities given personal or agency biases (Burgess et al., 2017; Hughes et al., 2022).

Despite these challenges, we strongly suggest that directly engaging with people in contextually meaningful ways throughout the research process is essential to developing socially-just and culturally-responsive conservation action (Vucetich et al., 2018; Armitage et al., 2019; Hughes and Nielsen 2019; Nie, 2002; Hughes et al., 2020b; Morehouse et al., 2021; Hughes et al., 2022). Here, we share our personal stories of engaging with communities on the unifying topic of grizzly bear (*Ursus arctos*) conservation, an often-contentious issue in Alberta, Canada. Our three stories provide examples of different forms of effective community engagement, and we highlight how our approaches were essential to our learning and achieving relevant conservation outcomes. However, our examples are not prescriptive; instead, we use them as a grounding point to offer some practical examples for conservation scientists to critically think about how they can more effectively engage communities in the research process. It is our hope that our case studies help illuminate a more holistic and applicable approach to human-wildlife dynamics and conservation outcomes, established on a foundation of strong community support and robust interdisciplinary science.

Case study 1: Social dimensions of grizzly bear (*Ursus arctos*) recovery

In this case study, Courtney explains the importance of engaging the community to understand their values, perspectives and experiences with grizzly bears, and what they see as the future for recovery efforts.

I have always been interested in human dimensions, and so when I began my study in Alberta, I was curious why human-

grizzly bear conflict persisted despite over 15 years of research informing their conservation and management. It became obvious that in order to identify and address the causes and deeply-rooted conditions of conflict, the human side of the equation - values, perspectives and experiences with grizzly bears - must be better understood (Hughes and Nielsen, 2019; Hughes et al., 2020a; Hughes et al., 2020b; Hughes et al., 2020c). Ultimately, my study sought a deeper understanding of what people really want for grizzly bear recovery and how to achieve these outcomes.

I employed a qualitative, social constructionist perspective integrated within the policy sciences framework. I engaged key informants to first understand the historic and current context of grizzly bear recovery and various aspects to human-bear conflict, and seek recommendations for participants in my study. I engaged 67 different community members who live alongside grizzly bears to share their first-hand narratives, across the provinces' grizzly bear management areas (Hughes and Nielsen, 2019). I visited people in their homes, on their farms, and in the forest, and learned about their values, perspectives and experiences with grizzly bears as well as their views on the decision-making and policy processes embedded in human-grizzly bear relationships (Hughes and Nielsen, 2019; Hughes et al., 2020c). Geographically, logistically and financially, this was challenging but necessary to understand the diverse dynamics between people and bears. I also encountered skepticism from the scientific community, relative to the meaningfulness or applicability of my qualitative methods for a "science-based" recovery policy. However, the participants and their voice were most important, and ultimately learning from people as we walked through their fields or sat at their coffee table enabled rich dialogue, built mutual appreciation and respect, addressed the lack of trust in researchers, and fostered lasting relationships (Hughes and Nielsen, 2019; Hughes et al., 2020c).

By engaging directly with people, and reciprocally sharing back information, updates and research findings, I learned that conflict really wasn't about how people value or experience grizzly bears per se, it was about peoples' unmet needs and unheard voices in decision-making and policy processes (Hughes et al., 2020c; Schroeder et al., 2020). Despite over a decade of grizzly bear science, recovery policy did not adequately account for what people valued and needed, yet policy-makers expected communities and individuals to adopt recovery policy. I learned that the people who live with bears want a seat at the decision-making table and have their different voices heard (Hughes and Nielsen, 2019). Recovery policy, and the processes in which people are engaged in determining outcomes, must therefore include and consider the people whom live with bears (Hughes and Nielsen, 2019; Hughes et al., 2020c). By engaging directly with people through my research, I could help make this critical component of human-

wildlife dynamics explicit - that people are central to conservation solutions.

In addition to using my findings to help inform Alberta's grizzly bear recovery policy, I developed important relationships with community members, building appreciation for and sharing knowledge between each other. As a result, our relationships helped to co-produce a population inventory for an understudied grizzly bear population in northwest Alberta, implement bear safety outreach, and design and implementation a local citizen science program called GrizzTracker (Hughes et al., 2021; Hughes et al., 2022). More broadly, my experiences engaging with a diversity of community members in applied research have been invaluable in informing other conservation projects at local and global scales (Morehouse et al., 2020; Fleury and Hughes, 2021; Kimaro and Hughes, 2021; Morehouse et al., 2021; Sibanda et al., 2021a).

