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Women in human-wildlife dynamics 2021

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Women in human-wildlife dynamics: 2021

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Editorial: Women in human-wildlife dynamics: 2021

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Editorial on the Research Topic
Women in human-wildlife dynamics: 2021

Fewer than a third of the world's researchers identify as women (Marescotti et al., 2022). Historical and on-going biases, gender stereotypes and other barriers discourage women from entering science-related fields. Barriers come in all shapes and sizes and may often be unintended. Recent research by Huang et al. (2020) has revealed an increasing gender-based gap in publications, associated with high rates of career drop-outs among women. Eagly (2020) expands on this to consider the unequal impact of parenthood, the higher proportion of women in teaching roles within academia (where teaching productivity is typically inversely related to research productivity), and the issue of disproportionate access to (or bias against) internal and external funding, laboratory space, and other resources faced by women researchers. Outside of research, women in conservation face equivalent challenges to career progression and equality in this profession (Jones and Solomon, 2019). Focusing on the conservation field of human-wildlife dynamics (HWD), this special issue provided a platform to better understand the roles and challenges for women in HWD as:

- community members and/or leaders living with wildlife;
- practitioners and/or researchers working with others who live with wildlife;
- advocates, educators, artists and/or innovators for people and wildlife.

We invited formats such as storytelling narratives, and biographies which do not easily conform to scientific publishing. However, this facilitated more personal and professional insights into authors' experiences within the field of human-wildlife dynamics, which are largely invisible in empirical research. Guidance on reviewing atypical article types is rare within the natural science literature (but see Byrne, 2016) and we are extremely grateful to our reviewers in this process. Here are the highlights of the 'Women in Human-Wildlife Dynamics" series of article collection

Women as professionals, mentors and volunteers in human-wildlife interventions

Almuna et al. share in their opinion piece their role as female professionals and facilitators in situations that address human-wildlife dynamics in rural landscapes of Chile. They compare their experiences across regions in Chile and emphasize the need for a gender-balanced perspective in conservation. Sheherazade et al. share their lessons learned in woman-to-woman mentorship in Indonesia. While the perspectives that authors share is based on their own experiences, the community case study article compares these experiences with the broader literature on mentor- and leadership. In Namibia, Marker et al., use the Cheetah Conservation Fund's long-standing volunteer programme to highlight a substantial gender-bias in the volunteering sector, at least for this conservation organisation. Although this bias appears in favour of women, this skewed representation unlikely favours women in conservation. Participants in Marker et al.'s survey revealed challenges they've faced in their career, namely their personal safety and credibility, and the integral role that volunteering has played for them in gaining employment. They emphasize the financial implications and barriers that this poses to future conservationists including the high risk that women without the financial means to undertake voluntary work may result in them being excluded from conservation.

Women as practitioners and community members

In Mongolia and India, Alexander et al. draw from their knowledge and experience in snow leopard conservation to describe the roles and responsibilities of women in livestock management and agriculture, and how those intersect with biodiversity conservation and ecosystem management. The case studies showcase how community-based conservation often builds on existing community structures and social norms, which often neglects women's roles, rights and decision-making power on biodiversity conservation. In parallel, Akayezu et al. investigated the effectiveness of tourism revenue in counterbalancing unsustainable resource use in Rwandan forest communities. These authors draw to our attention the importance of gendered community roles and the different functions that men and women play in activities of conservation concern, meaning that a more nuanced approach to conservation initiatives are likely to be more impactful. Leong et al. raise a similar concern with regards to stakeholder views on bat conservation in Singapore. Although none of these authors set out to explore the role of gender in human-wildlife dynamics specifically, their findings regarding gender inequality and gender-based differences in roles or impacts, highlight the need for more focused research in this area.

Women at the interface of wildlife trade, recreation and governance

In her contribution, Davis focuses on women's roles in illegal wildlife trade in Southeast Asia, with a specific lens on social drivers and processes of hunting and consumption of wildlife. While women play a fundamental role in Southeast Asia resident matrilineal and bilateral societies and can be fundamental in initiating change in conservation practices, their role is often overlooked in research. Green et al. reviewed 40 case studies from 34 countries on community-based approaches that target illegal wildlife trade of *Felidae* species. Based on a 'Theory of Change' framework, they synthesized approaches, successes, challenges and recommendations for community action on illegal wildlife trade.

In regard to governance and law enforcement, Sommerville et al. provide a community case study of activities to increase women's effective participation in wildlife in Zambia. The case study highlights that proactive steps to include and empower women in terms of wildlife governance and benefit-sharing yield improvements in terms of representation, access and in the sharing of benefits. Likewise, in a north American context, Rizzolo et al. researched visitors' recreational patterns in wildlife refuges in the United States and showcase how changes in consumptive activities regulation can cause differential and inequitable impacts on different groups of people participating in nature-based activities. Understanding how subgroups of visitors may respond to regulatory changes, especially women, is therefore important to avoid the displacement or alienation of such groups from visiting a site.

As an all-women editorial team, the need for patience, support and understanding was an unspoken agreement as we each battled to balance elusive work-life balance and carving out time for this voluntary editorial work. We are therefore thrilled to see this collaboration culminate in a collection of ten excellent articles for this Research Topic.

The authors' diverse perspectives on gender equality in HWD and conservation highlight the complexity of the topic. Effective policies and practices require empirical data and practitioner insights regarding what works and what does not (Sutherland, 2022). We call on researchers, practitioners, and policymakers to prioritize gender equality in conservation and collaborate to implement evidence-based solutions.

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 KW-T was employed by company Toitu Envirocare.

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Critical research gaps in understanding Southeast Asian women's wildlife trade and use practices

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The hunting and consumption of wildlife is a global practice with practices that are socially nested, mediated, and shared across social categories, including gender. Research into wildlife trade increasingly recognizes the importance of understanding and investigating social drivers and processes of hunting and consumption. However, studies of social norms, motivations, and actions specific to women are still lacking within wildlife trade literature, particularly within Southeast Asia. Women are central to how a society operates and to societal practices, and they are fundamental actors in initiating change in these practices. In Southeast Asia, women are especially powerful actors within resident matrilineal and bilateral societies. This article will reflect on wildlife trafficking through the roles and activities of women. While women's narratives are lacking across all current wildlife trade research, I will highlight in this article critical research gaps, gender-specific issues in methodology, and important research opportunities.

KEYWORDS

gender, Southeast Asia (SEA), illegal wildlife trade, wildlife consumption, poaching, kin networks

Introduction

The trade and consumption of wildlife are universal practices, engaged in by human actors across genders, societies, social strata, and geography. These practices can be sustainable, but a recognized driver of biodiversity loss is the global illegal and/or unsustainable trade in wildlife (Fukushima et al., 2021). In Southeast Asia[1], high biodiversity dovetails with illegal and/or unsustainable wildlife trade and consumption (hereafter IUWT) (e.g. Jiao et al., 2021; Nuttall et al., 2022). Much of this trade and consumption begins and ends within Southeast Asia (Blair et al., 2017), but some poaching and trade is intended to supply demand in China (van Uhm and Wong, 2021).

1 "Southeast Asia" refers to the following 11 countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Est, and Vietnam.

On a global scale, Southeast Asian demand is also an important driver of population declines of species in Africa (e.g. Nguyen and Roberts, 2020). While IUWT is becoming increasingly well-documented in this region, important research gaps exist. One of these is a gender gap in understanding- and addressing-women's[2] role in IUWT. This is important because IUWT is a continual process of social change (e.g. Van Kirk, 1983): actors enter and exit into the trade as poachers, traders, or consumers, according to complex social and contextual factors, including those mediated by gender (e.g. Dwyer and Minnegal, 2010). Preferences for wild products temporally fluctuate across this complex landscape of factors, and by extension, so do the specific mechanics of the trade itself (e.g. Nijman et al., 2019). Identifying and describing gender-specific motivations and practices represent an opportunity for understanding this particular landscape of social change, and shifting changing practices positively for conservation's ends.

Because there is a paucity of information on this issue within Southeast Asia, this article is not a formal review of available literature on this topic (although most, if not all, of the available published English-language literature is included here). Instead, I present some examples of the roles women can (and do) fill in IUWT, research gaps in understanding these roles, and suggestions for changes towards effective data collection and conservation practice. This article is not the first to call for more nuance in understanding gender-specific differences in the use of wildlife in general (see for example Margulies et al., 2019), and is not the first to focus entirely on research gaps in understanding women's role in wildlife trafficking (see the work of Agu and Gore (2022) and McElwee (2012)); however, this article is the first to present a synthesized roadmap of gaps and opportunities in IUWT research conducted within the Southeast Asian region. I have also aimed in this article to acknowledge women's complexities by highlighting poor methods for gathering women-specific information. Poor methods may influence IUWT research to focus on men over women, out of misplaced belief that men are more active participants in IUWT. Whether men are indeed more active participants in IUWT is an open question that has not been adequately addressed in many IUWT contexts. However, we can suspect that both men and women may be equally active in different ways; for example, Nana (2022) points out that men are most likely to be criminalized for poaching in Cameroon, but women do not receive the same penalties, and are the most active actors in selling bushmeat. This complexity is discussed further within this article.

This article is a direct call to action to place women more firmly and centrally in scientific and practical considerations of the complex issues that drive IUWT in Southeast Asia. Ardener (1985) noted the propensity of social scientists to declare that they "do not study women", with little recognition that the study of any linguistically, geographically, and demographically demarcated group of people will constitute study of women. One can make a strong argument that this same research blindness exists in IUWT research (e.g. Agu and Gore, 2022).

The focus of this article is to present examples of women's roles in IUWT in Southeast Asia, situated within anthropological and sociological work around broader topics that can illuminate potential research paths (e.g., the roles of women in domestic and international trade within Southeast Asia). Through this process, I illustrate gaps in current research, and suggest some changes in research practices to best address these issues, as well as the uptake of conservation interventions designed to address these issues.

A theory that will underpin the arguments made in this article is Appadurai (1988) theory of commodities as "thoroughly socialized things"; i.e., as objects engaged with by diverse social actors in correspondingly diverse ways, attributed with culturally, socially, and even demographically-specific meaning. As such, one can theorize that women may potentially engage with wildlife products as commodities differently from their male counterparts, according to gender-specific differences in social structure, kinship (e.g. Dube, 1997), and biology (e.g., women with vaginas are unlikely to use a wildlife product to treat erectile dysfunction).

Behavior change is the conservation practice mainly referred to in this article, to illustrate deficiencies in research that can hamper the success of the implementation of conservation interventions to curb IUWT. Other conservation interventions will be described, where appropriate. Behavior change is used as the primary conservation touchpoint for this article because understanding and engaging with women is argued to be essential for the success of behavior change and other human-focused conservation strategies (e.g. Davis et al., 2020; Agu and Gore, 2022).

"A women's place" in Southeast Asia

The historic societal structures of Southeast Asian countries offer a compelling foundational argument for the value of understanding socially-grounded, women-specific influences on individual action. Across the countries of Southeast Asia, societies tend towards matrilineality and bilaterality (Dube, 1997). Some characteristics of *matrilineality* are where women receive and control property rather than men, men move into their wife's household rather than vice versa, and women have a

2 "Women" here refers to any individual who would be treated and viewed as such in societies in Southeast Asia. This historically encompasses individuals regardless of the individual's "biological sex". "Female" will also be used under the same definition, in certain sections of this article where the more common term within the literature is "female", e.g. "female social networks".

stronger influence within their society as a whole (Dube, 1997). Characteristics of *bilaterality* include property being split equally, married couples moving equally into either the male or female's family, and genders equally holding power and agency (Dube, 1997). Some scholars have argued for the influence of Chinese patrilineality within Southeast Asia, but convincing evidence has shown the enduring power of matrilineality and bilaterality (e.g. Whitmore, 1984). Southeast Asian men may claim their societies are patrilineal/patriarchal (*pers. obs.*), but consultation of the literature- or indeed, even limited ethnography within Southeast Asian countries- will show that this is hopeful speculation on the part of Southeast Asian men. In the context of kin, Dube (1997) notes the commonality of bilaterality across Southeast Asia, with households individually choosing which kin networks (husband or wife) they will become part of, versus patrilineal societies where women must always join their husband's kin. Men have a noted lack of control over women in Southeast Asia; vice versa, women can have extraordinary control over one another (Dube, 1997). Dube (1997) notes that throughout Southeast Asia men often are simply "interlopers" into "female clans", i.e., kin networks. Within these female clans, older females especially have immense agency and authority that they cultivate as they age. Rather than cultivating agency and authority in spite of restrictive societal ideals, Southeast Asian society encourages a "class" of strong women to influence and shape attitudes, norms, and practices. Plentiful research shows that regardless of economic status or situation, women in Southeast Asia can and do have ample agency and power within their families, communities, and society as a whole (Dube, 1997; Leshkowich, 2014; Akter et al., 2017 Papanek, 1975, Walker, 1999; Turner, 2010; Yokoyama, 2010; Tan, 2013). These powerful actors can, in turn, shape patterns of IUWT across Southeast Asia.

Women as physical actors

One conservation focus is on poaching as the driver of biodiversity decline, and poaching appears to be dominated by men (e.g. Nijman et al., 2017; Lunstrum and Givá, 2020). Women appear to be more constrained to the "home" and the duties within, while men appear to be more active in the forest, since they seem to be more likely to hunt (e.g. Murdock and Provost, 1973). However, women frequently enter spaces where they interact with wildlife; women work on rice fields, where wildlife is present (Villamor et al., 2015), and have the potential to be active participants in setting snare traps around field boundary edges (with one intent of limiting crop raiding by wildlife). In addition, while women may not be typical poachers with camping gear, guns, and snares (although we can note that no studies in Southeast Asia have researched whether women do poach in this manner), they may influence poaching in other ways. In their reviews of women's role in wildlife trade in Africa and Europe, Agu and Gore (2020, 2022) summarized the different roles women have been found to play, from practical administrative roles in poaching syndicates (Hübschle, 2014) to more subtle "encouragement" of their male kin and connections who are engaged in poaching (Sundström et al., 2020). Women from forest-adjacent communities worldwide are also known to actively enter the forest to forage for herbs and other plants (Price and Ogle, 2012), and have been documented hunting opportunistically (Andrew and Agu, 2022).

Researchers may have neglected studying women as active individuals in physical (and social) spaces due to patriarchally-grounded beliefs that women have little agency in their families and within their communities. Such research biases can be exacerbated by methodology grounded in the researcher's own patrilineal/patriarchial social norms; for example, studies that speak only to the "head of a household", and/or assume that a household head is always male. These studies may then be unable to answer important questions about women's attitudes and actions, which is important because women can (and do) control their households' physical space, and poachers and traffickers can be invited into these homes, which facilitates participation in IUWT (e.g. Agu and Gore, 2022). Other research methods may also be faulty when investigating sensitive questions, without the use of methods designed to overcome biases. This is particularly important when considering the practices of women- there is evidence that women are less willing to discuss illicit behavior (e.g. Gregson et al., 2002). Reporting women's responses as directly truthful, when precautionary methods such as trust-building interviews and specialized questioning techniques are not employed, may also under-represent women's actual level of participation in IUWT.

Rapid economic growth across Southeast Asia has diversified opportunities for employment. Women dominate small-scale trade across the region (e.g. Turner, 2010; Tan, 2013; Elsing, 2019), and as such women are often the predominant actors within market spaces. Women predominantly sell goods, and purchase goods for their households. They are important actors in determining which commodities will enter into their households, both as commodities to be sold on to other actors, and as commodities to be used by the household. Women have been identified as directly acting to sell wildlife products in Africa (e.g. Agu and Gore, 2020). Two opportunities where behavior change-grounded conservation interventions may be applied are those with the intended outcome of reducing the sale of wildlife products by women at the market, and reducing the direct purchase of wildlife products at a market. As suggested by Graham (2022), women can be powerful "agents of change" in IUWT, in such critical contexts. However, within Southeast Asia it may be particularly challenging to stop women from selling wildlife products, in light of the widespread economic constraints, lack of alternative livelihoods across the region, and historic precedence (e.g. Fabinyi, 2016; Friess et al., 2016;

Jaiteh et al., 2017). The COVID-19 pandemic has aggravated these challenges; Anagnostou et al. (2021) noted that the widespread closure of public markets that occurred in the pandemic caused high economic impact on the women who dominate these spaces. Women are often the most vulnerable group in a time of crisis, particularly when they are reliant on external forms of income (Agu and Gore, 2022). This can then push women into greater participation in IUWT; generalized economic impacts of COVID-19 (such as loss of employment) may spur greater reliance on natural resources, potentially leading to increased unsustainable wildlife harvesting (e.g. Lindsey et al., 2020 and Roe et al., 2020), and/or legal wildlife trade pushed into illicit markets (e.g. Booth et al., 2021). Additionally, women can be some of the most active players in the wildlife-human disease interface that can occur in markets by being the primary actors in the process of acquiring and even slaughtering domestic and wild animals. No available literature exists on this facet of wildlife trade in Southeast Asia, but it is an apparent and widespread practice in personal observations across the region, and in the recorded dynamics of trade in comparative (in terms of the scale of IUWT) regions such as West Africa (e.g. Nana, 2022). Understanding and engaging with the women who work within this context will be of benefit in advancing OneHealth ideas, most prominently that the preservation of wildlife and human health (particularly vulnerable individuals and societies) relies on tools such as decentralized emerging infectious disease surveillance at live wildlife markets (Aarestrup et al., 2021 and Watsa and Wildlife Disease Surveillance Focus Group, 2020). The success of these tools relies on the engagement of individuals directly at the disease interface, i.e. predominantly women.

Women are also important actors in cross-border trade. In Laos, cross-border women traders are specifically identified with the appellation *mae kha*, illustrating their critical societal role (e.g. Walker, 1999; Turner, 2010; Yokoyama, 2010; Tan, 2013). However, this small-scale trade generally does not provide significant opportunities for economic advancement (e.g. Nguyen et al., 2014), particularly for women who trade across the porous country borders in the region; these activities can be illegal (e.g., unpaid import fees) and therefore targeted by authorities who fine the traders (Endres, 2014). When a practice is already criminalized on one level, it is theoretically easier for an individual to perpetuate additional criminal acts (Brantingham and Brantingham, 1993); thus, it may be lucrative for women who are already engaged in these activities to begin illegally collecting, transporting, and selling wildlife. Trading more "dangerous" goods may also be attractive from a purely gender-specific standpoint; Endres (2014) points out a benefit for women as traders in that they can leverage their gender to present themselves as "weak" and therefore harmless, to gain smaller/no penalties (see also Agu and Gore, 2022). In light of these factors, women-focused qualitative studies at Southeast Asian borderlands would be of benefit.

Women-specific social drivers of behavior

Female social networks are extremely important to consider in studies of behavior; "[women] find strong bonds with each other in shared life experiences which can transcend … differences" (Papanek, 1975). As two examples, Villamor et al. (2015) found such strong female social networks in Sumatra that women within these networks would work on one another's rice fields without any pay, while Nguyen et al. (2014) found that small-scale women traders in Vietnam would all put money into a "pot" and use the aggregated funds to support each person in the network, on a rotational basis. These strong networks can in turn powerfully amplify the behavior of just one woman; e.g. if one woman begins using serow bone to treat her bruises, use may transmit more easily throughout the entire group [e.g. as seen in other cases illustrating such behavioral transmission (Tucker et al., 2011)]. Another important aspect of such social networks is that they can be maintained and strengthened through the giving of gifts, which can include wildlife products (e.g. Davis et al., 2021). Such "gifts" imply some form of reciprocity, so can be given in response to an altruistic act (such as helping out on a rice field), or with the expectation that the recipient will give something in return at a later date. Understanding the interplay and influence of these female-specific networks for the design and implementation of demand reduction interventions will advance IUWT research and inform successful interventions, for a wide variety of wildlife products.

Women have also been found to be primary users for certain wildlife products. For example, Doughty et al. (2019) found that individuals buying and using saiga horn in Singapore tended to be middle-aged, Chinese-heritage women. One driver of use of saiga by these women was that it was recommended to them by others as a treatment option for "heatiness". In the case of these users, the most influential group was cited to be "Family". While "Family" influence can be an important driver for all genders, across the world, women may be especially influenced by the desires and recommendations of close kin. Studies have shown that across societies, middle-aged women are often especially bound to their parents and children (Waite and Harrison, 1992). As such, they may be especially willing to engage in social activities with these kin-members that further strengthen the bond, such as purchasing and using a parent or child-recommended medicinal product. Middle-aged women are doubly "susceptible" due to exerting power over their children, and having power exerted over them by living parents. In addition, Chinese Singaporeans- and individuals in Chinese societies across China and Southeast Asia- have traditionally lived in multi-generational households, where older female actors can carry immense power over younger females in the household (e.g. Teo et al., 2003). This more "dominative" driver contrasts with the examples given in the preceding paragraph of "freely given" aid and assistance within largely equitable female

social networks; yet both examples illustrate the importance of understanding women-specific contexts when attempting to understand behaviors around wildlife consumption and use.

Another highly-specific example of a women-driven social driver is the suggestion of wildlife products for the treatment of women-specific uterine ailments, as noted by Davis et al. (2020) in Cambodia, with older female kin encouraging the use of bear bile by younger women, particularly to treat post-partum ailments. This encouragement can take the form of specific verbal encouragement, as well as purchase of the bear bile by older females, for use by the younger female kin. While bear bile is used by both genders in Cambodia, use of bear bile by women is specific to female clans (kin networks) and female-identifying individuals with uteruses. Older women within female kin networks represent a particularly influential group whose motivations will be of immense benefit to understand and leverage, as researchers increasingly seek to design behavior change interventions to address IUWT. In this respect, older women may be powerful "agents of change" who "are positioned within their social network in such a way [as] to engender transformation" (Graham, 2022).

A key social driver of behavior is attitude. In the Theory of Planned Behavior, a widely-used theory in conservation social science, attitudes are argued to be one of the direct mediators of behavioral intention, which in turn is a direct mediator of behavior (Ajzen, 1991). The argument follows that understanding attitudes in turn facilitates researcher understanding of actual and potential behavior (e.g. Hrubes et al., 2001; Shrestha et al., 2012; Glikman et al., 2019). While persuasive counterarguments have emerged that investigating attitudes alone does not provide sufficient understanding of behavior (Nilsson et al., 2020), attitudes (combined with other socially and contextually-grounded factors) do provide an approximate measure of the potential for X behavior to occur (St. John et al., 2010). As such, it is worth considering women's attitudes towards wildlife, as part of broader understanding around why behaviors- such as the trafficking and/or consumption of wildlife- may occur. While a negative attitude held by a woman towards a wildlife species may not necessarily encourage her to initiate the behavior of poaching, trading, and/or consuming that species, she may influence other actors, such as her direct kin, to poach, trade, and consume (e.g. Agu and Gore, 2022). Women may also be more negatively affected by conservation decisions based only on male attitudes (e.g. Doubleday and Rubino, 2022, Flaherty and Jengjalern, 1995, and Keane et al., 2016). Conservation interventions lacking complete buy-in from all relevant stakeholders often fail (Cooney et al., 2021). Biased research can lead to ineffective conservation interventions that fail to consider women and their specific gender-based behavioral and social differences. A prominent example of of biased research is studies that sample household heads rather than a gender-balanced sample; although, studies that analyze specific differences in positive/negative conservation behaviors between male and female-headed households can uncover greater nuance and by extension, can have greater impact in making effective conservation decisions (e.g. Thoms, 2008). Ultimately, thoughtfully designed studies that gather psycho-social information from both men and women will be most effective at guiding applied conservation interventions addressing important conservation issues, such as IUWT.

Conclusion

Gender-focused IUWT research is still arguably in nascent stages, particularly in Southeast Asia. I have identified within this article a number of gaps in knowledge, including: women's role in hunting wildlife; women's role in determining which wildlife is brought into the home; the extent of women's involvement for trading wildlife; women's motivations for trading wildlife; women's motivations for using wildlife; the role female kin networks play in influencing transmission of wildlife use; the extent of women's involvement in selling and slaughtering wildlife at a market; and motivations for selling and slaughtering wildlife. These are examples of important research avenues, but even more fruitful and important opportunities exist. Initiating research projects into these and other women-in-IUWT-specific questions will result in important outputs that- if applied appropriately- will unquestionably enhance the efficacy of IUWT-directed conservation interventions in Southeast Asia.

IUWT is one of the most significant challenges facing the world, with well-publicized negative impacts on global biodiversity and global health. To date, conservationists have struggled to adequately address this global crisis. Continued failure to consider influential groups, such as women, is likely to waste critical resources and hamper conservationists' ability to have impact. To initiate the "social change" needed to safeguard global biodiversity and health, women must be acknowledged, understood, and engaged.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Conflict of interest

The author declares 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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Q-methodology to understand stakeholder discourses on bat conservation and management in view of the COVID-19 pandemic

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Human-bat interactions are becoming more frequent with growing proximity between people and wildlife. As such, it is important to understand the perspectives of human stakeholders in these interactions, especially considering how media coverage of bats' potential roles as the reservoirs of the ancestral virus to SARS-Cov2 has exacerbated negative perceptions of bats. We used Q-methodology to describe diverse viewpoints on bat conservation and management and identify areas of consensus among stakeholders in Singapore. We derived perspectives, problems, and priorities for bat conservation and management based on qualitative and quantitative analyses. The results reveal three distinct discourses. The ecocentric viewpoint advocates conserving bats for their intrinsic value. The anthropocentric viewpoint outright rejects the idea of conserving bats because of the perceived public-health threat that bats pose. The third discourse prioritizes educating citizens and enhancing general appreciation for biodiversity. All stakeholders agree on the need to reconsider COVID-19-related concerns about bats and address misconceptions that could hinder conservation. The top recommendation by stakeholders is to assess and improve bat-related attitudes and beliefs so that citizens become more supportive of conserving bats for their inherent value and roles in maintaining Singapore's ecosystems. Considering both diverging and consensus viewpoints and engaging various stakeholders in conservation and management decisions can yield both attitudinal change and more effective solutions while meeting the ecological and social needs of conservation.

KEYWORDS

consensus, inclusive conservation, Q methodology, quantitative, qualitative Singapore, viewpoints

1 Introduction

Bats are critical to ecosystems because they sustain important ecological functions and provide multiple ecosystem services (ES) such as pollination and consumption of pest insects (Russo et al., 2022). However, they exhibit a high rate of endangerment, with the main conservation threats being forest loss, agricultural expansion, overharvesting, disturbance, and urbanization (Frick et al., 2020). Bats are further threatened by largely erroneous perceptions about their role in emerging infectious diseases – a phenomenon that undermines support for bat conservation, as recently observed in relation to the COVID-19 pandemic (Rocha et al 2021; Shapiro et al., 2021). A misunderstanding of bats' role in emergence of SARS-CoV2, the causative agent of COVID-19 has strengthened negative attitudes towards bats, an issue likely exacerbated by misinterpretations of scientific evidence by the media and that may significantly threaten bats (Lu et al., 2021). Negative perceptions of people interacting with bats in some manner in their daily lives are especially important to address given that the conservation of a less charismatic species is at stake.

Conservation and management approaches must increasingly consider not only biophysical factors, such as habitat preservation, but also non-biophysical factors, such as human attitudes and perceptions, and stakeholder values and viewpoints (e.g., Chan et al., 2007; Vande Velde et al., 2019). This is especially pertinent for bat conservation in the Anthropocene, when humanity must urgently consider social aspects to ultimately change human behaviors towards bats (Straka et al., 2021). Additionally, social acceptability (e.g., willingness of residents to cooperate) is an important determinant of the sustainability and effectiveness of conservation and management approaches (Redman et al., 2004), especially since the COVID-19 pandemic. Indeed, limiting the propagation of negative bat-related attitudes and behaviors requires all human stakeholders (e.g., virologists, public-health officials, conservation scientists and practitioners) to collaborate on framing messages about bat-associated disease (MacFarlane and Rocha, 2020). Overall, effective biodiversity conservation and management hinges on integrating ecological science and planning practice and, in turn, improving communication among all relevant stakeholders (Gagné et al., 2020).

Quantitative surveys are useful for identifying the prevalence of different views on an issue and analyzing large samples, and are relatively easy to respond to, but they can also limit the type of participant responses (Eyvindson et al., 2015). In contrast, qualitative methods, which let participants respond more freely, are more suited to elucidating deeper social phenomena such as the genesis of attitudes and behaviors (Bennett et al., 2017). Combining both quantitative and qualitative techniques can paint a more holistic picture of human subjectivity. One methodology that does this is Q Methodology (QM), which is increasingly applied to biodiversity conservation and management in various contexts (e.g., Vaas et al., 2019; Vande Velde et al., 2019; Arumugam et al., 2021; Bavin et al., 2020).

People are more likely to comply with conservation and management decisions that they find palatable. Identifying palatable decisions requires some consideration and understanding of the perspectives of affected people, in all their subjective complexity. We set out to understand stakeholder perspectives on the conservation and management of bats in Singapore, in the wake of the COVID-19 pandemic. Singapore has undergone extreme deforestation, urbanization and land-use conversion in pursuit of the economic prosperity it now enjoys, but at the expense of biodiversity (Davison et al., 2012). With the government pushing for a "biophilic city" as part of its nature conservation masterplan, residents are made to live near wildlife and must co-exist with the biodiversity around them to bring about a more sustainable and livable city (Er & Chan, 2016). It is therefore vital that this study considers a wide range of contextually relevant, socially and empirically informed values and viewpoints on bat conservation. Ultimately, we seek to integrate multiple approaches and conservation values in the framework of a means-ends objective network (MEON) to propose objectives and directional actions for bat conservation and management practitioners (Marttunen et al., 2017). A MEON is a problem structuring method that can facilitate the identification and structuring of shared objectives (e.g., Vande Velde et al., 2019; Marttunen et al., 2017). It distinguishes among four types of objectives: (1) fundamental objectives are the endpoints that define the basis for bat conservation and management; (2) means objectives are the actions needed to achieve fundamental objectives; (3) process objectives concern the decision-making process; and (4) strategic objectives are influenced by all decisions made over time (Marttunen et al., 2017). By highlighting how the four types of objectives relate to each other, a MEON can reveal the way to attain the fundamental objectives. Thus, prioritized shared objectives can be highlighted to inform and increase the palatability and overall effectiveness of bat conservation and management decisions.

Specifically, we demonstrate the use of QM to 1) identify and describe stakeholder discourses (i.e., values and viewpoints) related to bat conservation and management in Singapore and, 2) recommend approaches that make sense in the wake of COVID-19 on the basis of consensus among stakeholder discourses.

2 Methods

2.1 Study area

Singapore is a tropical city-state with a land area of 728.3 km^2 (Singstat, 2022; Figure 1) and a fully urbanized population

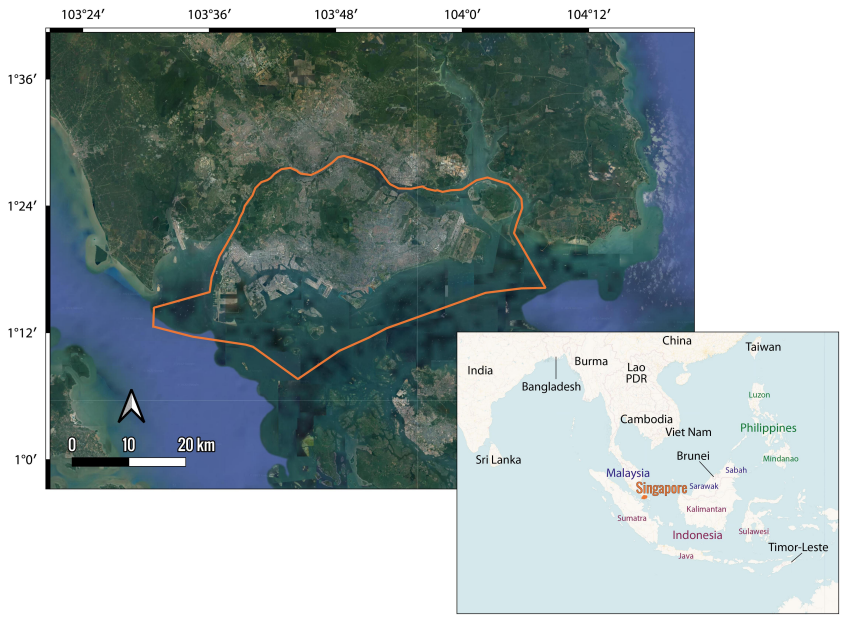

FIGURE 1
Study area. We worked in the Republic of Singapore, whose national boundaries (land and sea area) are in orange on the larger, satellite-view, map. The smaller map shows Singapore's location in Asia (orange marker, black-outlined orange font). Larger plain fonts denote other country names, with distinct colours for archipelago nations (their major islands in smaller font). We built this map in QGIS 3.14 (QGIS Geographic Information System, QGIS Association, http://www.qgis.org), with the base layer for the smaller map from Carto (https://a.basemaps.cartocdn.com/rastertiles/voyager_nolabels/{z}/{x}/{y}@2x.png).

of 5.45 million (Singstat, 2021). Extensive habitat loss due to historical land-use change caused bat diversity to decline by 33% to 72% (Lane et al., 2006), and the nation now has between 20 and 25 bat species (Simmons, 2005; Lane et al., 2006). Ongoing and intensified urbanization has resulted in significant forest loss (Lum and Kang Min, 2021) and consequently, increasing human-wildlife conflicts (Ngo et al., 2019). Despite its highly urbanized landscape, Singapore retains a high green cover of 46% (Gaw et al., 2019), including vegetation in four Nature reserves, more than 350 parks and in its streetscapes (Nparks, 2021a; Nparks, 2021b).

2.2 Q methodology

We used QM to identify and describe discourses about the conservation and management of bats in Singapore in view of COVID-19. Q method combines qualitative and quantitative techniques to explore and analyze subjective perspectives and shared values surrounding an issue (Zabala et al., 2018). One unique feature of Q methodology is that it works with small sample sizes because the goal is to describe a population of viewpoints on an issue, as opposed to how many people express a given viewpoint (Zabala et al., 2018). A QM study has four stages (Zabala et al., 2018):

1. **Research design** – Researchers define an issue and prepare a concourse by selecting representative Q-statements for the Q-sort.
2. **Data collection** - Participants rank statements according to how much they agree with each statement.
3. **Analysis** – Researchers apply multivariate data-reduction techniques to analyze the placement of the Q statements by looking for relationships between rankings that illustrate shared views or subjectivities.
4. **Interpretation** – Based on their analyses, researchers generate descriptives or narratives that represent the set of perspectives surrounding an issue.

Our Q-method study was reviewed and approved by the ethical board of the National University of Singapore (NUS-IRB reference code S-20-142E) and respondents gave informed consent.

2.3 Q participants – formation of P-set

To prepare for a QM study, the participants who will rank the Q-sort statements are selected to represent the P-set (i.e., group of participants in the Q-sort process; Zabala et al., 2018). To recruit a purposive sample of participants whose perspectives

we expected to be diverse or especially strong, we tapped into our local networks and mapped online profiles (i.e., snowball and purposive sampling). In total, 30 participants from eight sectors: research (n=7), tourism and cultural heritage (n=6), NGO (n=5), unemployed/self-employed (n=4), government (n=3), education (n=2), environmental consultancy (n=2) and pest management (n=1) constituted the P-set (Table S3).

2.4 Q statements – formation of Q-set

In Q method, researchers form a so-called Q-set (i.e., the set of Q-sort statements that will be used for the Q-sort). We first prepared a concourse – a population of statements representing the broad range of viewpoints – using information from three types of sources: 1) interviews conducted with six members of the P-set; 2) online social-media and newspaper articles and readers' comments; 3) the scholarly literature, which we searched using these key words (in both singular and plural forms): "bats", "conservation", "management", "human-wildlife conflict", "public health", "beliefs", "perceptions", "threats", "risk", "pandemic", "COVID-19" and "Southeast Asia". We randomly obtained one participant from six of the eight sectors (representatives from the pest management and education sectors were not available) for the interviews (mentioned above) as part of the process of forming the Q-set. The concourse contained a total of 80 statements that we closely scrutinized for conflicting or contrasting interpretations, duplications, and ambiguity; we omitted such statements from the eventual Q-set (Watts and Stenner, 2012). The final Q-set contained 50 statements that we thematically identified and categorized (Table S1). We conducted a pilot test using these 50 statements with five specialists in local wildlife conservation and management who were not part of the P-set, and modified the statements based on their suggestions.

2.5 Q sorting

From 19 April to 28 May 2021, we conducted the Q-sort interviews over Zoom and using an online Q-method software (Lutfallah and Buchanan, 2019), as follows. First, we asked each P-set participant to sort the 50 statements into three groups: 1) agree; 2) disagree; 3) no opinion/undecided/neutral. Next, we asked them to place statements on a pyramid – essentially, a "quasi-normal" distribution – in a way that reflected their opinions on a scale from strongly disagree (= – 4) to strongly agree (= + 4; Zabala et al., 2018; Figure S1). Finally, in a post-sorting interview, we invited participants to elaborate on how they placed statements, notably the salient ones (i.e., at the two extreme ends), and to raise any points or issues they felt were lacking in the Q-set. The post-sorting interview promotes flexibility and a deeper, qualitative understanding of participant responses, thereby complementing the quantitative sorting of statements that provides structure to the interview and data analysis (Mukherjee et al., 2018).

2.6 Factor analysis

After calculating a Pearson correlation coefficient matrix to compare similarities between pairs of Q-sorts, we used principal component analysis (PCA) to group participants (fixed variables) based on the calculated matrix of association between Q-sorts (dependent variables). Grouping similar sorts of similar views reduces the number of discourses, so that participants who sort similarly are grouped in the same factor or component by PCA. We used a combination of Humphrey's rule of extraction, Kaiser-Guttman criterion and visualization of the scree plot of eigenvalues to determine how many factors to extract, and varimax rotation to rotate the matrix to ensure maximum variation within each group (Zabala et al., 2018). We eventually extracted eight factors, then rotated and retained three based on the criteria mentioned, while ensuring at least two significant loading Q-sorts per factor ($P < 0.01$, significant factor loading threshold value = 2.58 x (1 $\sqrt{}$no. of items in Q-set) = 0.37; see also Balch and Brown, 1982). Factor loadings represent the extent to which each Q-sort is associated with each retained factor, so Q-sorts that load significantly on a given factor (i.e., factor exemplars) share a closely related sorting pattern. We used "QMethod" online software (Lutfallah and Buchanan, 2019; https://qmethodsoftware.com) to conduct all analyses.

2.7 Factor interpretation

We combined factor exemplars to form composite Q-sorts, or factor arrays, to represent each rotated factor. We then described the discourses by interpreting each statement's factor array and z-score (i.e., weighted average of statement ranks by participants grouped within a factor), including an analysis of the post-sorting interviews. We also considered the placement of salient statements and the statements that could be considered consensus (do not distinguish any pairs of factors) and distinguishing (significantly different) between factor arrays to develop the discourse narratives.

3 Results

A total of 30 participants were included in the Q-sort from eight stakeholder groups (Table S3). The three factors extracted each represented a stakeholder discourse (factor interpretations) and collectively explained 57% of the total variance. This is well above the range of expected variance (35 – 40%) suggested by

Watts and Stenner (2012). Below, we describe each discourse according to three main themes: (1) the perspective (general view on bat conservation); (2) the problem (main issues identified); and (3) the priorities (actions to take), with the aim to elucidate these encompassed viewpoints. We have bracketed Q statements and associated ranks such that, for example, (S1: +2) represents statement 1, rank +2 (Table 1).

3.1 Areas of disagreement among discourses

Discourse 1 – Do we need a reason to conserve bats?

Interpreted from factor 1, D1 explains 45% of the variance (Eigenvalue = 13.5). Discourse 1 had the most participants (18 of 30) from multiple stakeholder groups (six of eight) loading onto this factor.

Perspective – Discourse 1 exemplars hold ecocentric viewpoints. Bats should be conserved primarily for their intrinsic worth (S7: +4; S5: +3; S9: +3), and bat conservation is an ethical duty rather than a means to maintain ES.

Problem – Discourse 1 reflects a neutral, non-critical view of local media in its negative influence on people's perceptions of bats (S50: 0; S14: 0). In referring to COVID-19 and bats, one participant explained that "the local media does an impeccable job in informing the public with factual rather than sensational pieces". Another remarked that the "well-educated Singaporean society live (*sic*) in a city with one of the largest green covers (*sic*)", so residents are generally "well-accustomed to Nature". Discourse 1 exemplars are therefore not convinced that negative public perceptions are the biggest conservation threat to bats (S14:0; S50: 0; S27: 0; S10: −1), saying that Singaporeans are "less likely (*sic* than other nationalities) to get carried away" with myths and misinformation. Rather, the biggest threats are extensive habitat loss (S42: +2) and a lack of emphasis on bats in environmental impact assessments (EIAs; S18: +3).

Priorities – Although D1 exemplars deem bat-mediated ES as unique, important, and irreplaceable (S29: +3; S2: −4), they are not convinced that bat conservation and management should prioritize quantifying and valuating these services (S44: 0). They highlight the need to better integrate urban and Nature spaces so residents can co-exist peacefully with wildlife (S4: +2; S45: +2; S38: -2). They stress the importance of protecting remnant forest patches to prevent further habitat loss and agree that doing so should accompany equally important governmental greening efforts (S39: 0). All while acknowledging the need for more coordinated conservation and management by stakeholders (S16: +1), D1 exemplars say the government should remain the most important decision-maker (S48: +1).

Discourse 2 – Why would we even consider conserving bats?

Discourse 2, interpreted from factor 2, explains 7% of the variance (Eigenvalue = 2.23) with four participants from two stakeholder groups loading on this factor.

Perspective – Discourse 2 stands out in its outright rejection of bat conservation. This anthropocentric view prioritizes public health and safety over ES by bats (S23: +3; S26: +4). Bats should not be conserved for their ES because "these services are replaceable by less dangerous and more charismatic biodiversity groups such as birds" (S1: +2; S2: +2; S29: −2; S44: −2). Post-sorting interviews clarified that despite a generally negative view of bat conservation, D2 exemplars appreciate local biodiversity as part of Singapore's "City in Nature" concept (see also, e.g., Koh et al., 2022) but "prefer not to conflict with them (*sic* referring to biodiversity) so long as they rest (*sic*) in Nature and refrain from entering urban habitation".

Problem – Discourse 2 exemplars disapprove of the presence of bats in human dwellings (S26: +4; S15: +3; S4: −2) for two main reasons. One, the perceived health risk (S26: +4; S23: +3), e.g., "television programs and online articles have reported bats carrying pathogens transmissible to humans" and the consequent belief that bats "pose a real danger". As such, they agree that the media strongly influences negative perceptions (S14: +1; S50: +2). Two, their dissatisfaction with bats entering and roosting in houses and feeding on fruit trees, and the lack of effective solutions by relevant agencies (S43: −4; S47: −4). One participant said: "hotlines are ineffective as they are mostly unanswered", and while the general advice is to not bother bats, "they still fly into my house and feed on fruits, and sometimes fly too close to my face". Discourse 2 supporters also emphasize the lack of cooperation among stakeholders (S16: +3), elaborating that "different agencies (e.g., Animal Concerns Research and Education Society (ACRES), National Parks Board (NParks), pest management companies) provide different information and advice", leaving them "confused and unsure of what action would be most effective".

Priorities – Discourse 2 exemplars highlight that local bat research must be more publicly accessible and used to promote appreciation and interest in bats (S25: +4). They are uncertain about whether a bottom-up or top-down approach to bat management would work best (S48: 0). Instead, they suggest targeted engagement (S37: +3) to help people "better understand the behaviors of bats" and more collaborative efforts by all stakeholders in deterring bats from entering dwellings (S16: +3).

Discourse 3 – We must show people why we should conserve bats.

Discourse 3, from factor 3, explains 5% of the variance (Eigenvalue = 1.56) with eight participants from five stakeholder groups loading on this factor.

TABLE 1 Statements (S) and their respective z-scores (z-sc) and ranks (r) for each of the three respective identified factors.

	Statements (S)	Factor 1		Factor 2		Factor 3	
		z-sc	r	z-sc	r	z-sc	r
1	Bats in Singapore are associated with more disservices than ecosystem services.	-0.56*	-2	0.99*	2	-1.22*	-2
2	Bats are not required in the ecosystem since other taxa such as birds present in the environment perform similar ecosystem services.	-2.42	-4	1.01*	2	-2.05	-4
3	Bats are essential to the integrity of natural ecosystems in Singapore.	1.90	4	1.38	2	0.55*	1
4	Citizens should be inherently proud of the biodiversity present in Singapore and learn to, of their own accord, co-exist peacefully with wildlife such as bats.	1.20*	2	-0.95*	-2	0.09*	0
5	Like all native species, bats are part of the land and inherently have the right to exist.	1.51*	3	-0.34	-1	0.17	0
6	Bats should be conserved for their significance in certain religions.	-0.43	-1	-1.62*	-3	-0.44	-1
7	Biodiversity is inherently good and needs to be conserved regardless of its value to humans.	1.75*	4	-0.11	0	0.46	1
8	In Singapore, the negative aspects of bats in relation to human health outweigh the positive aspects regarding ecosystem functioning.	-1.60	-3	0.44*	1	-1.56	-3
9	Bats are an important part of Singapore's natural heritage.	1.44*	3	-0.45*	-1	0.38*	1
10	The COVID-19 pandemic has not significantly changed perceptions about bats since Singaporeans already previously held negative opinions about bats. *	-0.42	-1	-0.11	0	-0.60	-1
11	Human-bat encounters in Singapore hinder the conservation of bats as residents generally face more negative than positive bat encounters.	-0.34	-1	0.94*	2	-0.47	-1
12	COVID-19 has made Singaporeans more aware that bats can carry pathogens that are deadly for humans and has therefore heightened fears about bats.	-0.24*	-1	0.94	2	0.43	1
13	The government should urgently address the increased misconceptions of bats resulting from COVID-19 as this directly threatens the survival of bat populations in Singapore. *	-0.50	-1	0.22	1	-0.24	-1
14	Local tabloid journals tend to sensationalize issues about bats thereby negatively affecting perceptions and hindering conservation efforts.	-0.08	0	0.78*	1	-0.10	0
15	Protection of bat populations in Singapore rely on keeping bats away from human habitation as far as possible.	-1.26	-2	1.49*	3	-1.52	-3
16	There needs to be better integration among all stakeholders concerning the conservation of bats in Singapore.	0.74	1	1.52*	3	0.58	1
17	Protection of less charismatic species like bats should be a priority for wildlife management in Singapore.	0.53	1	-0.12*	0	0.71	1
18	Bats should be included as a mandatory component of all environmental impact assessments (EIAs).	1.41	3	0.56*	1	1.24	3
19	Underlying misconceptions about bats are largely due to inadequate knowledge and awareness of bats.	0.89	2	-0.50*	-1	1.26	3
20	Humans encroaching into bat habitats is primarily a conservation issue as bats tend to colonize urban areas only when they lack natural habitats. *	-0.75	-2	-0.37	-1	-0.02	0
21	Having more green spaces surrounding human habitation can help promote more positive human-wildlife interactions, which in turn can be positive for bat conservation.	0.32*	1	-0.41	-1	-0.55	-1
22	The lack of legal protection and laws preventing people from disturbing bats is a major hindrance to their protection. *	-0.27	-1	-0.25	0	-0.14	-1
23	Public health safety takes precedence over the protection of bats, and bat populations found to carry deadly pathogens should therefore be exterminated.	-1.42	-3	1.56*	3	-1.48	-2
24	The link between bat tourism and conservation could be highly valuable and should be looked at as a potential avenue to further bat conservation efforts in Singapore. *	-0.65	-2	-0.41	-1	0.09	0
25	Research conducted on bats should go hand-in-hand with public outreach, as this serves as an avenue to get people interested in bats.	0.57*	1	1.58	4	1.11	3
26	As bats are natural reservoirs of many coronaviruses, they pose a major public health risk and should not be co-existing among urban residents.	-1.92	-3	1.96*	4	-1.55	-3
27	The way that Singaporeans can get paranoid and overreact to things they perceive to be dangerous and risky is a hindrance to bat conservation.	-0.17*	0	-0.91*	-2	0.85*	2
28	Investing in bat conservation is only necessary when the species in question is endangered.	-1.95	-4	0.10*	0	-1.55	-3
29	The ecosystem services that bats provide in Singapore (e.g., pollination, seed dispersal) are highly valuable and bats should therefore be protected.	1.32*	3	-0.80*	-2	0.37*	0
30	Many residents are unaware of the existence of bats in Singapore which poses a challenge for bat conservation. *	0.02	0	0.11	1	0.19	0
31	Bats are slow-breeding mammals with very few offspring and should therefore be protected as their populations take a long time to recover. *	0.56	1	0.77	1	1.01	2
32	Bats are traditional symbols of good fortune and prosperity.	-0.27*	-1	-1.42*	-3	0.24*	0

(Continued)

TABLE 1 Continued

	Statements (S)	Factor 1		Factor 2		Factor 3	
		z-sc	r	z-sc	r	z-sc	r
33	It is not a priority to reconsider the concerns raised by residents about bats in Singapore since the COVID-19 pandemic as these are unlikely to have changed. *	-0.97	-2	-0.97	-2	-1.21	-2
34	COVID-19 has made Singaporeans more aware of the presence of bats around them in a way that has brought about more concerns than interest. *	-0.02	0	-0.33	-1	0.20	0
35	Humans negatively impact bat ecosystems which in turn results in the emergence of diseases and related health issues.	0.87*	2	-1.38*	-3	-0.23*	-1
36	Relative to the past, bats currently do not face major conservation threats in Singapore.	-1.61	-3	-0.21*	0	-1.92	-4
37	As it is difficult to broach the subject of bats, tailored public outreach is crucial to dispel myths and support bat conservation efforts.	0.06*	0	1.52*	3	0.73*	1
38	The government's initiative of planting native species of trees is not crucial for the conservation of bat populations since most species are adapted to the urban matrix.	-0.99	-2	0.06*	0	-1.25	-2
39	Rather than greening the landscape with more native trees, conservation of bat populations in Singapore should focus on protecting existing green spaces. *	0.08	0	0	0	-0.40	-1
40	Webinars, guided walks, and public forums on wildlife have strong potential to educate the public about bats and soothe any fears.	0.71	1	-0.208*	0	1.09	2
41	It is the way we interact with bats rather than their presence in our environment which poses a problem.	0.45*	1	-0.73*	-2	1.03*	2
42	The loss of natural habitats has always been and remains the biggest challenge to the conservation and management of bats in Singapore.	0.95	2	-0.37*	-1	0.85	2
43	The government has been successful in managing human-bat conflicts, such as by providing adequate and effective measures to deter bats from entering houses.	-0.48*	-1	-2.26*	-4	-1.36*	-2
44	Quantifying and valuating ecosystem services of bats should be the focus of conservation and management of bats in Singapore.	0.01	0	-0.72*	-2	0.25	0
45	To be a successful 'City in Nature', Singapore must encompass as many wildlife taxa as possible (including bats), regardless of their charisma and popularity among residents.	0.78*	2	-1.56*	-3	1.71*	4
46	Classes about local biodiversity and Nature-related topics should be taught more in schools.	0.81	2	0.39	1	1.36*	3
47	Bats entering and roosting in houses or feeding on fruit trees of residents in Singapore are common occurrences associated with being a 'City in Nature' and does not warrant exceptional concern.	-0.13*	0	-2.17*	-4	0.77*	1
48	The management of bats in Singapore requires a top-down approach to effectuate coordination among stakeholders.	0.48	1	0.09	0	-0.64*	-2
49	Residents lacking an attachment towards Nature are likely to have more conflicts with wildlife including bats.	0.15	0	0.19	1	1.79*	4
50	Media outlets (e.g., local news journals, social media) need to exercise more prudence with their content creation, given their highly influential role on bat perceptions.	-0.07*	0	1.07	2	1.02	2

Asterisks after z-scores represent distinguishing statements at $p < 0.01$. Asterisks after statements represent consensus statements at $p < 0.01$.