Case study 2: Engaging trail users in grizzly bear management solutions

In this case study, Sarah discusses her approach to quantifying trail user perspectives in grizzly bear management by working with citizen scientists in Canada's busiest National Parks.

When I first started researching grizzly bears and recreationists in protected areas, my end goal was to conduct research studies whose final recommendations looped back to the impacted community and resulted in on-the-ground change that benefited bears and people. I quickly understood that involving local communities in my research would be essential to build a foundation of support for management options. I found interdisciplinary approaches that explored human-dimensions were just as critical to success as talking to the communities who, over generations, had developed their own unique relationships with these carnivores.

The Canadian Rocky Mountain National Parks of Banff, Jasper, Kootenay, and Yoho are visited by approximately five million people annually (Elmeligi, 2016). Managing grizzly bears in this landscape can be challenging; many visitors come to national parks to see grizzly bears (Richardson et al., 2014), but increasing human use can negatively impact grizzly bear population success (Gibeau et al., 2001). Management actions restricting human access are commonly applied to reduce the human impacts on ecological processes (Petersen, 2000), but are controversial as they may be perceived as restricting visitor freedom (Hall et al., 2010), and are frequently opposed by local residents and businesses (Richie et al., 2012).

I often heard concerns from stakeholders that travel restrictions would decrease visitor satisfaction to the extent that they would not return and would "tell all their friends never to come here." Yet, there was little to no data assessing the

validity of these statements. Understanding perspectives of trail users can inform management approaches that are likely to be supported, but most stakeholder consultations do not involve park users themselves. I targeted trail users' perspectives through an intercept survey, and worked with citizen scientists to disseminate the survey and assist with other aspects of the project. The trail user survey identified management options either supported or opposed by trail users, and acknowledged the competing demands faced by Park managers where recreation occurs in high-quality grizzly bear habitat. The survey results directly supported management options based on user needs, including closing the trail when a grizzly bear was in the area, limiting group sizes, and not allowing dogs on the trail. Trail users also displayed a voluntary willingness to change their recreational activities to prioritize grizzly bear habitat use and access (Elmeligi et al., 2021).

I also engaged 97 citizen scientists, and provided them with training to assist with trail camera deployment, trail user survey dissemination, and data entry. The number of citizen scientists seeking participation in my research demonstrated a strong desire to engage in grizzly bear research, and ultimately facilitated a comprehensive and robust data set, which greatly amplified and strengthened my project. Maintaining open communications with citizen scientists over two field seasons, ensuring they felt their time was well-spent and their contributions valued, was integral to my approach. I sent weekly project emails to all citizen scientists with progress updates and interesting results or photos from the remote cameras. At the end of each field season, all citizen scientists also received an online survey to provide feedback on their experience and offering a one-on-one debrief. Their input importantly shaped future engagement in training and scheduling around their needs. Engaging citizen scientists in my research provided enthusiastic community members an opportunity to contribute to conservation science, and share that enthusiasm with other trail users. Additionally, citizen scientists would engage in peer-to-peer conversations with other users at the trailhead, which led to broader discussions; these were conversations that I could not have had in the same way and offered important insights for my project.

Overall, by engaging with my community, park managers were provided with the social science data needed to make evidence-based management decisions, trail users were acknowledged for their values and needs, and citizen scientists were meaningfully engaged to build and contribute to local a grizzly bear research community that has continued to be involved in other grizzly bear conservation programs. There is a high level of individuality in bear behavior, which can make management challenging; by focusing management actions on human use rather than bears, some of the uncertainty around management effectiveness can be alleviated (Elmeligi et al., 2019).

Case study 3: Building trust and engaging communities in southwestern Alberta

In the following case study, Andrea describes how she worked to build trust and engage the community in a population estimate of threatened grizzly bears in southwestern Alberta.