Perspective – Discourse 3 recognizes the influential role of citizens in bat conservation and management through their interactions with and perceptions of Nature (S49: +4; S46: +3; S41: +2). This discourse recognizes negative attitudes and perceptions as the biggest barriers to bat conservation (S49: +4; S19: +3; S27: +2).

Problem – Discourse 3 exemplars worry about urbanites' detachment from Nature and how this might drive reduced understanding and knowledge of Nature. They emphasize that because Singaporeans tend toward paranoia and overreacting to things they perceive as dangerous (S27: +2), conservation issues lie in certain human-bat interactions rather than in the presence of bats in urban areas (S41: +2).

Priorities – Discourse 3 stresses the need for conservation efforts to focus on citizens. This includes nurturing an interest in and attachment to Nature from a young age (S46: +3) and remediating negative bat-related attitudes, behaviors, and perceptions (S19: +3; S25: +3) through specific outreach and education targeting a wider audience than the scientific or Nature-loving communities (S25: +3; S37: +1). Post-sorting interviews reveal that whereas webinars and public forums may not be very "effective with the general public" because they largely "preach to the converted", guided tours encompassing diverse local species may be "more exciting" and could attract more people. Exemplars say a bottom-up approach to conservation and management decisions would work best (S48: –2), highlighting how current local wildlife working groups form this way, with most bat education and outreach conducted by NGOs.

3.2 Areas of consensus among discourses

None of the stakeholders are sure of how COVID-19 has affected public perceptions of bats, with many pointing out that

little is known about pre-COVID-19 and current perceptions of bats. However, one point of consensus is that Singaporeans now are more likely aware of bats and their potential to carry deadly pathogens and so, fear them more. Stakeholders emphasize the need to reconsider residents' concerns about bats in the wake of COVID-19 – doing so is indeed crucial to address possible misconceptions that could hinder conservation.

Where management is concerned, participants agree that bats in Singapore have sufficient legal protection, although EIAs must emphasize bats more. Post-sorting interviews clarified that under the Wildlife Act, it is legal to kill, trap or remove bats that are found damaging or destroying private property (see also Singapore Statutes, 2021). Participants revealed that this has resulted in instances of "nettings put-up deliberately in houses to trap bats, causing them to die from stress or exhaustion".

There is insufficient appreciation for cultural ES. Stakeholders describe local bat tourism as "not feasible" due to a lack of big colonies of charismatic species, while some think such tourism could disturb bat populations. Participants agree that bats are rarely associated with the concept of blessings or prosperity, and that such "less valuable" cultural ES should not be promoted for conservation.

3.3 Means-ends objective network

Stakeholders highlighted several aspects of the role of residents in bat conservation and management. One necessary action is to instill an attachment to Nature in residents, especially the youth, through classes about biodiversity and Nature (Figure 2). Bat research must be made more publicly accessible so that it is understandable and improves awareness and knowledge of bats, ultimately dispelling myths and addressing misconceptions (Figure 2). Concerning the decision-making process, stakeholders raised the need for better integration and inclusion of all stakeholders (Figure 2). Particularly, they highlighted that bats must be included in all wildlife-related EIAs, and that existing natural habitats must be protected to ensure no further habitat loss (Figure 2). Stakeholders added that proper, reliable EIAs need more expertise, and that coherent delivery of conservation and management messages hinges on better communication among stakeholders (Figure 2). The overall objective for bat conservation and management in Singapore first revolves around protecting and conserving bats for their intrinsic value. Also, for Singapore to be a true 'City in Nature', citizens should be proud of and co-exist peacefully with Singapore's wild biodiversity (Figure 2).

4 Discussion

Our study – the first to consider the socio-ecological aspect of bats in Singapore – demonstrates the utility of Q methodology to uncover different stakeholder perspectives on the conservation and management of bats in Singapore in the wake of COVID-19. Polarity among the three discourses reflect the divergent interests of groups of human stakeholders in the local conservation and management of bats. Consensus among the discourses can be used to determine shared stakeholder objectives in the form of overall perspectives, problems, and priorities for decision-making.

4.1 Diverging viewpoints

We observed distinct polarization among the identified discourses.

Discourse 1, emerging from the widest range of stakeholder groups, takes an ecocentric, environmentalist stance that embodies the idea that protecting bats requires no justification. Rather, it is an ethical obligation of humankind. Such ecocentric or biospheric attitudes to conservation appreciate Nature for its intrinsic rather than utilitarian values (Thompson and Barton, 1994). Despite their range of professional profiles, D1 exemplars all agree that bats play an integral role in Singapore's natural ecosystems and in providing regulation and maintenance ES such as seed dispersal of native plants (Chan et al., 2020) and pollination of durian (*Durio zibethinus*; Russo et al., 2022). Most D1 stakeholders have environmental or natural sciences backgrounds (Table S3) and, as such, likely have preconceived attachments to Nature and wildlife, which could explain their ecocentric, environmentalist point of view.

Discourse 2, which is anthropocentric and contrasts with D1 and D3, strictly de-prioritizes the protection of bats mainly due to perceived public-health and safety concerns. This discourse criticizes current management of bats, highlighting the lack of coherence among responsible agencies and the ineffectiveness of current efforts to deter bats from entering residences. Although there is zero evidence that bats are hosts of SARS-CoV-2 (see also Shapiro et al., 2021) and no local media have reported otherwise (Table S2), D2 reveals persistent fears of bats. A review of stakeholder characteristics (Table S3) shows that exemplars have likely based their perceptions on their prior encounters with bats without necessarily knowing about bats' ecological roles or ES. Discourse 2 is therefore likely to have been shaped by stakeholders' negative experiences and encounters (Table S3).

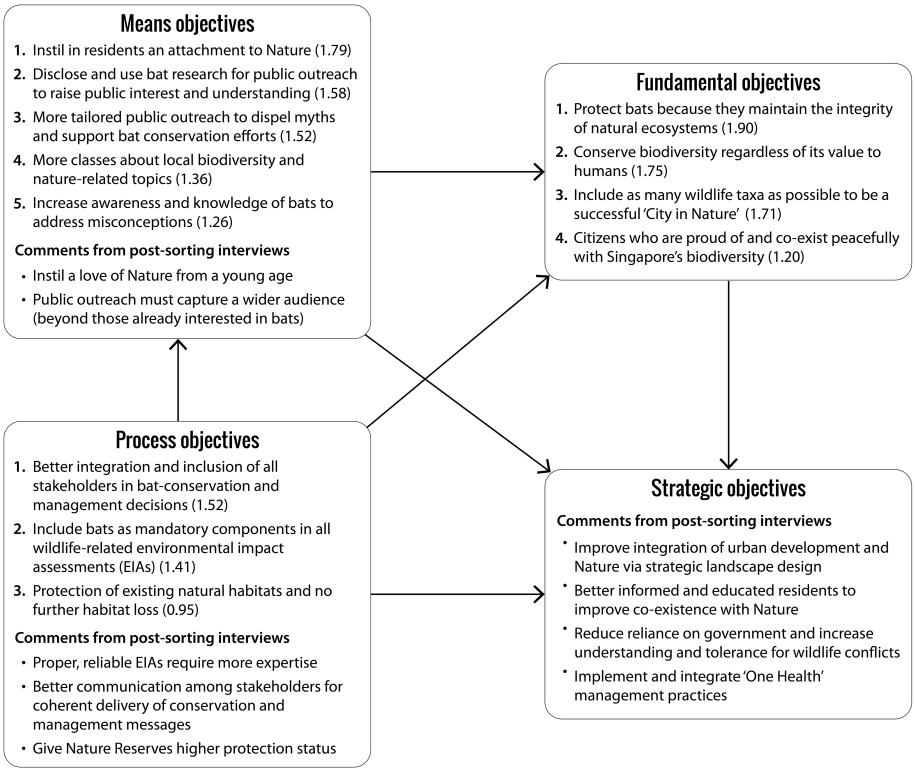

FIGURE 2
'Means-ends objective network' of stakeholder objectives based on identified discourses, z-scores of statements, and post-sorting interviews. Objectives adopted from Q statements are ordered in decreasing order from highest to lowest z-scores (averaged over the 3 discourses). Arrows represent the direction of influence between objectives.

Discourse 3 champions public education and outreach, so exemplars believe that people need a convincing reason to conserve bats. This opinion distinguishes D3 from D1. Participants loading on D3 hold roles as educators, whether in school settings or with the general public (Table S3). Although local bat-related public education and outreach efforts exist, bats are rarely the only focal taxa and are hardly addressed individually (Nparks, 2021c). This makes bats unlike some other taxa, such as macaques (*Macaca fascicularis*) and wild boars (*Sus scrofa*), that have received individual attention because of their propensity to be involved in conflicts (Nparks, 2021d; Nparks, 2021e). However, it must be noted that teaching the public about the importance of bats and the need to address the threats to their conservation does not guarantee a change in attitude or behavior towards bats (see also Frick et al., 2020). Changing negative attitudes and (more importantly) behaviors toward bats necessitates carefully planned and interdisciplinary studies firmly grounded in social science theories (e.g., Theory of Planned Behavior, Cognitive Hierarchy Theory, etc.) and methodologies (see also Kingston, 2016; Straka et al., 2021).

4.2 Converging viewpoints

4.2.1 Perspectives

Ongoing urban development in Singapore continues to threaten bats – a problem amplified by residents' negative bat-related viewpoints – viewpoints that participants agree have likely been exacerbated by COVID-19. Participants have noticed an increase in Singaporeans raising concerns about bats and being more aware of their presence compared to before the pandemic. However, any increased awareness does not necessarily translate to greater bat-related knowledge or interest. Participants also highlight the importance of how the media presents information on bats, given how influential the media in Singapore is and the consequent potential for the public to misunderstand articles about bats (see MacFarlane and Rocha, 2020), especially in relation to public health. Indeed, misinterpretation of scientific evidence by the media can pose a serious threat to bats (López-Baucells et al., 2018; MacFarlane and Rocha, 2020). Still, most participants agree that Singapore's local media has recently been disseminating largely accurate

information about bats. In contrast to previous portrayals of bats in Singapore as the "culprits" behind the SARS virus (Chang, 2013), the media have reported that bats are "highly unlikely" to carry the coronavirus that causes COVID-19 (Toh, 2020; Table S2).

4.2.2 Problems

As a highly developed small-island city-state, Singapore faces severe land scarcity. Urban development threatens approximately 22% of the nation's remaining forest patches (Gaw et al., 2019) and stands to cause further forest degradation and fragmentation – a reality that ultimately forces bats into residential areas and raises the frequency of human-bat interactions. Further, low bat-related awareness, understanding and interest will likely create and/or exacerbate tension between bats and human urbanites. Post-sorting interviews reveal that post-COVID-19, residents have been increasingly complaining about bats entering and roosting in houses and feeding on fruits in gardens. Such negative perceptions of these interactions have likely developed or worsened due to sensationalized global media reports following the pandemic.

4.2.3 Prioritizations

There is a need to bolster public education and awareness campaigns to address negative views of bats and misconceptions that they pose a public health threat. Bat conservation and management in Singapore can be made more effective with the knowledge of current attitudes towards bats as outreach efforts can be tailored to the society. All participants agree that in the wake of COVID-19, perceptions of bats must be studied to address misunderstandings that could affect bat conservation and management. Because it is almost impossible to keep urban bats away from human dwellings, residents must learn to co-exist with them as part of a 'City in Nature' – for this to happen, negative bat-related attitudes must be dispelled. Indeed, during post-sorting interviews, stakeholders recounted anecdotes of residents increasingly asking for bats to be removed from their premises, and trapping and killing bats. Still, participants agree that bats are generally well-protected by law and are relatively undisturbed. Local conflicts largely involve one common species, *Cynopterus brachyotis*, which is well-adapted to the urban landscape, and rarely involve uncommon or endangered species, which occur in forest patches (Lane et al., 2006). This speaks to how important it is to preserve remnant forests. There is also a need for the public to support naturalization, e.g., planting native trees that could provide alternate food resources for bats, or restoring connectivity among fragments. Additionally, better integration of future urban development and wildlife through strategic landscape design (see also Hwang and Jain, 2021) is required to strengthen relationships between urbanites and wildlife and thus to promote conservation and mitigate conflicts.

4.3 Relevance to conservation and management

Conservation and management decisions are complex and increasingly expected to integrate the objectives of multiple stakeholders to improve attitudes (Sterling et al., 2017). Furthermore, the consequences of most conservation policies and interventions affect different stakeholders differently (Grimble and Wellard, 1997). Yet, considering and integrating multiple stakeholder objectives can be challenging and may divert attention from the decision-making process, which would therefore be easier if policymakers would consider a compromise or trade-off among stakeholders. The discourses we identified may provide a foundation to consolidate and integrate major perspectives into shared objectives for bat conservation and management *via* a 'means-ends objective network' (Figure 2). The points of consensus among stakeholders in this study can be directly applied to conserving and managing bats in Singapore. Effective public outreach necessitates understanding current bat-related attitudes (Figure 2). Finally, for citizens to peacefully coexist with wildlife (Figure 2), it takes coordinated efforts of stakeholders with possible consideration of 'One Health' management practices, which ensure the wellbeing of bats and people (Mackenzie and Jeggo, 2019).

Biodiversity conservation and management increasingly considers gender equity as integral to inclusive decision-making (Tallis & Lubchenco, 2014; Matulis & Moyer, 2017; Lau, 2020). Even though women play influential roles in conservation, environmental activism, and leadership at local, national, and international scales (Bell and Braun, 2010), gender inequality in conservation remains pervasive (Jones and Solomon, 2019; James et al., 2021). This is a serious problem because gender inequality hinders the achievement of biodiversity protection and ecological stewardship (Tallis & Lubchenco, 2014; Matulis & Moyer, 2017). Besides, given documented gender-based differences in knowledge and views of bats (e.g., Boso et al., 2021; Musila et al., 2018; Lu et al., 2021), stakeholder viewpoints of all genders matter. In this study, 40% of P set participants identified as women – they were distributed among six different stakeholder groups and represented all three discourses (Table S3). Although we did not test for gender-based differences in stakeholder viewpoints (and QM is likely unsuited to such analyses), we encourage future researchers to explore the role of gender in viewpoints on bat conservation and management so that decisions respect the ethical

norm of inclusivity and are thus more likely to be effective than when such consideration is not given.

5 Conclusion

It seems people are complaining more about bats in their buildings now than pre-pandemic and some are resorting to evicting or killing bats (e.g., Tsang, 2020; Zhao, 2020). Behaviors like this stand to raise societal tension, e.g., with exemplars of D1 – a situation that could boil over and become acrimonious in a densely populated city-state where people of all stripes literally live one on top of the other. As such, we propose that the responsible agency, in this case NParks, explore the applicability of a multi-pronged campaign to solve the issue in a safe and palatable way. More specifically, we point to the apparent success of efforts to mitigate human-macaque conflicts – efforts that combine: (1) teaching residents about macaques' non-verbal cues and the dangers of feeding them and (2) monkey guards who deter macaques from venturing near dwellings on the fringes of macaque habitat. Perhaps NParks could investigate imparting information about how to prevent bats getting into dwellings (e.g., sealing holes, installing window screens) and what to do when they find their way in, while also examining how urban greening strategies (i.e., plantings) might be tweaked to maximize the ecosystem services that bats render while reducing their tendency to approach buildings.

In the Anthropocene, the diverse and contextualized stakeholder discourses gathered from this study pave a path to better bat conservation and management, especially since COVID-19. Our QM findings are useful for resolving conflicts, appraising policies, and facilitating discussion and eventual critical reflection related to current bat conservation and management strategies in Singapore. While we elaborated most strongly on stakeholder discourses, our MEON helps to incorporate findings in a way that is more focused and easier for policy makers to understand. Singapore, with its dense human population, land scarcity and ongoing urban renewal and expansion, exemplifies the tension between development and conservation. This tension must be resolved. Specifically, residents' viewpoints and attitudes must be understood and, if necessary, modified to facilitate co-existence with bats in a "City in Nature" where bats are appreciated and conserved for their intrinsic worth and ecological roles. Moving forward, sustainable bat conservation and management should continue to involve discussion among all relevant stakeholders and consideration of their diverse viewpoints.

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.

Ethics statement

Our Q-method study was reviewed and approved by the ethical board of the National University of Singapore (NUS-IRB reference code S-20-142E) and respondents gave informed consent.

Author contributions

RL: conceptualization, methodology, writing – original draft, review and editing. CL: conceptualization, writing – review and editing. JZ: writing – review and editing. JC: conceptualization, methodology, writing – review and editing. All authors contributed to the article and approved the submitted version.

Conflict of interest

The 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.

Publisher's note

Supplementary material

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We are silently paving the way toward human–wildlife coexistence: The role of women in the rural landscapes of southern Andes

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Gender plays an important role in human–wildlife coexistence. Women have their own distinct form of environmental knowledge; women shape attitudes and perceptions related to wildlife and influence the use of natural spaces and the nature of human–wildlife interactions. Being a female farmer or practitioner involved in human–wildlife conflict mitigation poses a variety of obstacles and benefits. The way conservation conflicts are perceived and managed is gendered, and this needs to be taken into account when working with local communities to achieve effective and fluent dialogue, planning, implementation, and evaluation. The existing body of evidence is focused mainly in Africa and Asia and suggests that the sharing of landscapes between humans and wildlife has different implications for men and women with respect to their attitudes toward wildlife and how they are impacted by it. Although extensive research has been done in relation to gender, conservation, and natural resource management, the gender perspective of human–wildlife coexistence is underreported. Feminist political ecology emphasizes that gender differences originate in the need to overcome existing social and political barriers and is highlighting the importance of en-gendering research. In Chile, work in the rural sector poses various challenges, especially for women. Rural landscapes are, in general, dominated by men, with low female participation in decision-making spaces. Nonetheless, this appears to be silently changing. In this perspective, we contrast three undocumented experiences of our work as female researchers and facilitators of human–wildlife coexistence (northern case, central case, and southern case). The aim of this perspective piece is to expose current

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findings for the role of women in human–wildlife coexistence, contrast these with our reports, and propose future directions.

KEYWORDS

conflict, rural landscapes, *campesinas*, gender perspective, traditional local knowledge, Chile

Introduction

Social–ecological systems in rural settlements are dynamic cultural landscapes that are created and shaped by human stewardship and the richness of human–wildlife interactions (Plieninger and Bieling 2012; Huntsinger and Oviedo, 2014; Fernández-Giménez et al., 2022). Within these systems, humans and other-than-human beings establish biotic and cultural communities as cohabitants of a shared landscape (Rozzi, 2012; Carter and Linnell, 2016; Morehouse and Boyce, 2017). In rural landscapes, interactions between these cohabitants can cause some friction due to competition over resources and habitat use. Management of human–wildlife conflicts (HWC) has received increasing attention from researchers because it negatively impacts both wildlife and local communities that have traditionally dwelled on the land (Treves et al., 2006; Nyphus, 2016; Crespin and Simonetti, 2019; Araneda et al., 2021; Canney et al., 2021). Most of the studies addressing this topic have failed to acknowledge how the impact of HWC on humans differs between genders and is often asymmetrically adverse for women (Barua et al., 2013; Khumalo and Yung, 2015; Banerjee and Sharma, 2021). Although extensive research has been done in relation to gender, conservation and natural resource management (Espinosa, 2010), the gender perspective of HWC is rarely considered (Barua et al., 2013; Khumalo and Yung, 2015; Alexander et al., 2022; Herzog, 2007) and research on it has hitherto mostly focused on Africa and Asia.

The existing body of evidence suggests that the sharing of landscapes between humans and wildlife has different implications for men and women with respect to their attitudes toward wildlife and how they are impacted by it. Feminist political ecology is highlighting the importance of overcoming "gender blindness" by en-gendering research (Kellert and Berry, 1987; Ogra, 2008; Espinosa, 2010; Carter and Allendorf, 2016; Banerjee and Sharma, 2021). Some studies acknowledge that women play a major role in the sustainability and resilience of social-ecological systems, and their influence is critical when it comes to human–wildlife coexistence and harmonic cohabitation of space (Alexander et al., 2022; Carter et al., 2016; Kellert and Berry, 1987; Anthony et al., 2004; Espinosa, 2010). Women have their own distinct form of traditional environmental knowledge (Eyzaguirre and Linares, 2010) and shape attitudes to and perceptions of wildlife, as well as influencing the use of natural spaces (Westermann et al., 2005; Alexander et al., 2022). They preside over environmental activist groups and therefore influence management decisions and the conservation of biological resources (Herzog, 2007; Agarwal, 1997; Anthony et al., 2004). Addressing the gender dimension of human–wildlife interactions could help us identify new drivers of coexistence connected to perceptions, values, and behaviors and, therefore, new effective strategies for coexistence.

To this date, we have almost no information on this topic for Latin America. Particularly in Chile, being a woman involved in HWC poses a variety of obstacles, especially for *campesinas*[1] that subsist in a context of poverty, isolation, and lack of resources (Bahamondes and Herrera, 2009). In this perspective article, we will briefly communicate the need to address the lack of a gender perspective in human–wildlife coexistence research, and how doing so could contribute to alleviating the challenges faced by women involved in HWC (Westermann et al., 2005; Agarwal, 2009; Sodhi et al., 2010). We refer to two categories of female stakeholders that play different roles: *campesinas* (female farmers) and female practitioners (professionals and researchers), although focusing mainly on the first group as traditional dwellers of landscapes and carriers of essential traditional local knowledge (TLK) (Barreau and Ibarra, 2019; Guerrero-Gatica et al., 2020). For our purposes, *campesinas* are teachers and traditional keepers and carers of the land, whereas practitioners are observers, facilitators, and apprentices (Liamputtong, 2008). Each group contributes to coexistence with their own knowledge and resources. We present three undocumented

[1] *Campesinado* is a concept used to refer to the social group of *campesinos* and *campesinas*. Close translations for these terms are "smallholder farmers" or "family farmers", although they lack the richness, historical perspective, and significance of the Spanish term. The word *campesina/o* includes "millions of small- and medium-size farmers, marginalized landless people, women farmers, indigenous people, migrants, and agricultural workers from all around the world" (Woods, 2012). For the purpose of this perspective article and to use terminology that implies social justice, we will only speak of *campesinas* for women and *campesinos* for men farmers.

experiences of our work as female practitioners and facilitators of human–wildlife coexistence in three distinct rural areas in the Andes of Chile: north, central, and south (Table 1). From these experiences, we identify certain gender traits that we believe merit rigorous exploration in future scientific studies worldwide. We discuss what the gender-related variables are that should be looked at in future research with the aim of adding a gender perspective to the field of coexistence. We contrast our experiences with the existing literature that has treated this topic.

The need for a gender perspective in the field of human–wildlife coexistence

Diversifying knowledge and including new perspectives means moving away from male-oriented management measures. The limited amount of information about the relevance of women in HWC management and decision-making within the field might affect their potential to contribute and create change (Anthony et al., 2004; Anderson, 2020; Alexander et al., 2022). Collaborations between different female stakeholders for environmental management provide different results than male-led experiences (Fortmann, 1990) and lead to more democratic and creative management decisions (Gore and Kahler, 2012).

Many female practitioners and political ecologists are currently encouraging their audience to understand and challenge gender essentialist assumptions from ecofeminism that state that women are naturally more sensitive and connected to the environment (Banerjee and Sharma, 2021). These assumptions are originated in the historical accumulation of management forms and, therefore, are considered endogenous results of women–wildlife coevolution (Haraway, 2014). Women do have different priorities for conservation and resource management and different drivers for valuing wildlife (Kellert and Berry, 1987). However, the particularities of the woman–nature relationship have a more complex and socio-political origin and are the result of a historical, contextual, situated, and embodied conceptions (Montecinos et al., 2003). Feminist political ecology emphasizes that gender differences originate in the need to overcome existing social and political barriers (Agarwal, 1997; Ogra, 2008; Gore and Kahler, 2012).

In rural livelihoods, there are often roles for women and roles for men, and, through this article, we are not seeking to criticize the existence of these differentiated roles. The division of tasks, knowledge and responsibilities according to gender can generate complementarity and overlap (Rocheleau, 1989). Gender relations are multiple and related to social entities,

TABLE 1 General description of the three cases where the authors have done work in human–wildlife coexistence ([1]Vargas, 2021; [2]Vargas et al., 2021; [3]Vargas et al., 2022; [4]Almuna et al., 2020), including information on women and indigenous participation in the studies. We also present a list of the gender traits identified from our perspective that would be relevant to assess for future research.

	Northern case[1]	Central case[2,3]	Southern case[4]
Location	Coquimbo region	Valparaiso region	La Araucania region
Coordinates	29° 59′S–71° 9′W	32°21′S–70°47′W	38°47′S–71°31′W
Industry	Goat	Cattle	Poultry
Species in conflict	Puma (*Puma concolor*)	Guanaco (*Lama guanicoe*)	Diurnal raptors (*Parabuteo unicinctus*, *Accipiter chilensis*, *Geranoeatus polyosoma*)
Habitat	High Andes wetlands and shrubland	High Andes wetlands and shrubland	Andean temperate rainforest
Method	Workshops and semi-structured questionnaires	Workshops and semi-structured questionnaires	Semi-structured questionnaires
Female participation in study	60%	<10%	76%
Indigenous communities' participation in study	None	None	Mapuche, 49%
Female participation in animal management	High	Low	High
Gender traits	- High participation in animal caring duties - High participation in decision-making and organizational spaces - Mixed networks with female leaders - Strong women-to-women bonds - Deep connection to nature and intangible value for biodiversity	- Low participation in animal caring duties - Traditional practices negatively affected women's participation in decision-making and organizational spaces - Exclusive men networks - Tangible value for natural resources	- High participation in animal caring duties - Animal care related to home garden and household care - Mixed networks with female leaders - Strong women-to-women bonds - Deep connection to nature and intangible value for biodiversity - Creative conflict management measures

where factors like power, social class, generation and ethnicity are articulated. Hence, in some human communities, we will find gender relations where women are subordinate; in others, we find complementarity; and in others, we still find more protagonism. The problem arises when women's labor is less visible, recognized, and validated (UN Women, 2001; Lamas, 2013). When women decide to work in sectors dominated by men, they can suffer from discrimination and have to overcome a number of barriers to achieve validation or be heard (Banerjee and Sharma, 2021). Extreme situations can even feature sexual or emotional abuse (Tinkler and Zhao, 2020). This is specially the case for when women try to be part of decision-making spaces (Reygadas et al., 2007; Anderson, 2020; UN Women, 2001).

Women tend to create their own informal networks that are often powerful and highly influential (Agarwal, 1997; FAO, 2012; Gitungwa et al., 2021). Studies show that women's participation and leadership in organizations dedicated to natural resource management helps achieve a more creative and productive task force (Anderson, 2020). Women TLK has different sources to its male counterpart, and women's interactions with nature have their own unique and distinctive motivations (Painemal and Álvarez, 2016; Banerjee and Sharma, 2021).

Three experiences in Chile that illustrate a global concern

Within rural landscapes of South America, the *campesinado* has been defined as a rural producer who works relatively small patches of land, with the family being in charge of most or often all of the labor. *Campesinos* often do not own the land which they work (Woods, 2012). In Chile, the *campesinado* mostly fits with this definition, especially when referring to family farming, but it is relevant to add that total household income from livestock and agricultural exploitation is often very low, which leads to low employment and drives families toward multi-activity performing paid employment (Bahamondes and Herrera, 2009; Cid et al., 2017). Rurality is changing, with more activities being performed outside the farm, with women taking more part in rural work, and with urban and rural areas increasingly interacting (Cid et al., 2017). With these changes, new gender relationships are appearing that have not yet been analyzed. The relevance of women's paid and unpaid work is only starting to be recognized, and there is no notion of how this is impacting vulnerability and gender gaps in rural families.

How rural women and men are differentially adapting to these social changes, along with other changes in the landscape of climatic and structural nature, including variations in biodiversity and ecosystem resources, is unknown. This includes adaptation to changes in human–wildlife dynamics. As female practitioners addressing HWC in different areas of Chile, we have had widely different experiences but very similar concerns about how little we know about the role of women in this field worldwide. Through our work, we were able to recognize gender traits that, although they are only experiential and have not yet been evidenced by science, they provide a valuable preliminary insight in relation to gendered roles in human–wildlife dynamics. In 1987, Kellert and Berry (1987) recognized a lack of reliable data on the differences between men– and women–wildlife dynamics and how they were purely based on speculation and biases. After exploring the current literature, we were surprised by the fact that, 35 years later, there is still a major knowledge gap (Barua et al., 2013; Khumalo and Yung, 2015; Alexander et al., 2022; Herzog, 2007). The traits that we have identified and their implications are not sufficiently supported by our scientific field, and we believe that this is not because they are not happening elsewhere but because they are rarely studied.

Here, we present three cases of our own experience as female practitioners addressing HWC and coexistence in different rural areas of Chile (Table 1). The main results from these research initiatives have been published (Almuna et al., 2020; Vargas, 2021; Vargas et al., 2021; Vargas et al., 2022), and, based on these experiences, numerous questions arose regarding the distinct role played by women, particularly *campesinas* and indigenous women, in human–wildlife coexistence initiatives. After realizing how underrepresented this topic was in the scientific literature, we decided to write this perspective article, with the aim of proposing future directions based on personal experience and available scientific literature. We also represent and communicate the key elements of the role of women through a naturalistic illustration based on and inspired by these experiences to add breadth, clarity, and robustness to the message that we are attempting to convey (Figure 1).

The northern case involves goat farming by *campesinos*, who are also known as "*crianceros*", that practice this subsistence activity mainly in central and north-central Chile. It is characterized by nomadic pastoralism in search of fresh pastures, in which displacement is joined by the family group. Livestock activities are a men-dominated practice, but with high dependence on the support and cohesion of the family (including women and children) (Baeza, 1970). In this context, mothers and daughters take responsibility from an early age and play relevant roles in caring for the animals and manufacturing goats' cheese (Baeza, 1970). Working here, it was not uncommon to find women leading and representing the *crianceros* guild, and their work appeared to open spaces of trust and dialogue, where women had strong, long-lasting bonds and high networking capacities. This raises the question of whether this high female presence can allow us a better understanding of the dynamics and traditions behind their interactions with wildlife. The puma is the main predator present in the high Andes wetlands and shrublands that can eat their livestock. In this ecosystem, the *crianceras* freely grazed their goats, often accompanying the animals so that they did not

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FIGURE 1
"Private life of feminine rurality", illustration by María de los Ángeles Medina inspired by the spaces of intimacy between women and their animals, and between women and the social–ecological landscape. This naturalistic illustration shows how women dwelling on their spaces of silence and privacy develop traditional and local knowledge. From contemplation and action, they learn about animals and plants. They do this on their own and with their neighbors. This constant horizontal and intimate interaction makes them empathetic and sensible observers and guardians of our relationship with biodiversity and its life forms.

get lost or predated by the puma (Figure 1). This mobile grazing allowed the women to have close contact with nature and built a connection and sense of place. The time investment by the *crianceras* destined to care for the goats was also important, and the concern that they showed for the health and safety of the animals was evident. From our perspective, there could be a connection between these previous elements and the human–wildlife dynamics, associated with greater knowledge of the natural landscape or willingness to care for it.

The central case describes working with *campesinos* from the cattle sector of central Chile, who are mostly constituted by men, with only a few cases involving a female presence. Here, livestock management is carried out collaboratively as a community, through male associations. Women, in this case, can have an important role in the family economy, but by performing other activities such as agriculture, maintenance of home gardens, feeding livestock that remains near the house, and housekeeping (Fawaz and Soto, 2012; Menegoz and Covarrubias, 2019). Unlike the previous case, here, *campesinas* did not go to the mountains nor did they co-inhabit spaces with the guanaco. During the summer seasons, when cows and guanacos graze in a shared territory, the women would stay at their homes away from mountain life (Figure 1). They did not participate in the care of the cattle on the mountains. Their perception of the dynamics between livestock and wildlife was closely associated with what their husbands or children passed on to them. Our work in this context was challenged by cultural views and characterized by limited women's influence and participation. Here, statements such as "women bring bad luck" and "the mountain is a place only for men" created a tense and challenging atmosphere, especially because the main researcher was a professional and postpartum woman who arrived at the meetings with a month-old baby in her arms. This context was particularly challenging, with a marked masculinization of the space and numerous obstacles that made it even more difficult to move forward with the already complex work of HWC management.

The southern case presented here was located in the Andean temperate forest of south-central Chile. In the area, homegardens and poultry family farming are integrated into a broader agroforestry system (Galluzzi et al., 2010; Ibarra et al., 2021). The work here was carried out mainly with *campesinas* and a mixture of Mapuche indigenous and non-indigenous families, which helped create a space for cross-cultural knowledge exchange. In this opportunity, non-lethal methods for managing human-raptor conflict were assessed. Here, it was normal for women to take care of the poultry, whereas men took care of the livestock (Coña and de Moesbach, 2010). The reason for this probably is because, in almost every case, the chickens stay near to the house and the home garden, which is usually women's business (Figure 1) (Barreau and Ibarra, 2019). As in the northern case, here, we witnessed close contact between women and nature. There was creativity and efficiency in the management measures the participants came up with (Almuna et al., 2020); they recognized the intangible value of nature and showed great knowledge of wildlife behavior and their role within the ecosystem. Moreover, it was very interesting to see the significance that they gave to symbols and ancestral stories and how this impacted their attitudes toward raptors. This significance might be influenced by indigenous values immersed in the cultural mosaic present in the area.

In the cases presented here, we identified gender traits that vary together with the level of female participation. In the examples with more female participation, we observed greater networking capacities with strong women-to-women bonds, intangible valuation of nature, and a conspicuous difference in the fluidity of the work and communication between practitioners and participants. Women hold unique values and knowledge and carry out fundamental practices for coexistence, identifying that these practices could be a relevant breakthrough for this scientific field. Values and traditions played an important role in the three cases. In the central case, cattle rearing was men's business, and

the presence of women was even considered to be a nuisance. On the contrary, in the northern and southern cases, women played a notorious role in animal care that suggests that the practice of nurturing (their children, plants, and animals) could be highly significant for fulfilling an essential role in domestication, conservation, and human–wildlife coexistence in the rural landscape of Chile (Eyzaguirre and Linares, 2010; Barreau and Ibarra, 2019). In addition, in the southern case, shared landscapes with the Mapuche community that have extensive knowledge of the natural world and that consider biodiversity as an important part of their worldview could promote coexistence and intangible value of nature and its cohabitants within the non-Mapuche community (Rozzi, 2012; Ibarra et al., 2020).

The gender traits that we identify in these case studies make us wonder whether gendered roles, responsibilities and use of space may produce gendered risks. Risk may be more perceived by women; nonetheless, management of conflict has been reported to be predominantly male-oriented (Banerjee and Sharma, 2021). This is why the specific impact of HWC on women should also be determined. Some studies have reported that the negative impacts of human–wildlife interactions can often be long-term and uncompensated for women, which could certainly have an effect on women–wildlife dynamics (Ogra, 2008; Barua et al., 2013; Banerjee and Sharma, 2021).

Discussion

Here, we presented three different socio-cultural and ecological contexts, where the role of women varied from case to case. Our objective is to raise our concerns about the scarce amount of scientific evidence about the role of women in human–wildlife coexistence because, from our experience as practitioners, we have observed gender traits that suggest that the role of women is unique and fundamental in the pursuit of coexistence (Figure 1).

To consider gender itself as an explanatory variable to different perceptions and attitudes toward wildlife is to overly simplify the relevance of gendered human–wildlife interactions (Gore and Kahler, 2012). Some studies have reported gender differences in attitudes toward wildlife (Kellert and Berry, 1987; Gore and Kahler, 2012; Khumalo and Yung, 2015; Carter and Allendorf, 2016; Banerjee and Sharma, 2021). Some say that women, in general, show more positive attitudes toward animals, being involved in more conservation initiatives than men (Kellert and Berry, 1987; Herzog, 2015; Carter and Allendorf, 2016). Others say that women, in relation to carnivores, tend to show more fear and hold more negative perceptions (Dickman et al., 2013; Bhatia et al., 2017; Alexander et al., 2022). However, there is still not enough information to identify tendencies and associated factors. Acknowledging that these findings are valuable insights contributing to gender perspective, we consider that it is important to explore beyond the gendered and cultural differences in attitudes toward wildlife.

Future studies should also include other variables for a better understanding of the complexity and relevance of the role of women in human–wildlife dynamics in rural settlements. Feminist political ecology and cross-cultural research could be key frameworks to explore these other variables and address this complexity (Banerjee and Sharma, 2021). On the basis of the gender traits, we identified from our experiences, and we consider social identity is a relevant variable to include. Whether women identify themself as *campesinas*, indigenous, conservationists, hunters, urban dwellers, or others could impact their exposure to HWC and engagement in managing it (van Eeden et al., 2019). From our personal experience, we suggest additionally that time spent with livestock in nature and women's networking capacities as possible variables that could have an impact in their strategies to manage conflict.

Other authors recommend that household responsibilities, economic status, marital status, and number of dependents are also variables to consider because these may impact women's exposure and vulnerability to gender barriers and wildlife impacts (Khumalo and Yung, 2015; Banerjee and Sharma, 2021). As stated by Reygadas et al. (2007) and Agarwal (1997), we also believe that it is relevant to study women's unequal access to land ownership and the consequent low participation of women in decision-making spaces. This is one of the main reasons behind the division of labor, where women tend to dedicate their time to care duties (ECLAC, 2021). These care duties are basically productive and reproductive unpaid work that make male work available, together with others taking care of other alternative sources of income (looms, crafts) and supporting food production through home gardens, which reduces the monetary cost of feeding (Agarwal, 1997).

Human–nature relations are shaped by how the land is perceived or attributed meaning, which is why landscapes are a continuous work in progress (Skogen et al., 2019). We also believe that using a feminist political ecology framework when addressing gender differences is very important to challenge the notion that women are inherently closer to nature. It is our responsibility as female scientists to acknowledge that human gendered interactions have their roots in political issues such as unequal access and control over resources, unequal rights, and reduced access to decision-making spaces (Agarwal, 1997; Banerjee and Sharma, 2021). When gender-disaggregating data, research should focus on TLK including the voices of women, men, and children through community-based, participatory and interdisciplinary approaches to achieve effective and fluent dialogue (Gore and Kahler, 2012; Biskupovic and Canteros, 2019). Doing this not only supports inclusiveness and equity but also creates a space for women's knowledge to contribute to conservation (Sandberg, 2013; Alexander et al., 2022). This could make a difference in terms of feminist environmental justice by helping women to overcome existing social and political barriers (Agarwal, 1997)

and make coexistence initiatives more successful and expeditious (Banerjee and Sharma, 2021).

Author contributions

RA: Conceptualization, methodology, investigation, and writing. SV: Conceptualization, methodology, investigation, and writing. JC: Conceptualization and writing. MM: Conceptualization and illustration. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The 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.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2022.1006006/full#supplementary-material

DATASHEET 1
Spanish copy of the manuscript.

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Community livelihoods and forest dependency: Tourism contribution in Nyungwe National Park, Rwanda

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Introduction: Communities living adjacent to protected areas in Africa are characterized by high poverty rates and their well-being often depends on park resources. This often results in forest degradation and decline in wildlife populations, for example due to illegal hunting for bush meat. To counter this challenge in Rwanda, a tourism revenue sharing program was initiated in 2005, with 5% (doubled to 10% in 2017) of the park gate fees invested in community development projects. We evaluated the effectiveness of this tourism revenue sharing from 2005 to 2017, targeting communities adjacent to Nyungwe National Park located in south-western Rwanda.

Methods: We used questionnaires addressed to members of community associations and local government in 24 sectors around Nyungwe National Park. Additionally, data on illegal resource use and socio-economic status of the surrounding communities were obtained to quantitatively triangulate and draw insights from communities'perceptions. Using spatial analyses and spatial regression, we mapped trends in illegal activities relative to socio-economic characteristics.

Results and discussion: Both the qualitative and quantitative results indicate that the tourism revenue sharing program has not fully succeeded in improving community well-being around Nyungwe National Park. The tourism revenue sharing can consider targeting areas that demonstrate more need and reassessing prioritization of interventions supported by the program to achieve both poverty reduction around Nyungwe National Park and improved conservation outcomes in this protected area.

KEYWORDS

Community development, forest dependency, Nyungwe National Park, tourism revenue sharing program, Rwanda

1 Introduction

East African countries such as Rwanda generate a significant percentage of their national budgets from tourism (Nielsen and Spenceley, 2011; Republic of Rwanda, 2014). Indeed, the Government of Rwanda is committed to the development of the tourism sector, and, although challenged by the COVID-19 pandemic, the number of visitors has been generally increasing over the past decade (Republic of Rwanda, 2014; Rwanda Development Board, 2018). Visitors pay fees for specific activities in parks, such as mountain gorilla and chimpanzee trekking, while outside of protected areas and parks, tourists observe the scenic landscapes of the country and learn about local history and culture, with fees for some attractions or tours (Table 1 shows fees collected in Nyungwe National Park from 2010 to 2017). According to the World Travel & Tourism Council (WTTC), in 2018, tourism and travel contributed to 14.9% of Rwanda's total Gross Domestic Product (GDP) (WTTC, 2019). This adds value to the national economy, but also has the potential to contribute considerable direct benefits to the local people living adjacent to the touristic sites (Spenceley et al., 2010).

In Rwanda, the touristic attractions, especially protected areas, have high biodiversity value but are commonly surrounded by communities with high population density that are often poor (Masozera and Alavalapati, 2004; Plumptre et al., 2004; Hartter et al., 2016; Sabuhoro et al., 2017). While sustainable tourism in protected areas is achieved when biological resources are also properly managed (Leung et al., 2018), the poor communities near national parks in developing countries such as Rwanda rely heavily on harvesting resources from protected areas; for instance, fuel wood and bush meat for livelihood purposes (Masozera and Alavalapati, 2004; Sunderlin et al., 2005; Bernhard et al., 2020). In order to create a more mutually beneficial situation (i.e., increase the park protection, while ensuring community involvement in conservation); a tourism revenue sharing program has been introduced in Rwanda, as it has across sub-Saharan Africa and other high-biodiversity regions in the world (ORTPN, 2005; Ahebwa et al., 2012; Sabuhoro et al., 2017). With this initiative, the communities living adjacent to protected areas receive a percentage of the revenue from local tourism, and it is posited that this economic benefit may result in improved development, including food and/or economic security, and therefore reduce reliance on resources from the protected area (Bookbinder et al., 1998).

To achieve these goals in Rwanda, the tourism revenue sharing program was initiated in 2005 by the Rwanda Development Board [former Office Rwandais du Tourisme et des Parcs Nationaux (ORTPN)], the authority governing protected areas and national parks. In this program, originally 5% of the foreign exchange earnings from park visitation (gate fees and trekking permits) are returned to communities living adjacent to national parks (Nielsen and Spenceley, 2011; USAID, 2014); this percentage was increased to 10% in 2017. Through continuous support to communities, the tourism revenue sharing program is expected to contribute to reducing the dependency on park resources by funding projects which improve community-based enterprises and increase communities' participation in park conservation (Mulindahabi et al., 2011). The tourism revenue sharing can therefore supplement the direct benefits from tourism, including employment in the parks as guides or porters, tour operators and hotels that provide jobs to communities adjacent to national parks. The indirect tourism benefits comprise of the tourism revenue sharing itself and support to community projects and basic infrastructure (Spenceley et al., 2010; Munanura et al., 2020).

The types of projects to be supported are selected through a process that involves community associations (cooperatives), the local government (sector, district) and the park management (ORTPN, 2005).

While the tourism revenue sharing programs have shown positive impacts in some parts of the world (Ahebwa et al., 2012; Leung et al., 2018; Spenceley et al., 2019), researchers continue to question the contribution of tourism to the development and

TABLE 1 The number of tourists and revenues generated in Nyungwe National Park from 2010 to 2017.

Year	Number of visitors	% Increase per year	Amounts collected in USD	Amounts collected in FRW
2010	5, 755	–	252, 425	225, 920, 375
2011	8, 274	44%	385, 223	344, 774, 585
2012	7, 621	-8%	327, 047	292, 707, 065
2013	6, 902	-9%	271, 403	242, 905, 685
2014	9, 312	35%	367, 927	329, 294, 665
2015	8, 817	-5%	317, 992	284, 602, 840
2016	13, 644	55%	549, 610	491, 900, 950
2017	14, 415	6%	534, 821	478, 664, 795

Data source: Rwanda Development Board. The exchange rate (1 USD= 895 FRW) used was obtained from the National Bank of Rwanda (https://www.bnr.rw/index.php?id=23, accessed on 16 May 2019). USD, United States Dollar; FRW, Franc Rwandais (Rwandan Franc).

economic growth of poor communities living near rich biodiversity areas (Bookbinder et al., 1998; Isaacs, 2000; Sabuhoro et al., 2017). Around Volcanoes National Park in northern Rwanda, researchers have found that some projects fail to reduce people's dependency on park resources (Sabuhoro et al., 2017; Bernhard et al., 2020).

This study contributes to this growing literature, identifying linkages between community livelihoods, tourism revenue sharing, and trends in forest dependency in Rwanda specifically, by presenting data from Nyungwe National Park located in south-western Rwanda. The study objectives are the following: (1) determine communities'perceptions on the tourism revenue sharing program; (2) assess spatio-temporal trends in illegal forest dependency activities in the park relative to tourism revenue funding; and (3) explore the tourism revenue sharing projects' socio-economic impacts over the 13-year period from its inception in 2005 to 2017. The study pools the tourism revenue sharing budget allocation into two periods for analysis: 2005-2011 and 2012-2017. The period of 2005-2011 corresponds to when the program on tourism revenue sharing started until its first formal evaluation by the Wildlife Conservation Society (WCS, 2012), and the period of 2012-2017 constitutes the period after evaluation. During the first period (2005-2011), the percentage of the tourism revenue sharing was at 5% of the total gross earned in each park; but this percentage was increased to 10% in 2017 to improve the funding allocated to community projects around national parks in Rwanda.

2 Materials and methods

2.1 Study area

This study was conducted in and around Nyungwe National Park, a tropical montane rainforest located in south-western Rwanda (2° 0' 0" S -3° 0' 0" S and 29° 0' 0" E -29° 30' 0" E). The park covers a total area of approximately 1,019 km^2, including the fragment of Cyamudongo forest (i.e., Nyungwe: ca 1,015 km^2; Cyamudongo: ca 4 km^2). Towards the south, Nyungwe National Park is connected with Kibira National Park in Burundi, and the two are part of the largest remnant Afromontane forests in Central Africa (Plumptre et al., 2002). Nyungwe National Park consists of different rainforest habitats, savannah, and swamps, lying on an elevation range of 1,600 m-2,950 m a.s.l and supplying approximately 60% of the water sources to Rwanda (Republic of Rwanda, 2003). The park is an important conservation area as it is home to around 86 mammal species, 280 bird species and 230 tree species (Plumptre et al., 2007). The total number of mammals recorded comprises 13 primate species (Plumptre et al., 2002): including, chimpanzee (*Pan troglodytes*; endangered), colobus monkey (*Colobus angolensis*; least concern), blue monkey (*Cercopithecus mitis*; least concern), l'hoesti's monkey (*Cercopithecus lhoesti*; vulnerable) and mangabey (*Lophocebus albigena*; least concern).

Upon the establishment of Nyungwe as a forest reserve in 1933, tourist and visitor numbers were low and remained so until 2004, when a tourism development strategy was developed (Walpole, 2004). Since 2005, research and conservation activities and park infrastructure have seen substantial improvement, as touristic infrastructure inside and around the park area has been developed and tourist and visitor numbers have steadily increased (Lal et al., 2017). Alongside these developments, a tourism revenue sharing program was established in 2005 with multiple objectives, including, as previously mentioned, community involvement in sustainable conservation and livelihoods improvement (Nielsen and Spenceley, 2011). According to the policy document (ORTPN, 2005), the projects supported through tourism revenue sharing are implemented at the level of the sector (administrative boundary) and they aim at improving community livelihoods, long-term projects, provide jobs to locals and target the most vulnerable communities as beneficiaries. Since the initiation of the tourism revenue sharing in Rwanda, the minimum budget for each project was set at approximately $1,000, while the maximum budget was fixed at $120,000 (ORTPN, 2005).