When I began my grizzly bear population research in 2011, the most recent (2007) data estimated a grizzly bear population of 51 bears in southwestern Alberta and grizzly bears had recently (2010) been listed as a threatened species in the province (Alberta Grizzly Bear Inventory Team, 2008). However, area residents believed that number was low and did not match their experience with encountering grizzly bears (Quinn and Alexander, 2011), and communities were reporting increased sightings and conflicts (Loosen et al., 2014). The disconnect between local perceptions and provincial wildlife management had resulted in frustration within the local community. Further, I often heard community members express concerns about research fatigue; the historic communication between researchers and community members was lacking, which contributed to feelings of distrust when new researchers came in.

Where science and local perspective disagree, solutions to complex wildlife and ecological problems will be difficult (Clark, 2011). It was clear I had my work cut out for me in terms of providing updated grizzly bear abundance estimates using non-invasive genetic sampling of bear rub objects. Over half of my study area was private land and landowners were critical to my project (Morehouse and Boyce, 2016). Thus, to provide accurate information on grizzly bear numbers, I needed to engage with the community - if for no other reason than to secure access to my study area. However, the benefits ultimately went far beyond this. Landowners shared information regarding grizzly bear presence, habitat use, travel corridors and behaviors; provided continued land access; and assisted in the collection of hair samples. In the end, over 70 landowners and 4 livestock grazing co-operatives participated in the project. Indeed, the persistence of a sustainable grizzly bear population in southwestern Alberta is contingent on private lands; there simply is not enough public land in this region of the province to support the number of grizzly bears that live here.

As Stern and Humphries (2022) point out, the goal of independent data collection is not to validate local knowledge but rather to use both independent and local knowledge together to advance our understanding of the ecological system. By engaging the community, I was able to collect data across the entirety of the bear management area (i.e., public and private lands) as well as incorporate community experience into my data analysis. Over two years of field sampling (2013-2014), we identified 164 individual bears (Morehouse and Boyce, 2016).

Yet, our spatially explicit capture-recapture (SECR) models estimated an abundance estimate of 67.4 resident bears. To address this difference between detections and model-based abundance estimates, we also estimated the number of bears using the study area at some point each year by using traditional capture-recapture models; this number was much larger, 172 bears (Morehouse and Boyce, 2016). Together, these two estimates helped to reconcile some of the discrepancies between model-based abundance estimates and community perceptions of the bear population. Either one on its own does not tell the complete story, but together they make sense from both a community perception perspective and a mathematical perspective. Had I not been so engaged with the community, I may not have analyzed the data in multiple ways, which ultimately would have been a disservice to the advancement of grizzly bear conservation in Alberta.

I worked extensively with local communities from the inception of the project to ensure that they were engaged and informed of all project activities, which helped to build trust and project credibility. For example, I gave 55 public presentations between January 2012 and March 2016 and wrote personalized letters to each participating landowner and leaseholder at the end of each field season that included results specific to their property. No doubt, these efforts took a significant amount of time. Further, as an introvert, having to reach out and connect with people that were initially strangers, was a huge step outside of my comfort zone. However, my research and understanding of grizzly bear ecology has benefited tremendously from my engagement with the community. By engaging with the community, I was able to better target my field sampling, increase my hair collection sample size, and explore other research questions. Indeed, one of the published papers resulting from this research was a direct result of a question raised by a landowner during a public presentation (Morehouse et al., 2016). Further, I have continued to work in the area and have recently completed additional research projects in direct collaboration with community members that would not have been possible without a foundation of trust (e.g., Morehouse et al., 2020; Morehouse et al., 2021).

Discussion

While it is well known that the field of conservation science has historically provided extensive biological information on wildlife, there is increasing recognition that conservation problems are often social in nature (Soulé 1985; Bennett et al., 2017; Hughes and Nielsen, 2019). Mainstream conservation science that was informed solely by biological or ecological sciences may not acknowledge the integral role people play in conservation outcomes (Peterson et al., 2019; Hughes et al., 2021). Ensuring community support for management approaches can start with meaningful engagement of people in

scientific research and conservation decision-making, something that is often lacking despite multiple different approaches that can be tailored to specific communities (Bennett et al., 2017). We present what we see and have experienced as common barriers to community engagement and suggest potential solutions to inform human-wildlife dynamics, and in turn, produce better conservation outcomes.