2.2 Primary data

We used both key informant interviews *via* questionnaire and focus group discussions (Nyumba et al., 2018), and this approach allowed to optimise time and reach all the targeted communities in the area of interest (Figure 1). We conducted a six-week fieldwork from the 6th May to 13th June 2018. All the 24 administrative sectors around Nyungwe National Park were visited, and data were collected about the benefits of the tourism revenue sharing, perceptions, awareness and livelihoods improvement. Additionally, structured interview questionnaires were distributed to either the sector's business development officer or the agronomist, and only 19 questionnaires could be completed. The outcomes of this survey with the local government could complement the discussions with communities. In the community associations (cooperatives), we interviewed those who benefit from the tourism revenue sharing program (TRS) and those who had no direct connection with the TRS. This method would allow comparison of the perceptions of local communities having a project in their cell and those without a project in their cell. Two administrative cells in each of the 24 sectors were selected using a stratified random sampling. The data on projects supported through the tourism revenue sharing and the projects locations (sectors, cells) were obtained from the park management and validated by the local administration. In total, 48 cells were selected and 761 community members participated in the focus group discussions. Both men, women and the youth

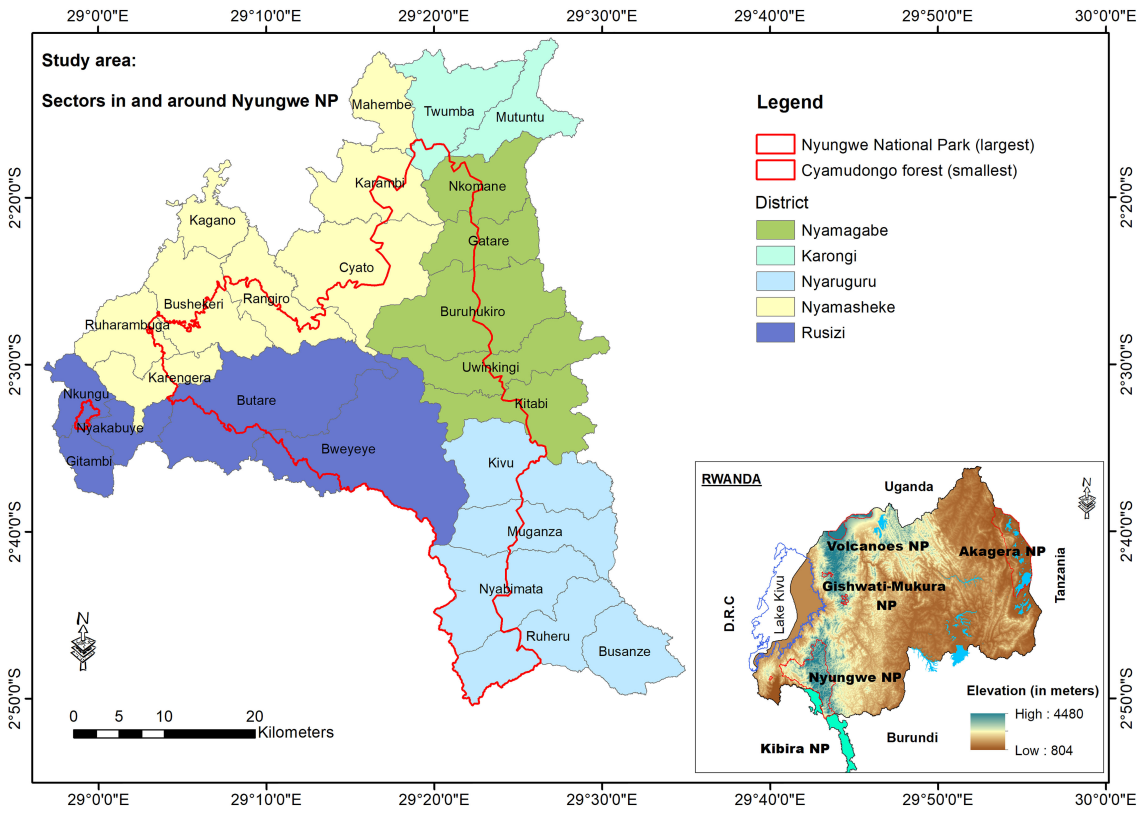

FIGURE 1
Administrative boundaries of the area of interest: 25 sectors within five districts bordering Nyungwe National Park are the primary spatial unit of quantitative analysis in this study. Cells are the administrative unit within sectors in Rwanda. Only 24 sectors are targeted for tourism revenue sharing (TRS), but we also considered the sector of Kagano, which received TRS funding only once.

attended; the smallest focus group had four and the largest thirty-three participants. In this article, the term "community" is used to mean a homogenous social structure with shared norms (Agrawal and Gibson, 1999). We used the term "(local) communities" as the plural of "community" and it refers to farmers, villagers living in the same administrative unit and usually all practicing the same economic activity (e.g., agriculture, livestock).

2.3 Secondary data

We used three types of secondary data to complement outcomes from key informant interviews and focus group discussions. The data on tourism revenue sharing projects and ranger-based monitoring were obtained from Rwanda Development Board, Nyungwe National Park management. We requested data on socio-economic status of communities living adjacent to the park, and these were shared by the National Institute of Statistics of Rwanda (NISR, 2018). Additional data on population density could be downloaded from AidData GeoQuery (Goodman et al., 2019).

The data on tourism revenue sharing investments in sectors around Nyungwe National Park included 136 total projects supported for all sectors from 2005-2017 and the total annual funding to each of those projects. The funding was in Franc Rwandais (FRW). Although the tourism earnings are mostly in US Dollars, the institution responsible for park management collects all the money for each park and considers the updated exchange rates to convert the tourism budgets in the local currency: FRW. The dataset on ranger-based monitoring contained 93,556 total summed observations of illegal activities recorded in the park and an unbalanced panel aggregated to the 24 sectors to 268 observations (due to dropouts over both time and space) over the period of 2005-2017. The additional socio-economic variables were used as control variables in a regression analysis that estimated the effect of tourism revenue sharing on illegal resource harvesting inside Nyungwe National Park. These variables constisted of population density, household consumption and education variables extracted from the Integrated Household Living Conditions Surveys (EICVs 3, 4 and 5) administered by the National Institute of Statistics of Rwanda. The population density and household consumption

were merged by sector and year as indentifiers and provided key socio-economic insights (see Supplementary Materials). Analyses were performed using Stata IC 16, ArcGIS 10.6.1 and GeoDa. Microsoft Excel was used to compile qualitative data.

2.4 Analysis

2.4.1 Project types and funding size

The tourism revenue sharing projects around Nyungwe National Park were classified into six groups: (i) education, (ii) environmental protection, (iii) water, health and sanitation, (iv) basic infrastructure, (v) food security, and (vi) income generating activities (Table 2). Note, the projects were grouped following the same categorization as in other protected areas such as the Volcanoes National Park (Spenceley et al., 2010).

2.4.2 Communities' perceptions on the tourism revenue sharing

The focus group discussions targeted one cell per sector that benefit from the tourism revenue sharing (TRS) and one cell that does not receive support from this program. In total 48 cells (2 cells for each of the 24 sectors) constituting 761 focus group discussions were considered for the analysis; including 336 communities who receive support from the TRS and 425 who do not directly benefit. The percentage of 'Yes' and 'No' responses was determined, and verbatim from some respondents were shared as quotes. The Chi-square test of independence was used to identify whether differences are significant among the views of communities who receive direct support and those who are not supported by the tourism revenue sharing program.

2.4.3 Quantitative analysis: Linking tourism revenue sharing and forest dependency

The quantitative analysis was performed to identify spatial and temporal trends in illegal activities relative to changes in population density, socio-economic behaviors and changes in community livelihoods. The data on illegal activities were first cleaned, then corrected for bias.

Bias presents a key issue with the use of ranger-based monitoring data (Keane et al., 2011). As a law enforcement tool, ranger patrols involve non-random spatial patterns of patrolling and introduce sampling bias. Increasing effort can reduce total illegal activities through deterrence, but also increase the proportion of activities detected (Albers, 2010; Keane et al., 2011; Critchlow et al., 2017; Moore et al., 2018). Preferably, we would account for both ranger effort and coverage using a spatially-extracted variable for proportion of park area covered in patrols. As such kind of data was not available, we calculated as best feasible proxy weighted encounter per unit effort using annual patrol days as the proxy for effort:

$$\delta_{st} = \frac{Encounters_{st}}{Effort_t} \qquad \text{Equation 1}$$

where δ is weighted detected encounters in sector s for year t. *Encounters* is raw encounters in sector s for year t. *Effort* is

TABLE 2 Categories of the tourism revenue sharing projects around Nyungwe National Park (NNP), Rwanda.

Project type	Examples (based on projects funded around NNP)
1. Education	* Construction and rehabilitation of schools or classrooms (nursery, primary and secondary), * Purchase school equipment.
2. Environmental protection (or alternatives)	* Beekeeping, * Fodder production (e.g., elephant grass), * Bamboo cultivation, * Improved cooking stoves, * Growing mushrooms.
3. Water, health and sanitation	* Water and electricity provision (water sources, water supply), * Water tanks.
4. Basic infrastructure	* Road rehabilitation, * Construction and rehabilitation of health facilities, * Purchasing equipment for health centers or health posts, * Construction of houses for poor families, the youth center, * Construction of a middle market.
5. Food security	-Agriculture: * Growing fruits, vegetables, maize, wheat or Irish potatoes, * Support in establishing tree nursery beds, * Support to set up a shelter for drying crops, granaries, grinders, * Construction of maize factory. -Livestock: * Rearing cows, pigs, fish, chicken, * Construction of a milk collection center.
6. Income generating activities	* Arts and culture: animal skin processing, pottery, traditional dance, handcrafts, * Construction of tile factory and modern kiln.

Data source: Rwanda Development Board, park management.

proxied by annual number of rangers participating in routine patrols.

In the spatial analysis of tourism revenue sharing relative to forest dependency, we first created kernel density based maps using the point pattern of encounters. This produced raster-based maps visualizing regions with high density of encounters of illegal activity in Nyungwe National Park. Kernel density estimates for illegal activity were overlaid with proportional symbols for tourism revenue sharing funding for each sector in each period, with 2005-2017 split into 2005-2011 and 2012-2017. Here we excluded any funding that was distributed to multiple sectors without information on the specific amount disbursed to each individual sector within the district. The % of the overall amount of funding that fell into this category is 1.41%. Then, we used the bivariate local Moran's I statistic to test the statistical significance of the relation of clusters to each other. The bivariate local indicator of spatial association and significance maps show sectors of high-low and low-high, which respectively indicate sectors receiving high tourism revenue sharing in a cluster of low illegal activities, or low tourism revenue sharing in a cluster of high illegal activities. A bivariate local Moran's I value of zero indicates random sorting of one variable relative to the other. -1 signifies dispersion and 1 signifies clustering (Lee, 2001; Anselin, 2002). The local Moran's I considers only the value of X at location A and the neighbourhood's value of Y, using the spatial lag of Y (queen contiguity). The bivariate local Moran's I is given by:

$$I_B = \frac{\sum_i (\sum_j W_{ij} y_j \times x_i)}{\sum_i x_i^2} \quad \text{Equation 2}$$

where x_i is tourism revenue sharing at sector i. $W_{ij}y_j$ is the spatial lag of y, which is the illegal activities count in sector j, using a row-normalized queen contiguity matrix, which was selected to accommodate the sector-level. The overall significance threshold for interpretation of bivariate Moran's I outputs in this study was 10%.

2.4.4 Econometric modelling

A spatial econometric model was constructed for panel regression analysis, of the type 'spatial lag of x' (SLX). Time-variant factors addressed by SLX regression at sector level include tourism revenue sharing investment (the variable of interest), population density, and local biophysical conditions such as precipitation. Time-invariant factors that we have controlled for include proportion of a sector that is inside protected area boundaries and areas with high tourist activity. Spatial autocorrelation was tested using univariate local Moran's I and constructed spatially lagged variables for those exhibiting Moran's I greater than 0.4. Therefore, the relationship between illegal activities and tourism revenue sharing investment was estimated by the model:

$$\delta_{st} = \alpha + \beta_1 X_{st} + \beta_2 W X_{st} + \beta_3 trs_{st} + \beta_4 W trs_{st} + \epsilon_{st} \quad \text{Equation 3}$$

where δ_{st} is weighted detected encounters in sector s and year t. X_{st} is a vector of controls, such as human population density and precipitation, and area of a sector within park boundaries calculated in ArcGIS (Goodman et al., 2019). trs_{st} is the tourism revenue sharing funds distributed to sector s for year t. W indicates spatially lagged variables. A temporal lag of one year was also incorporated to account for the delay between tourism revenue sharing investments and potential reduction in illegal activities. Standard errors were clustered to sector to ensure robustness to heteroscedasticity (Stock and Watson, 2008).

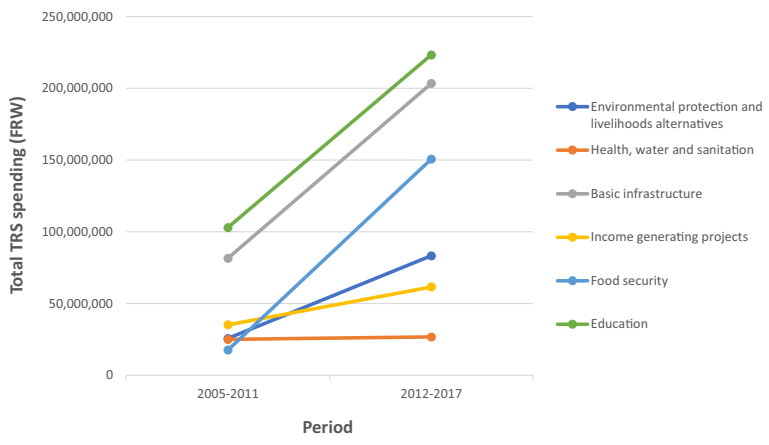

FIGURE 2
Tourism revenue sharing funding allocation per project type, demonstrating increases between periods 2005-2011 and 2012-2017. There was no project supported in 2011. TRS, tourism revenue sharing; FRW, Franc Rwandais. Data source: Rwanda Development Board.

3 Results

3.1 Project types and funding size

The funds allocated to projects under the tourism revenue sharing have increased between the two periods studied, 2005-2011 and 2012-2017 (Figure 2). The largest amounts have been invested in projects supporting education (e.g., construction of classrooms) and basic infrastructure (e.g., construction of houses for the poorest communities and relocating some households that were living in the buffer zone of Nyungwe National Park). Smaller budgets were allocated to environmental protection initiatives or alternatives (e.g., beekeeping, bamboo or elephant grass multiplication) and income generating activities (e.g., pottery, handcrafts).

3.2 Communities' perceptions of tourism revenue sharing

First, communities were largely aware of tourism revenue sharing projects, mainly since the year 2006. However, 11.3% of the total interviewees reported that they only heard about this program on the day of interview for this study (Supplementary Materials). These communities are from the cooperatives located in cells (administrative units composing a sector) without a project funded under the tourism revenue sharing program. However, communities members of cooperatives from cells with a funded project could understand the tourism revenue sharing since its initiation in 2005 (44.15% of the interviewees in this category understand what the program is about). Next, communities generally perceived the tourism revenue sharing to be an important program. There was no significant difference in the views on this between funded cooperatives and those that are not funded (χ^2 = 3.334, df =1, *P–value*=0.067), and indeed 40% of communities from supported cooperatives and 60% of communities from non-funded cooperatives agreed that the tourism revenue sharing is important (see Supplementary Materials). Critically, members of non-funded cooperatives had noticed that the neighbors' members of funded cooperatives receive additional support, from which they saw some benefits as well but not in the same way. Members of non-funded cooperatives emphasized that they are able to buy materials such as honey from cooperatives that are funded under tourism revenue sharing, which benefit them. One of the respondents from a funded cooperative explained:

"The tourism revenue sharing contributed a lot: now our children can get milk as we received cows under this program. Malnutrition is controlled. We wish to continue collaborating with the park management and get more support. We would like to get support on improving farming during dry seasons (e.g., setting up infrastructure for irrigation)."

The cooperatives that receive funding were also asked about their awareness of the development of tourism revenue sharing projects, and their involvement in project design, approval and implementation. Of the total, only 47.2% of the respondents confirmed that they had previously been asked about developing and submitting projects to be funded, yet 69.8% of respondents have contributed to the later project implementation. As indicated on Table 3, the same community group could share that they do not clearly understand the steps towards the projects approval (70% of respondents); but a few of them participate in the projects approval (29.6% of respondents).

The community associations generally face some challenges with implementing tourism revenue sharing projects, but they appreciate these projects and recommend their continuation with suggested improvements (Table 4). The majority of respondents want the tourism revenue sharing program to continue and improve (> 90% of responses) but they also recognize that some of the objectives of the program have not been achieved so far (51.8% of responses). A member of a funded cooperative underlined:

"The tourism revenue sharing program should continue because there is a long way to go for communities adjacent to Nyungwe National Park. The problems of crop raiding and increasing poverty rates are still there. The program can consider funding other cooperatives that are not close to the park boundary, as they also illegally harvest resources from the park."

The local government representatives could share examples of supported projects that are achieving the tourism revenue sharing objectives; including reducing harvesting resources from the park and improving community livelihoods. These leaders highligted beekeeping, agriculture, livestock and infrastructure

TABLE 3 The communities' perceptions of involvement in tourism revenue sharing' project design, approval and implementation.

Community perception	% of 'Yes' responses	% of 'No' responses
Aware of projects being developed	47.29	52.71
Understand steps to project approval	29.97	70.03
Contribute to project approval	29.64	70.36
Contribute to project implementation	69.88	30.12

n= 336 (only cooperatives that receive support).

TABLE 4 The communities' perceptions on whether the objectives of the tourism revenue sharing were achieved and willingness for improvement of the program.

Community perception	% of 'Yes' responses	% of 'No' responses
Objectives not met	51.84	48.16
Willingness to continue	100.00	0.00
Willingness to improve	99.60	0.40

n=761 (cooperatives receiving and those not receiving support).

projects (e.g., construction of classrooms, health facilities, water and electricity provision).

3.3 Tourism revenue sharing relative to forest dependency behaviors

The spatial regression analysis found that socio-economic characteristics contribute to community behaviors, in that they can exacerbate forest dependency in the form of illegal harvesting of forest resources. Unfortunately, however, the support provided by the tourism revenue sharing appears to have had a limited effect in terms of reducing these activities over time and space. Spatial regression results at the sector level consistently showed a significant negative relationship between the sectors' contribution to the national per capita Gross Domestic Product and illegal activities in Nyungwe National Park (Table 5). The two most recorded illegal activities are 'snares (illegal hunting)' and 'tree cutting' (see Supplementary Materials). During our interviews, we asked communities why some of their colleagues still practice the illegal hunting and tree cutting in Nyungwe National Park. One of the respondents explained:

"There are communities who still consider hunting as a normal practice that is part of their daily life. This is the case of Batwa group. Additionally, the value of a material made from park resources (e.g., timber) is higher than another object made of material from outside the park."

The results of the separate spatial statistical analysis using bivariate local Moran's I further support this finding. Some administrative sectors, like Bweyeye, Ruheru, Butare, and Karambi received high tourism revenue sharing funding during the period of 2005-2011; but still experienced high encounter rates

TABLE 5 Results of spatial regression analysis[1], using a panel of sectors and years.

	Spatially lagged	Spatially and temporally lagged	
	Illegal activities (CPUE-corrected)	Illegal activities (CPUE-corrected; temporal lag for TRS funding)	Household consumption
TRS funding allocation	2.31E-05		2.23E-03
	(8.18E-05)		(5.81E-03)
TRS funding allocation [L1]		4.64E-05	
		(7.00E-05)	
Population density	7.56E-01	1.06E+00	1.32E+02)
	(1.44E+00)	(9.06E-01)	(1.46E+02
Sector contribution to GDP	-1.88E+04*	-1.25E+04**	8.19E+05*
	(9.74E+03)	(4.82E+03)	(6.09E+05)
Precipitation (spatial lag)	1.53E+01	3.10E+01	1.64E+03
	(3.00E+01)	(3.08E+01)	(3.14E+03)
Year	1.49E+02**	1.56E+03	1.24E+03
	(6.20E+01)	(2.67E+03)	(5.34E+03)
Constant	2.99E+05**	4.64E-05	2.57E+06
	(1.25E+05)	(7.00E-05)	(1.06E+07)
n	121	121	123
R-squared	0.523	0.264	0.098

[1] Illegal activities from ranger-based monitoring data is the response variable; this is corrected by ranger effort and controlled for proportion of a sector within protected area boundaries. One specification includes household consumption (a proxy for income and average household welfare for each sector). Square brackets indicate temporal lag (e.g., [L1] = one-year time lag). Significance level: **p < 0.05, *p < 0.1. The robust standard errors in parentheses are clustered to district. Spatial weights are based on queen contiguity matrices. CPUE, catch per unit effort-corrected; GDP, per capita Gross Domestic Product; TRS, tourism revenue sharing; n, number of observations included in the model.
Data source: Rwanda Development Board and National Institute of Statistics of Rwanda.

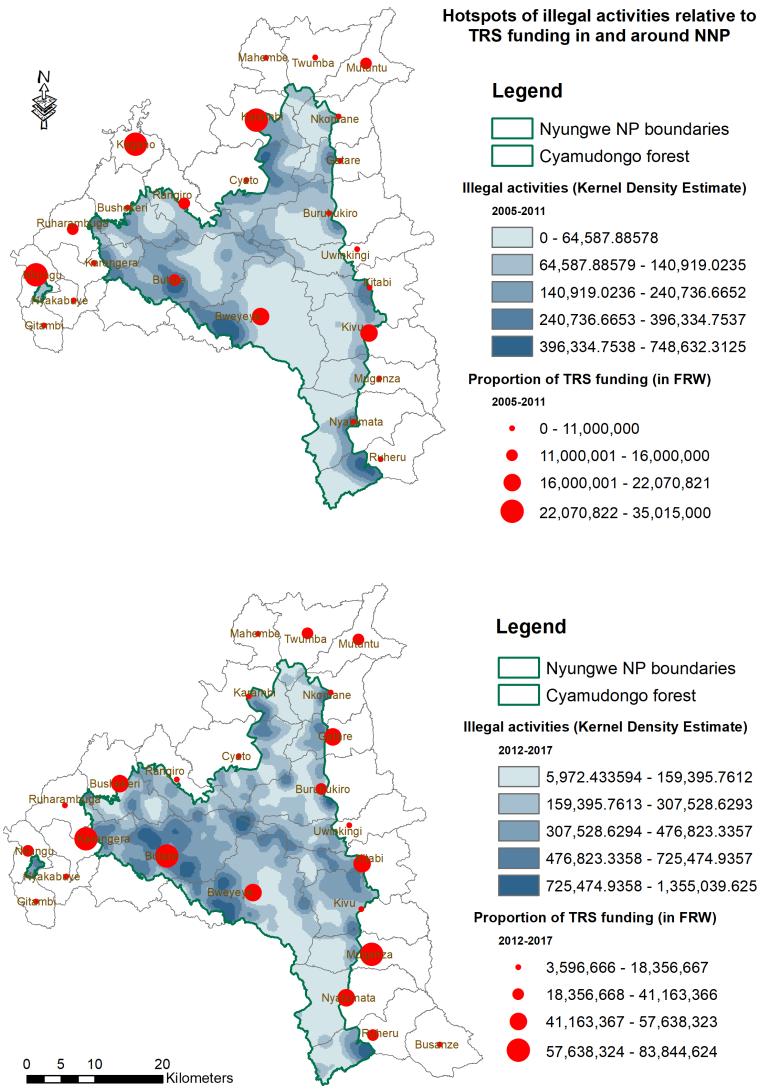

FIGURE 3
Hotspots of illegal activities in Nyungwe National Park relative to tourism revenue sharing funding to sectors bordering the park from 2005-2017, split into two periods 2005-2011 and 2012-2017. NNP, Nyungwe National Park; TRS, tourism revenue sharing; FRW, Franc Rwandais. Data source: Rwanda Development Board.

of illegal activities in the years following. The sectors of Gitambi, Mahembe, Nyabimata, Twumba and Mutuntu are likely to have low encounter rates of illegal activities, in contrast to the sectors of Bweyeye, Butare, Cyato, Ruheru and Uwinkingi (Figure 3). However, incongruity between tourism revenue sharing and illegal activity rates was also found. The negative statistic (Moran's I= -0.0361293) was observed in the period of 2005-2011, indicating that tourism revenue sharing funding is not clustered by sector and is dispersed across the area of interest. But there is improvement in the spatial targeting of the funding in the period of 2012-2017 where positive statistic (Moran's I= 0.0870272) was found (Figure 4).

4 Discussion

This study aimed at finding out the impacts of the tourism support to improving the livelihoods and reducing community dependency on harvesting resources from Nyungwe National Park, a protected area located in the south-western Rwanda. We presented the communities' perceptions about the tourism revenue sharing, their willingness to have the program continue and improve. We also quantitatively analyzed the relationship between the tourism revenue sharing funding and encounter rates of illegal activities inside the park. In the following sections, we reflect on two main study findings: (1) communities perceptions

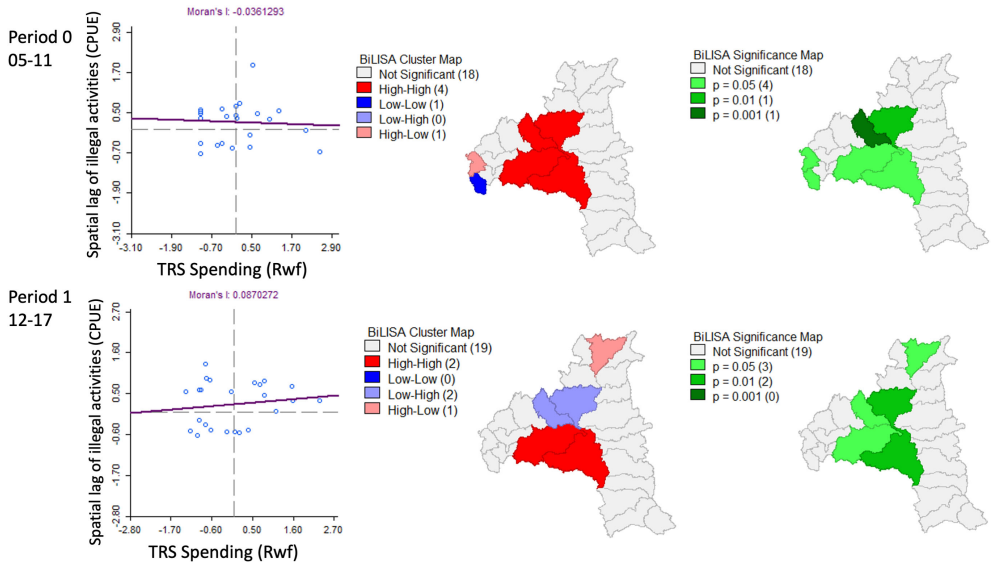

FIGURE 4
Bivariate local Moran's I of TRS funding allocation relative to the spatial lag of illegal activities in sectors adjacent to Nyungwe National Park (essentially, the 'neighborhood' of illegal activities). The green significance maps show the level of statistical significance of these clusters. For both map types, numbers in parentheses (e.g., Not Significant (18) or High-High (2)) indicate the number of observations within that category. High-High: a sector of high TRS funding surrounded by sectors of high illegal activities; Low-Low: a sector of low TRS surrounded by sectors of low illegal activities; Low-High: a sector of low TRS surrounded by sectors of high illegal activities; High-Low: a sector of high TRS surrounded by sectors of low illegal activities. TRS, tourism revenue sharing; Rwf, Rwandan Franc/Franc Rwandais.

about the support from tourism and (2) contribution of this community support to their livelihoods and reduction in illegal harvesting of resources in the adjacent protected area.