Barriers to engagement

Engaging communities in the research process explicitly recognizes that the values of people who have a stake in the issues are an important component to successful wildlife conservation (Hughes, 2018; Wallace et al., 2002). However, even when the importance of community engagement is recognized, a variety of barriers can hinder effective implementation of community engagement. Examples of such barriers include:

- Biases, misgivings or misunderstandings entrenched within traditional western scientific paradigms of what constitutes conservation science
- Differing opinions on who should do research and what defines rigorous results
- Disagreements on the best way to communicate and share results, and define best management practices.
- Uncertainty on how to approach communities
- Lack of institutional support for spending time and resources on community engagement
- Hesitancy by researchers to step outside their comfort zone (e.g., researchers may feel uncomfortable approaching and working with community members)
- Distrust between agencies and/or their staff and communities and/or data collected by communities.
- Difficulties in obtaining funding to engage communities in research efforts or to conduct interdisciplinary research projects because it does not align with a predefined disciplinary category (e.g., either biological or social sciences).

These barriers can feel challenging or daunting to overcome. In the paragraphs that follow, we provide ideas and suggestions for moving forward.

Solutions to engagement: A changing paradigm

Wildlife science is a continually evolving body of knowledge and understanding. What we once considered appropriate management actions (e.g., allowing bears to feed at garbage dumps in Yellowstone National Park) are now explicitly avoided

(Biel, 2006). This is an example of the ability of our field to shift thought paradigms in ways that directly and comprehensively change management approaches. As conservation scientists, we have come to appreciate that working with communities is essential. We do believe a paradigm shift is already underway, where biological and social sciences formerly operating in silos are now integrating multiple, innovative methods to explore, examine and understand human-wildlife dynamics more holistically. It certainly appears that collectively, conservation scientists have come to appreciate that engaging communities in the broadest sense possible is a more productive and meaningful way to address complex conservation challenges.

Building on this paradigm shift, we also believe that effective and meaningful community engagement can enhance research robustness and applicability in a continually changing world. We therefore suggest it is fundamental that researchers understand the contextual differences between communities and design engagement approaches accordingly, as we have illustrated by sharing our case studies. While we focused on grizzly bear conservation, our approaches differed not only according to our research questions but also the communities, their needs, and how best to understand their perspectives and elicit this information. Our goal is not to advocate for one particular method, but rather to encourage scientists to approach their research problem with flexibility and an open mind, then consider how effectively and meaningfully engaging with the community could contribute to and enhance their research in new ways.

Community engagement is not a cookie cutter approach, and scientists may need to think outside the box and embrace fluidity in working with communities (e.g., Maund et al., 2020; Hughes et al., 2021). In many cases, there are issues of trust between landowners, stakeholders, and government, rooted in historical contexts that can be complex and take time and sensitivity to navigate. We suggest then, that effective community engagement requires actively working with communities throughout all stages of the research process, from design to implementation and communication of results (Redpath et al., 2017; Sibanda et al., 2021b). Doing so can help cultivate more transparent, trusting relationships between scientists and communities. Practically, we also suggest that meaningful engagement could lead to conservation policies that are more likely to be accepted and implemented, rather than resisted or opposed.

Finally, we acknowledge that working in non-western cultures can present some additional considerations, despite our case studies occurring within a western science framework. For example, other cultures might have different ways of sharing information (e.g., oral stories, art) that might not fit well within standard western formats (e.g., written reports) or within typical timelines (e.g., fiscal-year-based grant cycles; Stoney Nakoda Consultation Team, 2022). By focusing solely on western science processes to inform research, we limit our understanding of

human-wildlife dynamics (and everything else; Berkes, 2005; Snow, 2005). With any community, it is important to develop effective communication that can efficiently and appropriately share information and ideas between researchers and community members, with respect and appreciation. There is no one-size-fits-all method to working with communities; the approach chosen needs to resonate with the community.

Guidelines for moving forward

Taking our case studies, the possible barriers to engaging communities, and some potential solutions to these barriers, we propose a series of guiding ideas we believe are fundamental to effective engagement. These are not meant to be an exhaustive list of “do’s and don’ts”; rather, we intend to provoke thoughtful consideration by conservationists of what effective community engagement might look like in their own research. We also recognize that a single individual might not have the necessary skill set to tackle these issues independently; as with most things in science, partnerships are essential. Building a research team that brings together different skill sets and areas of expertise can help ensure a more robust approach regardless of the question being asked (e.g., Morehouse et al., 2020; Sibanda et al., 2021a).

- Seek to deeply understand your community to determine how your research fits into community issues (e.g., how will your research relate to community events, concerns, or things community members care about). Ask the community for their thoughts on your proposed research.
- Select the most appropriate theoretical and methodological approaches to meet your research needs. Consider what approaches will resonate most with your community. Embrace flexibility and be adaptable to altering your approaches based on what you learn along the way.
- Check your biases and assumptions. Do your best to enter your community with an open mind. Listen rather than assume. Be willing to admit when you are wrong, and adjust your approach accordingly.
- Create and implement a community communication strategy or plan as part of your research process. This can be as simple or complex as your capacity allows. Ask your community for feedback, communicate research results and progress, share successes with community members, and broadly distribute project results.
- Build in time and funding into the overall research work plan to help ensure community engagement is a priority. Honor commitments you make to your community, as well as your funders.
- Appreciate your community and acknowledge their contributions to your research.

Closing statements

Regardless of research objectives, community engagement and interdisciplinary approaches strengthen wildlife science and improve relationships, thereby increasing support for management recommendations stemming from scientific research. As professional researchers, we should embrace the challenge of working with communities recognizing that we can gain so much more than we invest. All three of us believe that we are better scientists because we effectively engage with the communities in which we work. Each of our research projects took new directions that we would not have thought of if we did not work with our respective communities. These changes may have felt challenging at the time, but our research results were more robust and management recommendations more applicable. As we each live in different parts of Alberta and conducted different grizzly bear-related research projects, we inherently applied different approaches. In truth, we are three very different women, with different skill sets, working in three very different communities, but we have all come to appreciate our local communities and their contributions to our research.

In order to yield results that are meaningful for wildlife and people, people must be included. Human-wildlife dynamics are about peoples' relationships with the wildlife they share the landscape with, so they must be part of the solution. As we have shared in our stories, that engagement can take a wide variety of forms. We challenge each of our colleagues to join us, and others, in this paradigm shift in how human-wildlife research is conducted and applied. We must embrace the differences in and across communities, listen, be responsive and flexible, and work together. When we work together, we are enabled to see the forest for the trees, and address the bigger issues that drew us to this profession in the first place.

References

- Alberta Grizzly Bear Inventory Team (2008). "Grizzly bear population and density estimates for Alberta bear management unit 6 and British Columbia management units 4-1, 4-2, and 4-23 (2007)," in *Report prepared for the Alberta sustainable resource development, fish and wildlife division, British Columbia ministry of forests and range, British Columbia ministry of environment, and parks Canada* (Alberta: Government of Alberta).
- Armitage, D. P., Mbatha, E. K., Muhl, W.R., and Sowman, M. (2019). Governance principles for community-centered conservation in the post-2020 global biodiversity framework. *Conserv. Sci. Pract.* 2, e160. doi: 10.1111/csp2.160
- Bennett, N. J., Roth, R., Klain, S. C., Chan, K., Christie, P., Clark, D. A., et al. (2017). Conservation social science: Understanding and integrating human dimensions to improve conservation. *Biol. Conserv.* 205, 93–108. doi: 10.1016/j.biocon.2016.10.006
- Berkes, F. (2005). "Traditional ecological knowledge," in *Encyclopedia of religion and nature*, vol. 2. Ed. E. Bron Taylor (Continuum International), 1646–1649. Available at: www.religionandnature.com/ern.
- Bhatia, S., Redpath, S. M., Suryawanshi, K., and Mishra, C. (2020). Beyond conflict: exploring the spectrum of human-wildlife interactions and their underlying mechanisms. *Oryx* 54 (5), 621–628. doi: 10.1017/S003060531800159X
- Bhatia, S., Suryawanshi, K., Redpath, S. M., and Mishra, C. (2021). Understanding people's responses toward predators in the Indian Himalaya. *Anim. Conserv* 24, 421–424. doi: 10.1111/acv.12647
- Biel, A. (2006). *Do (Not) feed the bears* (Lawrence, KS, USA: University Press of Kansas).
- Burgess, H. K., DeBey, L. B., Froehlich, H. E., Schmidt, N., Theobald, E. J., Ettinger, A. K., et al. (2017). The science of citizen science: Exploring barriers to use as a primary research tool. *Biol. Conserv.* 208, 113–120. doi: 10.1016/j.biocon.2016.05.014
- Catlin-Groves, C. L. (2012). The citizen science landscape: From volunteers to citizen sensors and beyond. *Int. J. Zool.* 1–14. doi: 10.1155/2012/349630
- Clark, S. G. (2011). *The policy process: a practical guide for natural resource professionals* (New Haven, Connecticut, USA: Yale University Press).
- Elmeligi, S. (2016). *Grizzly bear management in Canada's rocky mountain parks: Balancing visitor experience with bear habitat requirements* (Gladstone, QLD, AU: Central Queensland University).
- Elmeligi, S., Finn, S., Nevin, O., and Convery, I. (2016). "Citizen science and the perceptions of nature," in *Shifting interpretations of nature*. Eds. I. Convery and P. Davis (Woodbridge: Boydell & Brewer).