4.1 Communities' perceptions of the tourism revenue sharing program

We found that the tourism revenue sharing is important for local communities living adjacent to Nyungwe National Park, and that these communities wish to have continued support under this program. However, interview responses of tourism revenue sharing' beneficiaries stress that improvements need to be made as some of the objectives have not been fully achieved in the last 13 years (2005-2017). It is important to note that communities are now aware of the tourism revenue sharing, in contrast to the outcomes of the program assessment conducted in 2011 (WCS, 2012). Our research participants also shared some challenges they face during the implementation of the tourism revenue sharing program (Table 6). In particular, the projects beneficiaries are not strongly engaged in the project design process. Communities are engaged in projects implementation, but with limited power over which projects are implemented at selected locations in different sectors around the park. This is true for basic infrastructure projects, which are usually developed by local government and receive much of the funding. The projects supported through tourism revenue sharing can focus on activities which improve the community livelihoods, and this may reduce the forest dependency behaviors. This recommendation was also made during the first evaluation of this program by WCS; communities would appreciate smaller projects that directly come from the park revenues: e.g., beekeeping, handcraft making. Future research can consider interviewing those that make illegal use of the park resources about their motivations. More importantly, assess the impact of the tourism revenue sharing after 2017 as the percentage was increased to 10%.

On one hand, these results indicate that the community projects funded under tourism revenue sharing are perhaps still immature and have not yet shown tangible impact; projects supported might not have yet directly addressed high poverty rates of communities around Nyungwe National Park, but they could be contributing to improved socio-economic conditions in the longer term. On the other hand, this supports the literature which has shown that tourism revenue programs require complementary initiatives, focused on capacity building and cultural benefits, and greater community ownership over the projects selected (Spenceley et al., 2019).

What, then, would be required of tourism revenue sharing projects around Nyungwe National Park, in order to make the

TABLE 6 Major challenges in the implementation of the tourism revenue sharing (TRS) and possible recommendations.

Challenge with TRS implementation	Community suggestions
1. Projects developed and submitted by community associations (or cooperatives) are likely to be less competent when there is a similar project submitted by local government	-It could be better to give space to communities for choosing what they want to be supported for improving their livelihoods. -There is need to have a focal person at the sector level who can review and assess projects submitted by cooperatives (community associations). -Training on developing high quality projects.
2. It takes long (5 to 6 months) for cooperatives to receive the money on their bank account, after their project has been accepted	-The districts should resolve this issue and release budgets on time. -Follow up if the cooperative has received the money and the way it is used afterwards.
3. Some cooperatives get funds but then the planned activities fail. Projects that are still immature, and not sure whether they will keep going	-Regular monitoring and visits to cooperatives supported, to make sure if they are achieving their performance. -Revise the types of projects that can be funded. - Consider supporting projects/initiatives with multiple interests and impacting to a large number of populations. -It would be better to give priority to small projects like providing small cattle, distribute fertilizers to people for supporting agricultural production.
4. Planned activities are not properly implemented and on time: because once the funds are approved, they go through different levels before being disbursed to the cooperative, and sometimes the cooperative does not receive the exact amount as initially requested	-Particular and strong measure to monitor the money flow (TRS funds) or explain to cooperative members why the initially requested budget is not always considered. -Follow up on how the funds are distributed from the district level to the cooperative.

The text was translated from the local language (Kinyarwanda) to English and all the content is as it was said by interviewees in 24 sectors around Nyungwe National Park. TRS, Tourism revenue sharing.

program more effective in reducing poverty and community dependency on the forest resources in the park? It appears that greater community ownership over project selection and approval, and greater spatial alignment of projects with community needs and incidence of forest dependency, would improve the tangible poverty-related impacts of the tourism revenue sharing program (Bernhard et al., 2020). To take a regional perspective, Carius and Job (2019) found that the tourism revenue sharing contributed to sustainable development goals in the region around Jozani-Chwaka Bay National Park and Biosphere Reserve, Zanzibar (Tanzania). This success was due to different factors, including: (1) 90% of the staff in the national park are community members; (2) the community involvement in governance and management of tourism revenue sharing is high; (3) tourism revenue sharing empowers local communities to invest according to their priorities; (4) the equitable contribution of both government and civil society ensures fair sharing to all beneficiaries; and (5) progress and decision is guided by regular monitoring and evaluation of tourism revenue sharing by semi-independent investors.

However, potential pitfalls still remain. Spenceley et al. (2019) reviewed the tourism revenue sharing around terrestrial protected areas in Africa and highlight that the initiative is among a suite of benefits for local communities adjacent to protected areas, and while beneficiaries already perceive that the support is important, there are still cases of failures in implementing tourism revenue sharing programs (Tumusiime and Vedeld, 2012; Spenceley et al., 2019). Tourism benefits have to be very high, more equitably and directly distributed to potential beneficiaries in need, to enable the theoretical linkages between conservation and improved community livelihoods to come to fruition as a result of the program. Before implementing community support projects, it is important to first identify conservation and community socio-economic needs and determine whether these projects align with community incentives (Kiss, 2004; Carius and Job, 2019). Additionally, follow up on the flow of money and who benefit from the tourism revenue sharing fund is essential as indicated by one of the respondents during our interviews:

"We developed a project and were aware that we will receive funding, but surprisingly we were later communicated that our fund was stuck at the district as we do not meet all the requirements to get the tourism revenue sharing fund on this particular project. We feel like the district dominates when it's time to decide which projects to be supported, instead of giving priority to the local communities to share what kind of support they need".

Challenges in implementing the tourism revenue sharing program were also identified in a similar protected area in Uganda: Bwindi Impenetrable National Park. Ahebwa et al. (2012) suggest addressing the imbalances in designing projects and distributing funds to community projects. The situation here still shows complications in accessing the tourism revenue sharing funds due to difficult conditions on these funds, and low budgets invested in the program. Most of the problems are likely to be under control of the government; especially the park management (Uganda Wildlife Authority).

4.2 Tourism revenue sharing and forest dependency behaviors

The results of the quantitative socio-economic analysis in this study show that sector contribution to per capita Gross Domestic Product has a significant negative relationship with illegal activities in Nyungwe National Park. In other words, the sectors with the most relative economic activity see the least illegal activity, controlling for the size of park area in that sector, among other variables. This is interpreted as evidence to suggest that insufficient economic opportunity could be among the main drivers of communities to illegally harvest resources from the park. This is also further supported by the results illustrating that the sectors that receive low funding for projects under tourism revenue sharing are often surrounded by a cluster of sectors with high illegal activities (Figure 4). Poverty persists in communities living adjacent to Nyungwe National Park and, while tourism revenue sharing is not a panacea, some of this forest dependency behavior could be more effectively addressed through continuous support under the tourism revenue sharing with improved implementation of the program. Additionally, the privatization of the park's buffer zone affected community behaviors as harvesting resources in the buffer zone is no longer allowed as it was before (Gross-Camp et al., 2015). Critically, these findings therefore recommend increasing the initiatives in highly forest-dependent areas to elevate the socio-economic conditions of the poor communities living in those areas. More importantly, projects that consider gender might contribute to behavioral change as mostly men do the illegal hunting and carry meat at home while women and children are usually involved in firewood collection from the park. Snares and tree cutting are the most encountered illegal activities in Nyungwe National Park (see Supplementary Materials). Particular attention could be on community projects that address meat and timber needs. This also may require a reassessment of projects, including their prioritization and selection, in areas which are already receiving high funding but are located in a cluster of sectors with high illegal activities (e.g., Cyato, Rangiro, Butare and Bweyeye in the period 2005-2011; Butare and Bweyeye in the period of 2012-2017), and sectors receiving low funding surrounded by sectors of high illegal activities (e.g., Cyato and Rangiro for the period 2012-2017). Similar findings in Rwanda' Volcanoes National Park also suggest that, going forward, a list of the community-supporting initiatives that would reduce forest dependency should be compiled in partnership with communities, and those projects enacted (Munanura et al., 2014; Sabuhoro et al., 2017). Future research could investigate additional data to better understand the impact of the tourism revenue sharing program. For example, the production data from cooperatives and data from education projects could enrich the results. Future studies could also concentrate on determining the contribution of projects funded by conservation NGOs and other civil society organizations that support community initiatives around Nyungwe National Park. Additionally, in light of the COVID-19 pandemic and its impact on tourism in East Africa and indeed across world, it will be important to revisit these data and analyses in the post-COVID-19 era to determine how the restrictions on travel and tourism have limited the ability of the tourism revenue sharing to support communities.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, upon formal request and approval from the institutions that shared these data.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

PA, TG contributed to the design of the study. PA, MD and IN conducted fieldwork. PA, KB performed the data analysis. PA, KB developed the first draft of the manuscript. All authors read, revised and approved the manuscript before its submission. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The 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.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2022.1034144/full#supplementary-material

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Increasing women's participation in wildlife governance in Zambia

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Community-based natural resource management bodies, including Community Resource Boards (CRBs) and Community Scouts, are responsible for governance and wildlife law enforcement in Zambia's Game Management Areas (GMA), community lands that buffer the National Parks. Despite commitments to inclusive governance and benefit sharing, men dominate the wildlife and natural resource sectors in Zambia; they make up the vast majority of wildlife scouts who patrol the GMAs and hold most positions on the CRBs who allocate benefits and decide on management priorities. Gender blind structures within community governance institutions during the recruitment and training process and social and gender norms that see leadership roles as men's domain act as barriers to women's participation in the sector. In response, the United States Agency for International Development (USAID) invested in a comprehensive package of activities to increase women's effective participation in wildlife governance and law enforcement, including gender-responsive CRB elections, empowerment training for newly elected women candidates, revised community scout training curriculum, and capacity building support for organizations that support scouts and CRBs. The intervention helped increase women's representation in CRBs from four percent to 25 percent in pilot communities. It also supported the Department of National Parks and Wildlife (DNPW) to recruit the first gender balanced cohort of community scout recruits and field an all-women patrol unit in Lower Zambezi National Park.

KEYWORDS

wildlife, gender, Zambia, natural resource governance, women's empowerment, community governance

1 Introduction

Zambia's protected areas are home to abundant wildlife including elephant, giraffe, lion, leopard and rhino, which bring in millions of dollars from tourism, hunting, and carbon credits, as well as international biodiversity conservation support. Protected areas account for 20 percent of land in Zambia, including 20 National Parks and 36 Game Management Areas (GMAs), which act as buffer zones around the National Parks (see

Figure 1) (Lindsey et al., 2014). While settlements are not allowed in National Parks, GMAs are mixed use spaces, where communities live alongside protected area habitats. But humans and animals are coming in more frequent contact with one another due to increasing wildlife populations from successful conservation efforts, as well as agricultural expansion due to increasing populations and market opportunities. This intensifies human-wildlife conflict that results in crop destruction, livestock attacks, and deadly human-animal encounters. At the same time poaching remains a major threat to animal populations in GMAs, both for bushmeat and the illegal wildlife trade (Lindsey et al., 2014; Watson et al., 2015).

Community-based natural resource management (CBNRM) has been widely adopted in Zambia since the late 1990s and is codified in the Wildlife Act of 2015, as well as the Community Forest Management Regulations of 2018. Management rights in GMAs are devolved to Community Resource Boards (CRBs), elected from local communities, and community scouts are hired to carry out law enforcement responsibilities under the Department of National Parks and Wildlife (DNPW) and with support from non-governmental organizations (NGOs). Global criticisms of CBNRM approaches relate to elite capture, non-transparent governance institutions, and a lack of consideration of community dynamics (Agrawal and Gibson, 1999; Sommerville et al., 2010; Barnes and Child, 2014; Musgrave and Wong, 2016). Gender and social inclusion are often criticized as afterthoughts in the implementation of CBNRM approaches (Flintan and Tedla, 2007).

A baseline gender assessment on CBNRM in Zambia (Malasha and Duncan, 2020) identified the current status and key barriers to women's full participation within the wildlife sector, revealing two key areas of exclusion for women: wildlife governance institutions and formal employment opportunities. Men dominate CRBs that make decisions around community natural resources and revenue streams (Malasha, 2020). Yet women have a strong vested interest in how natural resources are managed. Women and men bring unique knowledge and perspectives to decision-making bodies, though women tend to be underrepresented in management institutions (Ngece, 2006; Giesecke, 2012; FAO, 2018). A growing body of evidence shows women's participation in community resource governance brings benefits not only to women, but to their families, communities, and conservation efforts more broadly (Agarwal, 2009; Mwangi et al., 2011; Leisher et al., 2016; Beaujon Marin and Kuriakose, 2017). Prior to 2018, women made up less than 10 percent of CRB members across Zambia's 76 elected CRBs, and only four were led by women (Malasha, 2020). Many CRBs interviewed had no women representatives (Malasha and Duncan, 2020).

According to the Wildlife Act, CRBs are responsible for identifying community priorities for benefit sharing, distributing benefits, and representing community issues with the DNPW.

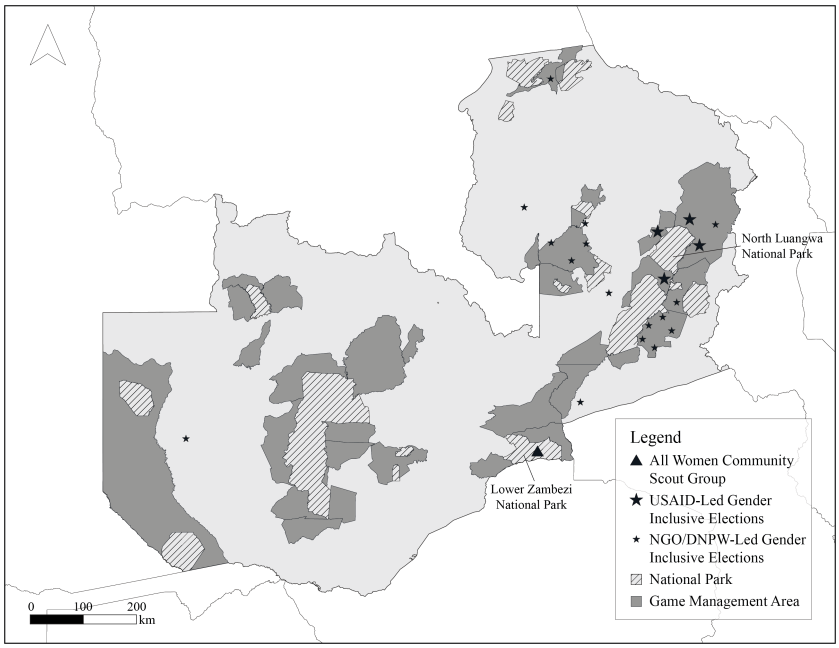

FIGURE 1
Map of protected areas in Zambia.

The lack of women's full representation has meant that women's issues are rarely prioritized (Malasha, 2020). The gender assessment found that even when a CRB earmarked funds for community projects that directly addressed the needs and interests of women, funds were often redirected to areas that men were more interested in. For example, one CRB reported that they spent gender earmarked funds on a social event, a community organized football match (a sport traditionally only played by men) (Malasha and Duncan, 2020). The lack of women's participation creates a vicious cycle whereby women increasingly feel excluded from CRB governance and so remain unaware of the relevance of the group to their lives, leading to further disengagement from CRB activities.

The DNPW oversees the wildlife sector and employs 1,254 wildlife police officers to help enforce forestry and wildlife regulations (personal communication, DNPW, October 4, 2022). Local conservation NGOs also employ 1,402 community wildlife scouts to help patrol protected areas (personal communication, DNPW, October 4, 2022). In rural parts of the country where employment opportunities are scarce, community scouts are an important job opportunity for young men and women. Yet women face social and structural barriers to access employment opportunities as community scouts (Malasha, 2021). As of 2018, just 11 percent of community scouts were women (personal communication, conservation NGOs, January 30, 2019). Given that high performing community scouts are often elevated to long-term government jobs as wildlife police officers, this pipeline challenge makes it difficult for women to get hired by the DNPW. Furthermore, the wildlife law enforcement sector—and the law enforcement sector as a whole—has long been criticized for being hostile to women's participation, as it is highly militarized, reinforcing the masculinization of the sector (Seager et al., 2021).

This paper describes structural and norms-based gender barriers within the CBNRM governance and law enforcement structures in Zambia based on qualitative and quantitative data. It then outlines interventions to support women's economic empowerment undertaken by the United States Agency for International Development (USAID) in partnership with the DNPW, international and local NGOs, and the communities themselves across Zambia between 2018 and 2022.

2 Intervention context – Barriers to effective participation

Malasha and Duncan's (2020) baseline gender assessment – which included a literature review, focus group discussions and key informant interviews – identified a number of structural, social and gender norms barriers that prevent women from entering and effectively participating in the wildlife and natural resource sectors in Zambia.

Within community governance institutions, structures are generally gender blind, as procedures for carrying out elections do not explicitly include or exclude women (Malasha, 2020). CRB terms last for three years, and elections are often carried out in a rush towards the end of a term. As a result, little attention and resources are available to fund well-run and inclusive elections. Since CRB positions are responsible for community benefit sharing, have a role in employing community scouts and are one of the few formal power structures in rural areas, they are highly coveted. Candidates with personal resources to spend on elections are at a considerable advantage, as buying food and drinks for perspective voters is a common practice (Malasha and Duncan, 2020). This practice disadvantages women, even from wealthier households, who typically have less decision-making power and access to financial resources at the household level (World Bank, 2012; Demirguc-Kunt et al., 2015).

There are equally strong structural barriers that prevent women from becoming community scouts. Rules governing the selection process for scout candidates are often gender blind, which can inadvertently discriminate against women. For instance, community scouts must have a Grade 12 certificate and are often required to pass a physical fitness test that includes running in heavy boots and backpacks, physical tasks which women are less likely to have experience with than men (Malasha and Duncan, 2020). The Grade 12 certificate, a seemingly gender-neutral requirement, also acts as a barrier to women's participation, as women are less likely to have graduated from high school than men — Zambia's secondary gender parity index was 0.84 in 2015 (Central Statistical Office of Zambia, 2016). Once selected, training approaches for scouts are typically one-size-fits-all, focused on eliminating low performers rather than building up the capacity of nascent recruits (Malasha, 2021).

In addition to structural barriers, women face social norms and cultural barriers that inhibit their participation. Gender norms and stereotypes in Zambia dictate that are men are seen as decision makers in both the home and public spaces, while women oversee family care and household chores (Malasha and Duncan, 2020). Women's care responsibilities limit the time they have available to attend community governance meetings, which impacts women's knowledge about natural resource management issues. Furthermore, even when women are in attendance, women interviewed for the gender assessment reported that their views are often ignored (Malasha and Duncan, 2020). Some women said they were not comfortable speaking up in large mixed gender public settings. Culturally, leadership roles, including wildlife law enforcement, are men's domain (Malasha and Duncan, 2020; Seager et al., 2021). Thus, when women choose to step outside of prescriptive gender norms and run for CRB office or enter wildlife scout employment, they often face push back from family members, their community, and the institutions in which they work (Bessa et al., 2021).

These gender norms are particularly challenging for wildlife scouts to navigate. USAID conducted focus group discussions with 10 newly recruited young women scouts and five new women CRB members during their first year of service. Scout recruits are typically young women, at an age when traditionally women in Zambia get married and start having children. Thus, these young women are breaking the mold by entering formal employment. Interviews with women scouts revealed that while their families may appreciate the income they bring home, they often face backlash—accused of neglecting their familial duties and jeopardizing their chances of marriage (Bessa et al., 2021). Married women scouts report that they often face pushback from their husbands, who may resent their wife for earning income, leaving childrearing and home responsibilities to them, and spending weeks in the field with other men. Even while out on patrol, women say they are frequently relegated to supporting roles, expected to cook, clean, and guard camp, as opposed to going on patrols, or given unrealistic tasks to prove they are not cut out for the work (Bessa et al., 2021). NGOs and government extension officers often cite these threats of backlash as reasons to avoid hiring women as scouts. Thus, harmful gender norms are used as an excuse to perpetuate gender inequality.

Women scouts interviewed also reported incidences of gender-based violence (GBV) from intimate partners. Some said their spouses have accused them of infidelity or seized their wages (Bessa et al., 2021). A few scouts also faced threats of physical or verbal harassment from community members for taking on men's roles. Women scouts reported instances of harassment and sexual coercion at work, where supervisors made non-consensual sexual advances to junior women staff and threatened retaliation against women who did not comply (Bessa et al., 2021). Only in recent years has the sector begun to acknowledge and pay attention to GBV risks, rather than simply discouraging women from entering the discipline.

Despite these barriers and risks, women are eager to participate in the sector, recognizing the potential benefits, as well as the risks, of stepping outside of traditional gender roles. At the same time, there is a need to build support from within their families and communities (Malasha and Duncan, 2020). When women have greater decision-making power in natural resource management, their interests are more likely to be considered (Ngece, 2006; Giesecke, 2012; FAO, 2018). Women's participation increases their income earning potential, either through formal employment as wildlife scouts or benefit sharing from CRB roles. When women earn more money, they prioritize family education, health and nutrition spending, increasing household wellbeing (Smith and Haddad, 2000; Armand et al., 2020; Booysen and Guvuriro, 2021). Involving women in natural resource governance and enforcement also increases the adoption of sustainable practices, crucial in both adapting to and mitigating the growing threat of climate change (Agarwal, 2009; Mwangi et al., 2011; Leisher et al., 2016; Beaujon Marin and Kuriakose, 2017).

3 Project description

Based on the findings from the gender assessment, USAID identified two entry points for women's meaningful engagement in wildlife management: formal employment as community scouts and leadership roles as CRB members. USAID aimed to enhance effective participation in these areas by addressing structural barriers and gender norms to entry, as well as building women's capacity for success once they are in the roles. To address CRB capacity, in 2020, in partnership with NGO partner Frankfurt Zoological Society (FZS), the Zambia CRB Association and DNPW, USAID piloted gender inclusive elections in four chiefdoms surrounding North Luangwa National Park — Chifunda, Chikwa, Mukungule, and Nabwalya (Malasha, 2020). To address wildlife employment opportunities, USAID worked with DNPW and another NGO partner, Conservation Lower Zambezi, to recruit and train a cohort of all-women community scouts, alongside mixed-gender community scout groups from across the country. Pre-recruitment sensitization efforts took place ahead of formal recruitment, followed by a three-month residential training program at Chunga Wildlife Training Centre in Kafue National Park, after which scouts were posted at their new jobs. Details on the specific programmatic elements undertaken are described below.

3.1 Laying the groundwork

3.1.1 Carry out a gender assessment

The gender assessment allowed USAID to identify barriers to women's participation and target approaches to different stakeholders. Most importantly, it created an evidence base for discussing the activities with government and NGO counterparts, as well as identifying individuals who might be resistant to the work and those who could act as potential champions. Some of the outcomes of the assessment are described above and have fed into adaptive management.

3.1.2 Work through champions

Because gender norms are rooted in existing social power dynamics, at the beginning of the project USAID identified champions at different levels and invested in them to lead gender dialogues and influence norms change within their spheres of influence. Traditional leaders, who hold hereditary positions, are charged with carrying out administrative functions under Zambia's customary governance system and are the custodians of cultural norms and practices. They were a primary target for gender champions work, based on their influential role in communities. The other group of champions targeted were community facilitators from partner NGOs who had worked in the communities for years and built-up trust and respect.

These champions engaged with influential individuals in communities who were resistant to the work in the hopes of shifting their position over time.

3.2 Recruiting women to participate

Before USAID interventions, both scout recruitment and elections were gender-blind. But in practice, there were many steps that prevented women from stepping forward initially and engaging effectively. To address these barriers, USAID mobilized teams of conservation experts with a gender focus to support the scout recruitment and CRB election through the following steps.

3.2.1 Increase awareness

The team focused on increasing awareness of open opportunities. Because women have smaller social networks than men and have been traditionally excluded from public roles, they often do not know when job recruitments occur. Staff made concerted outreach efforts to women's and religious groups and targeted training centers, clinics and water access points where women are more present. For elections, community sensitization meetings were held with women, men, and traditional leaders to explain the election process and help potential women candidates navigate the required steps. Based on discussions with community and traditional leaders, traditional leaders proactively reached out to families where women had limited support to answer questions and encourage men to support women's candidacies.

3.2.2 Consider quotas carefully

To advance recruitment of women community scouts, USAID considered the advantages and risks of using quotas and targets to reach women. USAID partnered with Conservation Lower Zambezi, who had already committed to mobilize an all-women scout team. Since scout trainings commonly bring together multiple CRBs and NGOs, USAID agreed to subsidize the participation of women from other partner organizations to train a cohort of equal numbers of men and women. USAID supported Chunga Training Centre to adopt gender-responsive approaches in the delivery of training and all women managed to graduate (Malasha, 2021).

While no government mandated gender quotas exist for CRBs, four traditional leaders worked with FZS to adopt affirmative action policies to build support for women's participation in CRB elections. Some chiefs were supportive, but only encouraged their subjects to participate, while one went further and implemented a 50 percent gender quota for the 10 person CRB. While quotas were helpful in increasing women candidate's participation, they did not guarantee elected women were able to meaningfully engage in the work (Malasha, 2021).