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

Author SE was employed by the company Sarah E Consulting.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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- Elmeligi, S., Nevin, O., and Convery, I. (2019). "Reducing uncertainty in bear management," in *The bear: Culture, nature, heritage*. Eds. O. Nevin, I. Convery and P. David (Woodbridge: The Boydell Press).
- Elmeligi, S., Nevin, O., Taylor, J., and Convery, I. (2021). Visitor attitudes and expectations of grizzly bear management in the Canadian rocky mountain national parks. *J. Outdoor Recreation Tourism* 361–11. doi: 10.1016/j.jort.2021.100444
- Fleury, G., and Hughes, C. (2021). *An educational video game to foster coexistence: Operation Ferdinand*. CDPNews. Winter, 39–43.
- Freitag, A., and Pfeffer, M. J. (2013). Process, not product: Investigating recommendations for improving citizen science 'Success'. *PLoS One* 8 (5), e64079. doi: 10.1371/journal.pone.0064079
- Gibeau, M. L., Herrero, S., McLellan, B. N., and Woods, J. G. (2001). Managing for grizzly bear security areas in banff national park and the central Canadian rocky mountains. *Ursus* 12, 121–129.
- Gollan, J., de Bruyn, L.L., Reid, N., and Wilkie, L. (2012). Can volunteers collect data that are comparable to professional scientists? a study of variables used in monitoring the outcomes of ecosystem rehabilitation. *Environ. Manage.* doi: 10.1007/s00267-012-9924-4
- Hall, T. E., Seekamp, E., and Cole, D. (2010). Do recreation motivations and wilderness involvement relate to support for wilderness management? a segmentation analysis. *Leisure Sci.* 32, 109–124. doi: 10.1080/01490400903547096
- Hill, C. M. (2021). Conflict is integral to human-wildlife coexistence. *Front. Conserv. Sci.* 2. doi: 10.3389/fcosc.2021.734314
- Hughes, C. (2018). *The importance and influence of the human dimensions in grizzly bear (Ursus arctos) conservation* (University of Alberta).
- Hughes, C., Foote, L., Yarmey, N. T., Hwang, C., Thorlakson, J., and Nielsen, S. (2020b). From human invaders to problem bears: a media content analysis of grizzly bear conservation. *Conserv. Sci. Pract.* 2, e176. doi: 10.1111/csp.2.176
- Hughes, C., Frank, B., Melnycky, N. A., Yarmey, N. T., and Glikman, J. A. (2020a). From worship to subjugation: Understanding stories about bears to inform conservation efforts. *Ursus* 2020 (31e15), 1–12. doi: 10.2192/URSUS-D-19-00002.2
- Hughes, C., and Nielsen, S. E. (2019). 'Bears are only the lightning rod': Ongoing acrimony in alberta's grizzly bear recovery. *Soc. Natural Resour.* 32 (1), 34–52. doi: 10.1080/08941920.2018.1502853
- Hughes, C., Steenweg, R. J., Vander Vennen, L. M., Melnycky, N. A., Fullerton, L., Witiw, J. T., et al. (2021). Working together for grizzly bears: A collaborative approach to estimate population abundance in Northwest Alberta, Canada. *Front. Conserv. Sci.* 2. doi: 10.3389/fcosc.2021.719044
- Hughes, C., Tremblett, K., Lee, T. A., Kummer, J., and Duke, D. (2022). How to do citizen science better? a case study evaluating grizzly bear citizen science using *Principles of good practice* in Alberta, Canada. *Animals* 12 (99)1068. doi: 10.3390/ani12091068
- Hughes, C., Yarmey, N., Morehouse, A., and Nielsen, S. (2020c). Problem perspectives and grizzly bears: A case study of alberta's grizzly bear recovery policy. *Front. Ecol. Evol.* 8. doi: 10.3389/fevo.2020.00038