3.2.3 Revisit pre-requisites

USAID worked with partners and DNPW to revisit the pre-requisites for recruitment that often make it difficult for women to compete fairly with men. Many pre-requisites for scout recruitment act as a barrier for women's participation, such as a Grade 12 certificate or physical endurance and fitness tests that are designed for men. The tests are not based on the minimum fitness or knowledge required to perform the job, for example by allowing all who complete the test within the time limit to proceed, but rather allow the fastest individuals to move forward to the next step. Continued dialogue with government and NGOs is required to further revise the pre-requisites for community scouts, as there is still a strong push for an educational requirement because it allows individuals to advance to a Wildlife Police Officer position. By law, there are no educational requirements for CRB members, a fact that was stressed during public meetings with potential women candidates and community members, as a lack of education and literacy had been used to discourage women from participating in the past (Malasha, 2021).

3.2.4 Help women prepare for candidacy

In order to reduce information and resource barriers that prevent women from being successful candidates, USAID identified cohorts of women interested in elections and helped prepare them physically and mentally in the weeks prior to the election. USAID and partners helped women candidates develop campaign strategies and practice public speaking skills. Women were encouraged to tailor campaign messages to their local context and build on their own personal strengths, rather than simply mimicking the approaches commonly taken by men. This cohort preparation model created a support structure for women candidates and helped ensure there was a critical mass of skilled women to stand for election. For scout recruits, USAID's partners outlined the physical fitness requirements for women ahead of time so they were able to practice and support women with gender sessions throughout to empower them to overcome challenges faced during training.

3.2.5 Ongoing community gender dialogue

Building on the entry level discussions with chiefs, community members were engaged early on to help them understand the goals of women's empowerment in the CRB election process and identify potential champions who could sway resistant members to accept women as leaders of their CRBs. Shifting gender norms is challenging and takes time, hence continued engagement with traditional leaders, community members, and women candidates, particularly through champions, is critical to encourage women's participation and garner community buy-in.

3.3 Supporting women in their new roles

Increasing women's representation in these leadership bodies is an important first step, but the program also provided follow-on support to ensure women were able to meaningfully participate in their new organizations. This included further orientation and training on their roles, establishing support networks for new recruits, and working to adapt institutional policies and structures within supporting NGOs and government agencies to better enable women's participation.

3.3.1 Revisit curriculum

Once selected for their new roles, scouts go through a three-month intensive field training program. At the request of Chunga Wildlife Training Centre, USAID supported an evaluation of the three-month curriculum to better address the needs of women in the training program. The curriculum now includes a gender module that discusses gender equality, gender norms, and GBV risks. USAID also provided training to the center's instructors to increase their capacity to carry out gender integration. USAID is also providing training and capacity building support to the DNPW to ensure gender integration is included in longer-term department training and support for community scouts.

3.3.2 Orient women on job entry

USAID promoted a gender-responsive CRB orientation to build members' understanding of position requirements and emphasize the equal role of women and men on the committee. CRBs rarely receive comprehensive introductions to their roles and responsibilities, which often leads to the sidelining of women members, who may be first time candidates and less aware of their duties and rights within the organization, or less willing to speak up in public settings due to engrained gender norms (Malasha, 2021). Spouses of women CRB members were also invited to the orientation to help them understand the roles of women in the institution.

3.3.3 Establish support networks

Newly elected women CRB members and community scouts can become isolated, as they are often the only woman, or one of a handful of women, within these institutions. Establishing support networks and creating spaces for women to come together is therefore important. The all-women scout unit provides a built-in support network for new recruits. Women work in this unit for a period of time, after which they can apply for a position in a specialized unit. This approach provides a support structure for young women to develop skills and build confidence as they enter the field, but does not permanently isolate them within a separate structure. While wildlife law enforcement is male-dominated, Lower Zambezi National Park, where the all-women unit works, has one of Zambia's highest ranking woman wardens, who plays an ongoing mentorship role with the new recruits.

3.3.4 Build institutional capacity to support long-term change

USAID also focused on building the capacity of the organizations that support scouts and CRBs. By training DNPW, NGO and associated staff who work directly with communities, partners gained technical skills and knowledge to advance women's leadership and economic empowerment within communities and their respective areas of operation. USAID developed a training of trainer's course on women's leadership and empowerment, designed to be integrated into existing extension programs. During the training, conservation organization staff were trained to deliver a 12-module course that builds women's confidence and assertiveness and their capacity to combat gender norms, communicate effectively, and effectively lead other women and men within their organizations. Conservation organizations are now using these materials to mobilize candidates and train women leaders in village action groups and CRBs. The training brings together individuals from across the country, building a community of practice and common language around gender integration in the wildlife space.

3.4 Combating gender-based violence

When women step outside traditional gender norms to enter a male-dominated field, the risk of GBV increases. To mitigate this risk, USAID invested in ongoing community dialogues about gender norms, developed materials and tools for implementing partners, and trained supervisors on GBV risks and mitigation measures. But sector wide shifts require additional top-down engagement and reform. USAID partnered with the Gender Division in the Vice President's Office to raise awareness on gender and GBV issues within the DNPW. USAID documented evidence of GBV in the wildlife sector and is helping conservation NGOs examine what they can do to effectively respond to and mitigate risks of GBV, while also identifying referral pathways for GBV service providers in the communities they work.

4 Data collection

Data for the following sections comes from formal and informal interviews with the participants in the above processes. Election data was collected during the gender-responsive CRB election process, with local staff recording the number of women and men who ran for a position, as well as those who were elected to both village action groups and CRBs.

Project staff then conducted follow up interviews with women and men CRB members at least six months after they were elected. For community scouts, data on the number of women and men scout recruits comes from DNPW. Follow up interviews were also conducted with women scouts six months and one year after completing the training course. Views shared were recorded anonymously to encourage candor.

5 Results

5.1 CRB Elections

During the first phase of gender-responsive CRB election pilots, 52 percent of potential candidates across the four chiefdoms were women (Malasha, 2020). Women now hold one in four CRB seats in these communities—up from four percent in 2018—and some hold leadership positions such as chairperson, vice-chairperson, or secretary. Village Action Groups (VAGs) in these communities, which support the work of the CRBs, saw women's participation increase from 23 percent to 41 percent (see Table 1).

The gender-responsive election approach has subsequently been adopted by 12 additional NGOs, who have carried out pre-election sensitization and training in 21 new GMAs since 2020. 16 NGOs have been trained to deliver the women's leadership and empowerment training and are integrating these approaches into their work with women leaders in communities.

5.2 Wildlife scout recruitment

Under the gender-responsive wildlife scout recruitment process, DNPW recruited a scout training class of 45 men and 45 women, the most inclusive cohort in the history of the scout training school. The cohort of women recruits supported one another through the grueling and physically demanding three-month training program. This critical mass of women recruits pushed the school to examine their own processes, curriculum, and requirements. Subsequent classes have also included a larger share of women than in the past, demonstrating a relatively quick shift in recruitment practices and acceptance of women as wildlife scout recruits (see Table 2).

Upon graduation, 10 scouts were selected for Zambia's first all-women patrol unit in Lower Zambezi National Park. These women scouts are performing the same tasks as their men counterparts. While many still receive push back for stepping outside traditional gender norms, they now have well-respected jobs and a stable source of income to support themselves and have become role models in their communities.

Law enforcement is still a men-dominated sector, and women scouts have to navigate pushback from within families, communities, and the institutions they serve. In some cases, this resistance has escalated to instances of GBV (Bessa et al., 2021).

6 Discussion

Over the past four years, USAID has worked with DNPW, conservation NGOs, and local partners to implement the suite of activities outlined above to increase women's participation in the wildlife sector in Zambia. The effort has achieved notable successes, dramatically increasing the number of women elected to CRBs and expanding the number of women scout recruits through approaches that improve their experiences and reduce risks. But shifting gender norms takes time, and the program has learned and adapted from the challenges it faced.

6.1 Successes

Two key elements enabled program success. First, the gender analysis was an important first step to contextualize the challenges preventing women from fully participating in the wildlife sector. The analysis identified elected governance and wildlife scout positions as areas for potential impact that were accessible to many rural women. It also revealed the risks associated with gender equality interventions, particularly related to GBV. Socializing these analyses was crucial to gain buy-in and interest from government, NGOs and traditional leaders.

Second, the program engaged and cultivated local leaders with social influence and power as project champions early on. In the early stages of work, these champions helped advocate for women's participation, making it clear to community members that they supported and encouraged women's inclusion in CRB elections and scout recruitment efforts. In the longer-term, champions create a

TABLE 1 Gender breakdown of CRB and VAG election results.

Year	CRB or VAG	Total	Women	Men	Percent Women
2018	CRB	121	5	116	4%
2018	VAG	328	74	254	23%
2021	CRB	128	32	96	25%
2021	VAG	680	279	401	41%

TABLE 2 Gender breakdown of community wildlife scouts trained in 2019-2021.

Year	Total	Women	Men	Percent Women
2019	148	36	112	24%
2020	97	26	71	27%
2021	134	43	91	32%

mechanism for scaling by leveraging their networks and broader influence. Providing champions with additional resources and connections to better leverage existing resources can help build long-term support for gender norms shifts.

The willingness of government and NGOs to acknowledge GBV risks within the sector and take proactive steps to address them was remarkable and it is worth sharing more broadly. Multiple NGOs have identified pathways to examine GBV risks within their operations and the communities they support. Long term, this will help create a more inclusive environment that supports women's participation and safety.

The USAID package of approaches was deployed through multiple partners in different locations across Zambia. While there was a critical mass of activities around women's leadership and empowerment in elections within the North Luangwa ecosystem and around community scout recruitment and training in the Lower Zambezi ecosystem, the diversity of approaches and partners makes a full evaluation of impacts challenging. The breadth of organizations involved in this effort, however, is extremely encouraging, and the women's leadership and empowerment training of trainers cohort has become a strong platform for social inclusion within Zambia's conservation sector.

Each of the approaches implemented received a generally positive review by community members, traditional leadership, NGOs and government alike. Most importantly, the individual women expressed gratitude that their aspirations and capacity development were kept paramount in all activities. These women were able to push beyond traditional gender norms in their communities, acknowledging the risks but also eager to seize new opportunities for themselves (Malasha, 2020).

6.2 Challenges

Despite these successes, increasing women's participation in the male-dominated wildlife and natural resource sectors is challenging.

6.2.1 Pushback from the community and some stakeholders

The use of quotas or targets can be an effective way to increase women's representation within the labor market and in decision-making bodies (Beaman et al., 2009; Beaman et al., 2010; Pande and Ford, 2011). But quotas can be less effective at achieving improved outcomes when there are perceived to be few viable women candidates (Profeta, 2017). While quotas were effective in wildlife scout recruitment, CRB based quotas often faced pushback from community members, who felt they were used to force out qualified men in favor of less qualified women. USAID and its partners are moving beyond a simple quota-based metric of success and instead focusing on the quality of engagement.

Both women CRB members and wildlife scouts have faced persistent community resistance to women in leadership roles, at times escalating GBV. This pushback has come from both men and women. This illustrates the long-term nature of efforts to change gender norms. Yet the support of some progressive chiefs and village headpersons is creating shifts in acceptance, and as more women are seen in these positions of authority, increased community acceptance may follow.

Efforts to increase women's participation received opposition from some key stakeholders, especially within government partners. These individuals were wary of discussions of gender equality, arguing it would disturb the status quo and could reveal other weaknesses within the department, such as a lack of transparency in managing resources and related revenues. Given the structure of the wildlife industry in Zambia, the DNPW is a key stakeholder whose buy-in and support is necessary to take these initiatives beyond initial pilot communities.

6.2.2 Limited capacity of NGOs to respond

Though many organizations were willing to promote inclusive approaches, they have limited institutional capacity to advance gender integration or address GBV. Concerns over the cost and time associated with effective gender integration remains a consistent challenge cited by partners. Pre-election and recruitment support for women candidates requires advanced planning and staff resources. While many of these activities could be built into standard, year-round work plans, leveraging other travel/meetings to reduce costs, in practice these efforts are still viewed as a one-off project.

7 Conclusions and the way forward

The approaches taken in Zambia could be adapted to community-based natural resource management frameworks in other countries, as the structural and gender norms barriers that restrict women's participation in natural resource sector are present globally. By building a cadre of gender champions and addressing underlying gender norms, in addition to improving recruitment and training practices, USAID hopes the transformations seen in the

wildlife sector in Zambia will last beyond the time frame of the project and contribute to lasting change in the sector.

Data availability statement

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

Ethics statement

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

All authors contributed equally to the drafting and revision of the manuscript and have read and approved the submitted version.

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Conflict of interest

Authors MS, TB, PM and MD were employed by the company Tetra Tech.

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Women's thirty-year contribution to cheetah conservation: An insight into volunteer-based conservation program supported by female scientists

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Women make up a small percentage of the scientific community, including conservation. Today, conservation efforts are vital for the survival of many species, however there is a gender bias within the conservation field. Encouraging more women into conservation could be a key to increasing efficiency and success in conservation goals of organizations and governments. Here we investigate the long running Earthwatch, working guest and intern volunteer programs of the Cheetah Conservation Fund (CCF) to understand women's involvement with volunteer based conservation, and questionnaire data to understand women's contribution to conservation after volunteering and what challenges women face in conservation. Our results showed there was significantly more female volunteers than male volunteers (p-value <0.000) and on average, females contributed to 73.7% of the volunteer population annually. Volunteer's age at time of volunteering varied between the three volunteer programs. Women's motivations for volunteering and challenges that women face in conservation was dependent on the volunteers' age. CCF's holistic approach to conservation, volunteers' love for cheetahs and ability to gain practical skills were the leading motivations why women volunteered with CCF. Many (87%) of the female interns said volunteering was a means of helping them gain employment. Women's credibility, family responsibility and personal safety were the main challenges that women face working in conservation today. Addressing gender disparities in every stage of career progression will lead to overall improved conservation outcomes.

KEYWORDS

female, conservation, cheetah, STEM - science technology engineering mathematics, volunteer, intern

Introduction

Most of the world's biodiversity today is threatened with extinction (Wake and Vredenburg, 2008; Ceballos et al., 2020), and the survival of many species relies heavily on conservation (Zegeye, 2017). *Ex-situ* conservation programs are known to help with species survival by maintaining insurance populations, and reintroduction of populations, that were once extinct in the wild (Russello and Amato, 2007; Xia et al., 2014; Grant et al., 2021). Many *in-situ* conservation programs help mitigate human-wildlife conflict, and provide community-based education programs throughout the species home range to ensure the survival of the species (Gusset et al., 2009; Sapkota et al., 2014). This is also the case for *in-situ* cheetah (*Acinonyx jubatus*) programs in Africa (Marker and Boast, 2015; Marker et al., 2020).

Despite the growing need for increased conservation efforts, there is a gender bias within the conservation field (Lievano-Latorre et al., 2020; Diele-Viegas et al., 2022). For STEM (science, technology, engineering, and mathematics) based fields, women make up only 28% of the global work force (UNESCO, 2017). There are various barriers and bias that contributes to promoting unequal opportunities and therefore women's contribution to scientific research (Davies et al., 2021). Barriers include 1) leave and pay inequity, 2) women's heavier care, domestic and office workloads, 3) conscious and unconscious bias which include discrimination and harassment and 4) lack of recognition (e.g. less funding or under cited in peer-review literature) (Elder and Schmidt, 2004; Sardelis and Drew, 2016; Jones and Solomon, 2019; Jones et al., 2020; Giakoumi et al., 2021). The lack of promotion and the gender pay gap are the leading reasons why most women leave the STEM industry (Hunt, 2016). According to Alvarez and Lovera (2016), it is only recently that the Conference of the Parties to the Convention on Biodiversity has taken tangible steps in an effort to mainstream gender in different biodiversity policies. It is therefore clear that women have not been accorded to have equal opportunities in research and conservation science in history.

The first step to increase diversity among leaders who drive research decisions and guide conservation science is gender diversity (Vollan and Henry, 2019). Recent research shows that having a gender equilibrium in conservation can positively influence conservation outcomes (Giakoumi et al., 2021), thus highlighting the need to encourage more women into conservation and removing the gender bias. Men and women bring different perspectives to conservation and climate-related issues, and the lack of gender diversity could impact research (James et al., 2022). Despite their under-representation in conservation, women have significant knowledge about the environment which they pass onto to other women through cultural (song, dance, storytelling) and daily labor practices (Goldman et al., 2021).

The Cheetah Conservation Fund (CCF), a science driven conservation organization based in Namibia, is dedicated to saving the wild cheetah. This non-profit organization was founded in 1990 by a female American conservation scientist, with operations being carried out by professional staff and the support of volunteers. Volunteers are a vital component in supporting the daily operations of CCF and therefore the conservation of the cheetah. Environmental organizations, both governmental and private, rely on unpaid volunteers to further the cause of preserving and assisting the threatened natural environment (Bruyere and Rapee, 2007). Worldwide, volunteers contribute the equivalent of US$48.8 billion (volunteer worth in Africa) and US$561.8 billion (volunteer worth in North America) per year in volunteer labor (Salamon et al., 2011). Without the assistance of many thousands of committed volunteers worldwide, the environmental movement would not exist (Bruyere and Rapee, 2007). For conservation organizations, like CCF, volunteer-based tourism provides additional labor while generating extra funds (Brightsmith et al., 2008). This means the donation dollar stretches further, thus allowing conservation organizations to spend more money in other essential areas, instead of spending limited funds on staff salaries.

The motivations for why women get involved in conservation may differ for women across the world. For some women in Africa and other parts of the developing world, the need to conserve biodiversity is crucial because of their dependence on the natural environment for subsistence and the association of the natural environment with cultural and spiritual values (Alvarez and Lovera, 2016). Additionally, people pursue volunteer-based tourism for their own satisfaction and for their opportunity for personal and profession growth (Han et al., 2019). Further understanding of volunteer motives for taking part in nature conservation programs is therefore crucial in designing and implementing programs aimed at utilizing the talents and labor that volunteers contribute to conservation efforts in an increasingly significant way (Caissie and Halpenny, 2003). Since its founding, CCF has hosted volunteers from around the world, from many STEM-based disciplines such as biomass demonstration, genetics, ecology, veterinary medicine and conservation. Volunteers are able to participate in activities from across CCF's different disciplines. CCF volunteers can be categorized into three groups, Earthwatch, working guests, and student interns with each program playing an important role in CCF's 31 year history. Earthwatch volunteers participated with CCF as a group of volunteers, who registered with Earthwatch Institute for a set duration based on the expedition length until 2013 when the program stopped coming to CCF, while student interns often volunteer as part of their higher education, or just after they have finished school and working guests are typically people who

want to volunteer while on holiday, or professionals volunteering their time with a specific CCF program. Volunteers are able to apply to join CCF's volunteer programs from an online application process and are selected based on their skills and attitude towards conservation. Gender and nationality plays no part in the recruitment of volunteers into CCF's volunteer programs. Hard working and passionate volunteers have been known to gain paid internships or offered a paid position with CCF after completing their volunteer program. Other individuals have been able to gain employment with other conservation organizations.

Here we analyze CCF's past Earthwatch, working guest and intern volunteer programs and female based questionnaire data to understand women's motivations into volunteering at CCF, how they have contributed to the conservation of the cheetah and some of the challenges women faced in the conservation field.

Methods

Volunteer program database

A volunteer database was compiled using information obtained from CCF's comprehensive volunteer database from 2000 - 2021. Limited information was available for volunteers in the 1990's and early 2000's. However, Earthwatch volunteers were a major group of volunteers before early 2000 when CCF's Research and Education Centre was opened. Where possible, information for all of the volunteers were included in the analyses.

Some of the volunteers (3.5% (*n=22*) Earthwatch, 16.2% (*n=115*) and 1.0% (*n=5*) working guests and interns) were unable to be assigned a gender due to either having a unisex name, or the database only having an initial recorded, so these volunteers were excluded from gender based analyses. Over half (71.5%; *n=507*) of the Earthwatch volunteers, and 6.7% (*n=52*) of the working guests were unable to be assigned a year they volunteered, so these volunteers were excluded from any year-based analyses. The year of volunteering was included for all interns.

Volunteer demographics (age at volunteering, length of volunteer program and repeat volunteer) was averaged and compared between male versus female volunteers per volunteer program and overall (male and female volunteers) between the three volunteer programs. The volunteer demographic results presented with the standard deviation is the mean unless otherwise stated. A chi-square goodness of fit test was performed at the 0.05 per cent significant level using R version 3.5.2 (R Core Team, 2017) to compare the difference between the overall (interns, working guests and Earthwatch) number of female and male volunteers. Women's contribution to each volunteer program was analyzed by calculating the percentage of female volunteers per year.

Administered survey

Two questionnaire surveys were developed based on the type of volunteer experience at CCF (intern/working guest or Earthwatch volunteers) and were sent to all female volunteers *via* email. Each questionnaire survey consisted of a combination of 11 opened-ended and closed-ended questions (Appendix A and B). They were asked to return the survey *via* email within 16 days. Survey participants included past volunteers from across different age groups and different nationalities, representing a good sample of CCF's past volunteers. Participation in the survey was voluntary, and all survey statistics were analyzed using Microsoft Excel 2013. For open-ended questions, the answers were scored and categorized to compare women's responses. Participants often indicated multiple categories within their answers, so one participant's answer was scored to the multiple corresponding categorizes. For the purpose of this study, only the questions addressing the three main aims were included in the analyses.

Results

Volunteer database analysis

Between 1990 and 2021, CCF hosted a total of 1,905 volunteers at their Namibian headquarters. Of this, 768 volunteers were working guests, 486 student interns, 709 Earthwatch volunteers (1997-2013) and 57 (3%) people had volunteered as a multi-program volunteer (e.g. Earthwatch volunteer who later returned to volunteer as either an intern or working guest). There were significantly more female (*n=1,321*; 69.6%) volunteers than male volunteers (*n=438*; 23.0%; $x^2 = 458$, *df=1, p-value <0.000*) (Table 1). The majority (75.4%; *n=43*) of the multi-program volunteers were female.

Women's involvement in CCF's volunteer programs have ranged annually between 54% and 100% for interns and working guests, and between 60% and 100% for Earthwatch volunteers (Figure 1). Annually, there is an average of 72.9% women interns and 74.6% female working guests. Female Earthwatch volunteers represented 80.9% of the Earthwatch volunteer program each year. There has been a constant growth in CCF's volunteer programs since 1990, excluding 2020 and 2021 where there was a drastic decline in the intern and working guest volunteer programs due to the Covid-19 pandemic (Figure 1).

The Earthwatch volunteers originally volunteered for a period of a month, then decreased to three weeks in 1999, and two weeks in 2000, as this was the design of the volunteer

TABLE 1 Overview of CCF's volunteers expanding 31 years including volunteer age and length of volunteering.

		Working Guest			Intern			Earthwatch		
		Male	Female	(U) Total	Male	Female	(U) Total	Male	Female	(U) Total
	Total	177	567	(24) 767	120	361	(5) 486	155	441	(113) 709
Age (yrs)	N	90	259	352	95	279	374	12	36	48
	Min	15	14	14	17	16	16	16	18	16
	Max	79	78	79	54	69	69	79	88	88
	Avg	40.4	39.2	39.4	22.9	23.9	23.6	45.1	57.3	54.3
	SD	16.4	16.6	16.5	5.3	6.5	6.3	19.8	17.6	18.6
	Median	38.5	37	37	22	22	22	41	61.5	58
Length of stay (wks)	N	157	427	599	108	338	453			
	Min	0.25	0.25	0.25	1	0.25	0.25			
	Max	108	52	108	52	52	52			
	Avg	6.6	5	5.4	10.5	8.4	8.8			
	SD	13.8	7.3	9.4	9.3	7.3	7.9			
	Median	2.5	2.5	2.25	8	6	6			
Repeat volunteering	N	22	35	57	8	10	18	4	5	9
	Min	2	2	2	2	2	2	2	2	2
	Max	6	13	13	4	3	4	2	2	2
	Avg	2.9	2.8	2.8	2.3	2.1	2.1	2	2	2
	SD	1.3	2	1.8	0.7	0.3	0.5			
	Median	2.5	2	2	2	2	2			

Earthwatch volunteer program ran from 1997-2013 and *U* represents the number of unknown genders of volunteers.

program. For the working guests, people volunteered for 5.4 weeks (± 9.4) and interns volunteered for 8.8 weeks (± 7.9) (Table 1). For both working guests and interns, the shortest volunteer period was two nights (0.25) and the maximum volunteer period was 2 years for working guests and 1 year for interns. Men had a slightly longer (6.6 ± 13.8 weeks for working guests; 10.5 ± 9.3 for weeks for interns) volunteer period compared to women for both working guests and interns (5 weeks for working guests and 8.4 weeks for interns) (Table 1). More working guests (7.4%) returned to volunteer multiple times compared to interns (3.7%), although there was no difference between the number of times a volunteer would return for further volunteer experiences between the two groups of volunteers (Table 1).

Interns were the youngest volunteer group (23.6 ± 6.3 years), compared to working guests (39.4 ± 16.5 years) and Earthwatch volunteers (54.2 ± 18.6 years) (Table 1). Male working guests (40.4 ± 16.4 years) were slightly older than female working guests (39.2 ± 16.6 years), whereas female interns (23.9 ± 6.5 years) were slightly older than male interns (22.9 ± 5.3 years) (Table 1). There was a larger age difference between male (45.1 ± 19.8 years) and female (57.3 ± 17.6 years) Earthwatch volunteers.