- Kimaro, M. H., and Hughes, C. (2021). Conditions of conflict: exploring pastoralist resettlement in relation with African lion conservation. *Soc. Natural Resour.*
- Loosen, A., Manners, N., and Morehouse, A. (2014). *Large Carnivore attractant management projects in southwestern Alberta 2008-2012* (Alberta Canada: Waterton Biosphere Reserve).
- Margulies, J., and Karanth, K. K. (2018). The production of human-wildlife conflict: a political animal geography of encounter. *Geoforum* 95, 153–164. doi: 10.1016/j.geoforum.2018.06.011
- Maud, P. R., Irvine, K. N., Lawson, B., Steadman, J., Risely, K., Cunningham, A. A., et al. (2020). What motivates the masses: Understanding why people contribute to conservation citizen science projects. *Biol. Conserv.* 246. doi: 10.1016/j.biocon.2020.108587
- Morehouse, A. T., and Boyce, M. S. (2016). Grizzly bears without borders: spatially explicit capture-recapture in southwestern Alberta. *J. Wildl. Manage.* 80, 1152–1166. doi: 10.1002/jwmg.21104
- Morehouse, A. T., Graves, T. A., Mikle, N., and Boyce, M. S. (2016). Nature vs. nurture: Evidence for social learning of conflict behaviour in grizzly bears. *PLoS One*. doi: 10.1371/journal.pone.0165425
- Morehouse, A. T., Hughes, C., Manners, N., Bectell, J., and Bruder, T. (2020). Carnivores and communities: a case study of human-carnivore conflict mitigation in southwestern Alberta. *Front. Ecol. Evol.* doi: 10.3389/fevo.2020.00002
- Morehouse, A. T., Hughes, C., Manners, N., Bectell, J., and Tigner, J. (2021). Dealing with deadstock: a case study of carnivore conflict mitigation from southwestern Alberta. *Front. Conserv. Sci.* 2. doi: 10.3389/fcosc.2021.786013
- Nie, M. A. (2002). Wolf recovery and management as value-based political conflict. *Ethics Place Environ.* 5, 65–71.
- Nyhus, P. J. (2016). Human-wildlife conflict and coexistence. *Annu. Rev. Environ. Resour.* 41, 143–171. doi: 10.1146/annurev-environ-110615-085634
- Petersen, D. (2000). Grizzly bears as a filter for human use management in the Canadian rocky mountain national parks. *USDA For. Serv. Proc.* 5, 354–361.
- Peterson, M. N., von Essen, E., Hansen, H. P., and Peterson, T. R. (2019). Shoot shovel and sanction yourself: Self-policing as a response to wolf poaching among Swedish hunters. *Ambio* 48, 230–39. doi: 10.1007/s13280-018-1072-5
- Pooley, S., Bhatia, S., and Vasava, A. (2020). Rethinking the study of human-wildlife coexistence. *Conserv. Biol.* 35 (3), 784–793. doi: 10.1111/cobi.13653
- Pooley, S., Linnell, J. D. C., Münster, U., van Dooren, T., and Zimmermann, A. (2022). Editorial: Understanding coexistence with wildlife. *Front. Conserv. Sci.* doi: 10.3389/fcosc.2022.830971
- Quinn, M., and Alexander, S. (2011) *Final survey report: Carnivores and communities in the waterton biosphere reserve*. Available at: http://www.watertonbiosphere.com/uploads/biosphere-resources_18_3002098588.pdf (Accessed March 2022).
- Redpath, S. M., Linnell, J. D. C., Festa-Bianchet, M., Boitani, L., Bunnefeld, N., Dickman, A., et al. (2017). Don't forget to look down—collaborative approaches to predator conservation. *Biol. Rev.* 92. doi: 10.1111/brv.12326
- Richardson, L., Rosen, T., Gunther, K., and Schwartz, C. (2014). The economics of roadside bear viewing. *J. Environ. Manage.* 140, 102–110. doi: 10.1016/j.jenvman.2014.01.051
- Richie, L., Oppenheimer, J. D., and Clark, S. G. (2012). Social process in grizzly bear management: lessons for collaborative governance and natural resource policy. *Policy Sci.* 45, 265–291. doi: 10.1007/s11077-012-9160-z
- Rust, N. A., Abrams, A., Challender, D. W. S., Chapron, G., Ghoddousi, A., Glikman, J. A., et al. (2017). Quantity does not always mean quality: The importance of qualitative social science in conservation research. *Soc. Natural Resour.* doi: 10.1080/08941920.2017.1333661
- Rust, N. A., Rehackova, L., Naab, F., Abrams, A., Hughes, C., Merkle, B. G., et al. (2021). What does the UK public want farmland to look like? *Land Use Policy* 106, 105445. doi: 10.1016/j.landusepol.2021.105445
- Salvatori, V., Balian, E., Blanco, J. C., Carbonell, X., Ciucci, P., Demeter, L., et al. (2021). Are large carnivores the real issue? solutions for improving conflict management through stakeholder participation. *Sustainability* 13, 4482. doi: 10.3390/su13084482
- Schroeder, S. A., Landon, A. C., Fulton, D. C., and McInenly, L. E. (2020). Social identity, values and trust in government: how stakeholder group, ideology, and wildlife value orientations relate to trust in a state agency for wildlife management. *Biol. Conserv.* 261. doi: 10.1016/j.biocon.2021.109285
- Sibanda, L., Hughes, C., van der Meer, E., Macdonald, D. W., and Loveridge, A. (2021b). *Better late than never: a case-study using diffusion of innovation theory to understand adoption of a human-lion conflict intervention* (Carnivore Damage Prevention News). Available at: https://www.protectiondestroupeaux.ch/fileadmin/doc/International/CDP_and_General_Infos/CDPNews22_July2021.pdf.
- Sibanda, L., van der Meer, E., Hughes, C., Macdonald, E. A., Hunt, J. E., Parry, R. H., et al. (2020). Exploring perceptions of subsistence farmers in northwestern Zimbabwe towards the African lion (Panthera leo) in the context of local conservation actions. *Afr. J. Wildl. Res.* 50 (1), 102–118. doi: 10.3957/056.050.0102
- Sibanda, L., van der Meer, E., Johnson, P. J., Hughes, C., Dlodlo, B., Parry, R. H., et al. (2021a) Evaluating the effects of a conservation intervention on rural farmers' attitudes toward lions. *Hum. Dimens. Wildl.* doi: 10.1080/10871209.2020.1850933
- Snow, C. J. (2005). *These mountains are our sacred places: The story of the stoney people* (Calgary, Alberta: Fifth House Ltd).
- Soulé, M. E. (1985). "What Is Conservation Biology?" *BioScience* 35 (11), 727–34. doi: 10.2307/1310054
- Stoney Nakoda Consultation Team (2022). *Enhancing the reintroduction of plains bison in banff national park through cultural monitoring and traditional knowledge: Final report and recommendations* (Morley, AB: Stoney Nakoda Tribal Administration), 104 pp.
- Syern, E. R., and Humphries, M. M. (2022). Interweaving local, expert, and indigenous knowledge into quantitative wildlife analyses: A systematic review. *Biol. Conserv.* 26. doi: 10.1016/j.biocon.2021.109444
- Vucetich, J. A., Burnham, D., Macdonald, E. A., Bruskotter, J. T., Marchini, S., Zimmermann, A., et al. (2018). Just conservation: What is it and should we pursue it? *Biol. Conserv.* 221, 23–33. doi: 10.1016/j.biocon.2018.02.022
- Wallace, R. L., Clark, T. W., and Richard, P. (2022). Reading, eds. *An interdisciplinary approach to endangered species recovery: Concepts, applications, cases*. (the University of Michigan: School of Natural Resources and Environment),