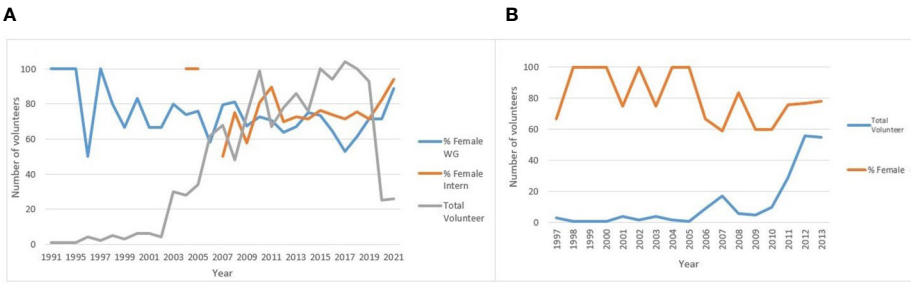

FIGURE 1
Percentage of women's involvement with CCF's **(A)** intern and working guest (WG) volunteer programs and **(B)** Earthwatch volunteer program with total representing the total number of volunteers per year.

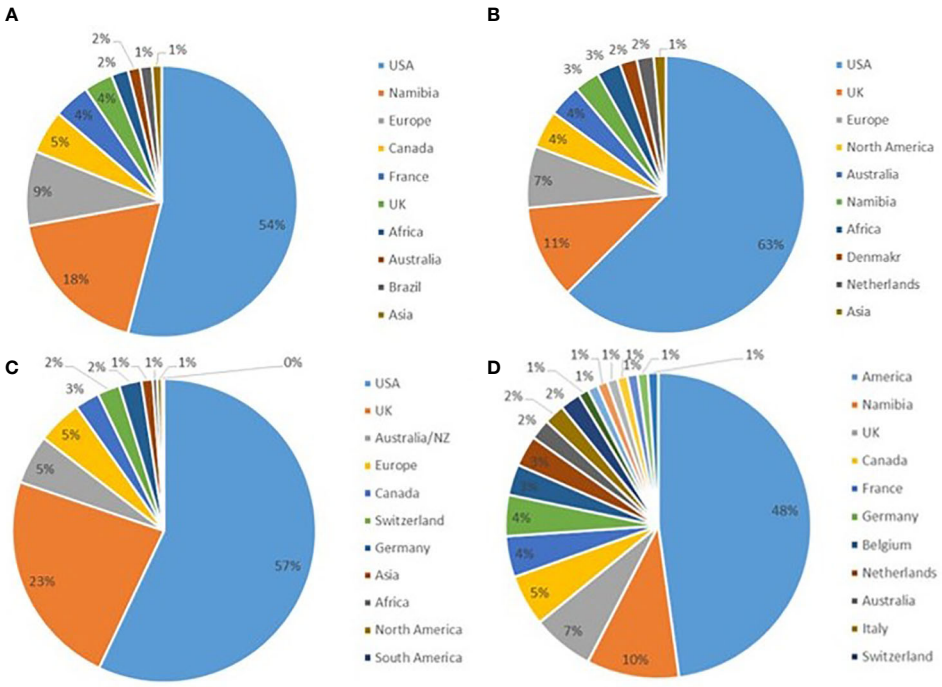

FIGURE 2
Country distribution of female **(A)** interns, **(B)** working guest, **(C)** Earthwatch volunteers and **(D)** survey participants. Countries that had less than 10 volunteers were analyzed as part of the continent.

The majority of the volunteers for all volunteer programs were of American nationality (Figure 2).

Survey responses

A total of 507 working guests, 340 interns, and 347 Earthwatch surveys were sent out to people *via* email. Of this 28.2% (*n=143*), 20.6% (*n=70*), and 30.2% (*n=105*) working guest, intern and Earthwatch, respectively, email addresses were no longer available (returned to sender). A total of 40 (11.0%) working guests, 32 (11.9%) interns, and 21 (8.7%) Earthwatch volunteers returned their completed survey before the deadline (Table 2).

Overall, the main motivation why females volunteered at CCF was because of CCF's approach to conservation (36.3%; *n=33*). People's love of cheetahs (30.8%; *n=28*), and their interest to travel (28.6%; *n=26*) were key aspects in why women chose to volunteer at CCF (Table 3). There was a difference in women's motivations to volunteer, based on their previous volunteer experiences. Earthwatch volunteers primarily joined CCF's programs to travel (57.1%; *n=12*), and for their love of cheetahs (52.4%; *n=11*), while working guests volunteered at CCF for their appreciation of CCF's approach to conservation (47.5%; *n=19*), and their love of cheetahs (35.0%; *n=14*). Interns indicated that they volunteered at CCF to gain practical experience (46.7%; *n=14*), and because of their appreciation of CCF's approach to conservation (43.3%; *n=13*) (Table 3).

When asked if volunteering at CCF was able to help women go into conservation related employment, 87.5% (*n=28*) of the surveyed interns, and 32.5% (*n=13*) working guests replied with '*yes*' (Table 3). The majority (89.5%; *n=17*) of the surveyed

TABLE 2 Demographics of female survey participants from CCF's volunteer programs.

Volunteer type	Sent	Delivered	Replied	Min Age	Max Age	Avg Age	SD	# Nationalities
Working Guest	507	364	40 (11.0%)	35	77	56.7	11.2	13
Intern	340	270	32 (11.9%)	22	52	30.2	6.5	12
Earthwatch	347	105	21 (8.7%)	39	97	64.1	13.7	6
Total	1194	739	93 (12.6%)	22	97	48.9	17.5	19

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TABLE 3 Female responses to survey questions relating to volunteering and women in conservation, for three different types of volunteer experience.

Question/Answer	Interns (%)	Working Guest (%)	Earthwatch (%)	Total (%)
* Q.1 Why did you volunteer at CCF?				
CCF's approach	13 (43.3)	19 (47.5)	1 (4.8)	33 (36.3)
Loves cheetahs	3 (10.0)	14 (35.0)	11 (52.4)	28 (30.8)
Travel	7 (23.3)	7 (17.5)	12 (57.1)	26 (28.6)
Practical experience	14 (46.7)	8 (20.0)	1 (4.8)	23 (25.3)
Passion	5 (16.7)	4 (10.0)	0 (0.0)	9 (9.9)
School	4 (13.3)	2 (5.0)	1 (4.8)	7 (7.7)
To go into conservation	0 (0.0)	0 (0.0)	6 (28.6)	6 (6.6)
Learn more	0 (0.0)	4 (10.0)	0 (0)	4 (4.4)
Inspired	1 (3.3)	3 (7.5)	0 (0.0)	4 (4.4)
Q.2 Did volunteering help your career				
Yes	28 (87.5)	13 (32.5)	–	41 (56.9)
No	2 (6.25)	23 (57.5)	–	25 (34.7)
Neutral	2 (6.25)	4 (10.0)	–	6 (8.3)
Q.3 Did you join Earthwatch to get involved with conservation				
Yes	–	–	17 (89.5)	
No	–	–	2 (10.5)	
**Q.4 Motivation to join conservation*				
Compelled to help	9 (29.0)	16 (43.2)	15 (75.0)	40 (45.5)
Passion	14 (45.2)	14 (37.8)	4 (20.0)	32 (36.4)
Interest	6 (19.4)	7 (18.9)	2 (10.0)	15 (17.0)
Inspired	3 (9.7)	3 (8.1)	0 (0)	6 (6.8)
Love for cheetahs	1 (3.2)	3 (8.1)	0 (0)	4 (4.5)
Opportunity	0 (0.0)	2 (5.4)	1 (5.0)	3 (3.4)
School	2 (6.5)	0 (0.0)	0 (0)	2 (2.3)
Travel	0 (0.0)	0 (0.0)	2 (10.0)	2 (2.3)
*Q.5 Challenges women face in conservation				
Credibility	15 (55.6)	11 (32.4)	-	26 (42.6)
No challenges identified	2 (7.4)	7 (20.6)	-	9 (14.8)
Safety	6 (22.2)	3 (8.8)	-	9 (14.8)
Pregnancy/family	6 (22.2)	2 (5.9)	-	8 (13.1)
Others	2(7.4)	5(14.6)	-	7(8.2)
Physical challenges	3 (11.1)	3 (8.8)	-	6 (9.8)
Respect	2 (7.4)	4 (11.8)	-	6 (9.8)
Sexism/discrimination	2 (7.4)	4 (11.8)	-	6 (9.8)
Stereotypes	2 (7.4)	3 (8.8)	-	5 (8.2)
Lack of opportunities	2 (7.4)	2 (5.9)	-	4 (6.6)
Q.6 Do men face the same challenges				
No	24 (84.4)	14 (42.4)	-	41 (63.1)
Yes	3 (9.4)	11 (33.3)	-	14 (21.5)
Unsure	2 (6.3)	7 (21.2)	-	9 (13.8)
Equal	0 (0)	1 (3.0)	-	1 (1.5)
Q.7 Is conservation male or female dominated				
Male	16 (50.0)	12 (31.6)	5 (23.8)	33 (36.7)
Equal	5 (15.6)	12 (31.6)	9 (42.9)	26 (28.9)
Female	11 (34.4)	10 (26.3)	3 (14.3)	24 (26.7)
Unsure	0 (0.0)	4 (10.5)	4 (19.1)	8 (8.9)
Q.8 Is there a difference between male vs female ran programs				

(Continued)

TABLE 3 Continued

Question/Answer	Interns (%)	Working Guest (%)	Earthwatch (%)	Total (%)
No	–	–	11 (57.9)	
Yes	–	–	5 (26.3)	
Unsure	–	–	3 (15.8)	
Q.9 How difficult was it for you to join conservation				
Easy	13 (40.6)	14 (37.8)	–	27 (39.1)
Neutral	12 (37.5)	6 (16.2)	–	18 (26.1)
Hard	4 (12.5)	10 (27.0)	–	14 (20.3)
Very Easy	1 (3.13)	6 (16.2)	–	7 (10.1)
Very Hard	2 (6.25)	1 (2.7)	–	3 (4.4)
Q.10 Supported conservation financially				
Yes	–	–	18 (90)	
No	–	–	2 (10	

Dash represents the question was not included in the survey for that volunteer program and * represents open ended questions.

Earthwatch volunteers said they joined Earthwatch to get involved with conservation (Table 3). Nearly half (49.2%) of the survey participants found it either easy or very easy to join conservation (Table 3). Very few (4.4%; *n*=3) survey participants mentioned it was very hard for them to join conservation (Table 3). The majority (90%; *n*=18) of the Earthwatch volunteers admitted to still be financially involved with CCF since their volunteer experience.

Women's biggest motivation to go into conservation was feeling compelled to help nature (45.5%; *n=40*). The second biggest motivation was passion about conservation and the natural world (36.4%; n=32), while only 4.5% (*n=4)* of participants mentioned going into conservation specifically for their love of cheetahs (Table 3). Six (6.8%) people mentioned they were inspired to join conservation as a career, either after volunteering at CCF or inspired by friends and family. For interns, passion (45.2%; *n=14*) was the main motivation to join conservation, while being compelled to help was the main motivation for working guests (43.2%; *n=16*) and Earthwatch volunteers (75.0%; *n=15*) (Table 3).

The main identified challenge that women face in conservation was credibility (42.6%; *n=26*). Other leading challenges included safety (14.8%; *n=9*), pregnancy/family implications (13.1%; *n=8*) and sexism/discrimination (9.8%; *n=6*) (Table 3). Over half of the surveyed interns mentioned credibility (55.6%; *n=15*) as a challenge they faced working in the conservation field. Women mentioned that they had to be more aggressive with presenting their opinions and credibility also extended outside of their organization of work (Table 4). It was also noted that safety was more of a challenge for interns (22.2%; *n=6*) compared to working guests (8.8%; *n=3*) (Table 3). One women shared that she had previously turned down a field position because the safety risk was too great for a women (Table 4). When asked if men faced the same challenges as women, 63.1% (*n=41*) of participants did not believe men have the same challenges. Fourteen (21%) participants said men face challenges in conservation, but were of a lesser degree to their female counterparts.

Survey participants suggested there was no substantial gender bias in conservation. Males, on average, were believed to dominate in conservation (36.7%; *n=33*) compared to 26.7% (*n=24*) who believed women were dominant in conservation (Table 3). Twenty-six (28.9%) survey participants indicated that men and women were equal in conservation. The majority (57.9%; *n=11*) of women said there was no difference between how conservation organizations were operated based on the gender of the person in charge.

Discussion

Women's motivations to conservation

The findings of this study indicate that what motivated women to volunteer more than 15 years ago is still what motivates people today (Bruyere and Rappe, 2007). The motivations for why women volunteered at CCF were consistent with those found by Caissie and Halpenny (2003), in which pleasure seeking and program perks were two of the five motivations. Motivations for why people volunteered at CCF were also consistent with some of those found by Bruyere and Rapee (2007), which included learning and project organization, and gaining job-related experience. In addition women who volunteered at CCF mentioned one of the reasons they volunteered was due to CCF's holistic approach to conservation, which is similar to Bruyere and Rapee (2007). Holistic conservation approaches are important as they take into consideration the underlying social, cultural and economic perspectives when conserving species (Zimmermann and Stevens, 2021). This suggests the reputation of the

TABLE 4 Noteworthy survey responses from female volunteers.

Volunteer type	Age now	Response
Q4. Challenges women face in conservation		
Intern	29	Fieldwork can be downright dangerous as the only women. There is also a boy's club when it comes to getting opportunities
Intern	28	Safety is a key concern of mine and one that has led me to reject project opportunities due to working alone in the field
Intern	24	Respect; if a male ranger walked up to a poacher and told them it's illegal, thy would listen but if a women did the same I don't think it would end well for either parties
Intern	34	Often women have to stand up for themselves and be slightly more "aggressive" or direct because we aren't taken as seriously. This can sometimes cause conflict between co-workers
Intern	30	I think woman have in all the fields more things to prove and to demonstrate to the entire world.
Intern	29	Being female you are not taken seriously most of the time, working with male farmers is challenging as females are often looked upon as being 'soft' or 'tree huggers'
WG	59	Safety will always been an issue to women
WG	56	Getting in – there is still a boy's club at the very top
WG	39	Landowners or agriculture people trust men's opinions more than female opinions
WG	64	Farmers don't take you seriously as a female
WG	51	Farmer would rather speak to male students than me who is qualified female vet
Q.8 Is there a difference between male vs female ran programs		
EW	79	You should be more concerned about saving the species, rather than male/female domination

Question number relates to the question number in Table 3. WG, working guest; EW, Earthwatch volunteer.

organization is an important consideration in deciding which organization to volunteer with. Our results were further consistent with Byrne et al. (2018) in which passion and enthusiasm for the natural environment were driving factors to volunteer in conservation.

People's trust in a volunteer tourism organization influences their intentions to participate with the organization (Han et al., 2019). This could explain the increase in volunteer numbers at CCF over the past 31 years. CCF has maintained a constant engagement with people and the reputation of CCF as a volunteer tourism organization has remained positive over the last three decades. Although this study only focused on the people who have volunteered at CCF's headquarters in Namibia, many international volunteers have also provided their time to important fundraising and education programs outside of Namibia. Many of these international fundraising and education programs would not have been possible without the support of CCF's international volunteers. Thus, suggesting the personnel required to prevent a species from going extinct is a lot larger than the number of volunteers reported in this study.

Despite having significantly more female volunteers than male volunteers across all three of CCF's volunteer programs, there was little to no difference in gender-based volunteer demographics (age at volunteering, length of volunteering, repeat volunteers). However, there was a difference between the average ages of volunteers for the different volunteer programs. Volunteers were given equal opportunities to participate in CCF's programs, and the younger volunteers saw this as an opportunity to start their careers in conservation. This finding is consistent with other studies that show that men and women often start their careers in conservation as equals, and it is only when you look at higher positions that women's gender impacts their ability to succeed in science (Blickenstaff, 2005; Giakoumi et al., 2021).

Additionally, the main motivation for interns to volunteer was to gain practical experience working with either cheetahs or in conservation. Although CCF is based in Namibia, volunteers are able to develop professional skills that are transferrable to other cheetah conversation jobs around the world, by learning directly alongside professional staff in the cheetah's rangeland. Almost half (49.2%) of the women in this study found it easy to gain employment in conservation as a result of them gaining practical experience in conservation and working with cheetahs. For those who did not gain employment in conservation after volunteering at CCF, it was due to them already having an established career outside of conservation or already retired, and they participated in volunteer conservation as a hobby.

In a study by James et al. (2021), there was a positive correlation between women's involvement and environmental outcomes, and the lack of female involvement could therefore affect desired conservation outcomes as women are known to interact differently with the environment. Women's involvement at every level is therefore beneficial to conservation as they bring different perspectives (James et al., 2022).

Other motivations for women volunteering at CCF included 'love for cheetahs' or passion for wildlife or the natural world. This finding is consistent with other studies which also included

that passion and enthusiasm for the natural environment were the main motivations to volunteer in conservation (Byrne et al., 2018; Poor et al., 2021). Guiney and Oberhauser (2009) found almost all volunteers felt nature was strongly important to them and they felt connected with nature when participating in volunteer conservation. These authors also found that connection with nature often started during childhood as volunteers were allowed to explore the natural world as a child, suggesting that people are taught from a young age to love the natural world and this reflects into adulthood. This strong love for nature or a particular animal, can then become a strong motivation which drives people to contribute their part to preserving the environment.

It is also worth considering the fact many of CCF's volunteers are self-funding which might affect people's motivations to volunteer. Despite wanting to find a strong connection to nature or willing to help conservation, only those who could financially afford to volunteer were able to participate in volunteer conservation, due to the financial burden volunteering incurs. Therefore, people with restricted finances are potentially missing out on opportunities to volunteer and develop skills that is important to starting a career in conservation. This could explain why the majority of the volunteers were from the USA.

Women's contribution to conservation

Our results showed that women's contribution to cheetah conservation changes throughout one's life. Younger volunteers (interns) showed a greater interest in contributing to conservation by gaining employment in conservation after their volunteer experience at CCF. Whereas, middle aged (working guests) volunteers were more likely to return for multiple volunteer experiences which contributed to conservation by labour and financially, and older (Earthwatch) volunteers continued to contribute to cheetah conservation by financial donations after their volunteer experience at CCF.

Financial support from individuals has been linked with threat appraisal of the target species and the coping appraisal of the threat of extinction towards the target species (Eylering et al., 2022). In other words, people are more willing to donate to courses/organizations based on how vulnerable to extinction the target species is and how an organisation is preventing the species from going extinct. This willingness to donate financially varies globally and women are more likely to donate than men (Eylering et al., 2022). This is consistent with our findings as 90% of the Earthwatch survey participants stated they were financially connected to CCF through donations.

At present, 47% of CCF's professional staff started their career in conservation *via* CCF's volunteer programs (unpublished data). This highlights the importance of volunteer conservation has, not just to the environment, but also to career progression within the field of conservation.

Women's challenges in conservation

Our results showed that women's credibility is still a main challenge. A number of studies have also highlighted that women struggle to be taken as seriously as men or given the same respect that men receive in the work environment (Holleran et al., 2011; Sardelis and Drew, 2016; Jones and Solomon, 2019). This makes it easier for women to lose their credibility or have their ideas dismissed. This lack of respect or the ability to see women as knowledgeable as men is not just amongst co-workers or managers, but also extends to farmers/landowners who will judge female conservationists and would not be as willing to work with them compared to their male counterparts. This has been observed by four of our survey participants. One survey participant went on to say that women needed to be more aggressive and assertive to get their message across.

Although many of the higher-level conservation positions are dominated by men who often do not see or acknowledge women's challenges in conservation or other STEM based fields (Blickenstaff, 2005; Jones and Solomon, 2019), our results showed that women perceived no influential difference in how men or women run conservation programs. One survey participant did say that organizations should be more concerned about saving a species rather than what gender was in management positions, suggesting no reason why high-level conservation positions should be dominated by men. However, gender bias continues to be seen. Recent research suggests this bias might be narrowing, as today female researchers are publishing more research compared to 60 years ago (James et al., 2022). Although, the same study also showed that men still continue to publish more literature than women. One way to overcome this challenge is the use of a double-blind peer review process which can result in significantly more female led research being published (Darling, 2014). It is essential to include women in conservation, as women are known to interact differently with the environment thus preventing women's involvement in conservation could lead to women's knowledge and perspectives being excluded from conservation actions (James et al., 2021).

Safety was the second leading challenge identified by women in this study and globally it is a big concern for women working in conservation, especially when it comes to field work and having to work in remote locations. For the purpose of this study, safety included both physical and sexual safety. Many female conservationists from Jones and Solomon (2019) study had either been victims of sexual harassment, or were forced to listen to sexual harassment from men in higher positions, with

several of their participants suggesting sexual harassment worsens when doing field work. This is consistent with some of the responses from the participants in this study, where one participant mentioned she had given up project opportunities outside of CCF's volunteer programs due to safety concerns or another women who believed that field work will always remain an issue to women. To help mitigate potential safety issues, women will tend to hire a field assistant when conducting field work (McGuire et al., 2012). Additionally, codes of conduct and sexual harassment policies for field work have the potential to improve field work safety, especially for women, trainees and early career stage conservationists (Clancy et al., 2014).

Our results also showed that women in their early career stages also struggle with pregnancy/family challenges that are associated with women working in conservation. Interestingly, women who already had established careers did not see family challenges while working. Poor et al. (2021) also found this and suggested mature women were in a better financial position in their careers where they could afford childcare and they didn't see the challenges of raising a family while working. Women tend to be early into their careers around the same time they start planning a family, making it difficult for women to either undertake field work while pregnant or having to leave young children behind for long periods of time. There is also concerns that certain activities (e.g. carrying heavy loads) are linked with increased health complications to women and their unborn child (e.g., increased risk of miscarriage or stillbirth) (Wan et al., 2011). Pregnant women also need to take additional precautions when working in the field, as parasite and disease infections can be more serious for these women (Wan et al., 2011; Makala et al. 2020). Women also tend to be the caretaker of the family and will often be the one responsible for taking care of sick family members (Wan et al., 2011) and often have heavier workloads in providing for the household (Mollel and Mtenga, 2000; James et al., 2021), especially in the African context. These additional requirements put on women by society leads to less time spent on their careers compared to men which could have ripple efforts into promotion or recognition.

Although only a minor challenge for women in this study, having few female based-role models in the forefront can be a challenge to inspire younger women into a conservation career (Byrne et al., 2018). The results from this survey showed that role models can have a positive influence in encouraging women to join conservation, as six women were inspired to join conservation after either listening to a women-led presentation or volunteering at CCF. Mentorship and role models are important for assisting women's productivity in conservation (McGuire et al., 2012). Sardelis and Drews (2016) study showed that women who are already in an established scientific career will often support other female scientists, and provide them with opportunities to share their findings at conferences. Although female-based role models were not a motivation to volunteer at CCF, CCF has a high percentage of female staff, with a high percentage of management and senior positions carried out by women, which provide strong role models for other women in conservation. Institutions in Australia for instance, have realized the gender bias against women and are working to change this and achieve non-gender bias in the Australian scientific community (Byrne et al., 2018). A study by Butler et al. (2018), showed there was a significance difference in how men and women use forest environments, with men typically managing the area for wildlife and commercial timber harvest, while women tended to be less active managers.

The cultural aspect was another challenge which came up in this study. Many societies will place a higher social value on men than females, which leads to gender inequality in education, reproductive health choices and violence against women (Barnett, 1997; Ansari and Shahid, 2022). Social norms are learnt through socialization and can prevent people's freedom (Cislaghi, 2018). Cislaghi (2018) has shown that women's ability to change social norms is possible but it requires a great number of women to behave differently in front of others and both men and women have to accept this new behavior. In addition the volunteer market is still very new in Africa, especially in Namibia, the country in which CCF is headquartered. Most Namibians will volunteer at CCF as interns to complete requirements for their college or university programs, rather than volunteering as an extra curriculum activity or hobby (e.g. working guest volunteer). As a result only those students studying towards a qualification in natural resources management or conservation will apply for a volunteer position at CCF, which might explain why there were fewer female African volunteers in CCF's volunteer programs.

Limitations of study

Although this study highlights gender issues with regards to women in conservation, further research is required to address these issues globally. Our survey responses include a high percentage of American volunteers, which could potentially lead to an American perspective of women in conservation. However, a recent study by Han et al. (2020) has shown people's motivations to participate in international volunteer programs to be consistent across the continents, which allows us to make the assumption our data can be generalized in a global context. It is also worth considering that past volunteers might have felt uncomfortable expressing less then desirable responses and decided not to participate in the survey knowing their answers would be investigated by CCF staff, leading to the potential bias of positive responses from survey participants. This is however an assumption and further investigation from external people would be able to address this potential limitation. Further research is also required to understand male volunteers' motivations for volunteering at CCF and their motivations to join conservation and how this differs to women's motivations.

By understanding the difference in male and female motivations to conservation, organizations will be able to engage equally with both genders to increase and improve conservation programs and remove the gender bias currently seen within conservation.

Conclusion

The Cheetah Conservation Fund has a long history of working closely with volunteers from across the world. This study has shown that CCF has been able to support a high percent (73.7%) of women in conservation through their volunteer programs over the past three decades, while highlighting the motivations, contributions and challenges women face in conservation. Volunteers had different motivations for volunteering which was also influenced by age. Overall, many women chose to volunteer at CCF for CCF's holistic approach to conservation, their passion and love for cheetahs and CCF's ability to allow volunteers to gain valuable experience working with cheetahs and in conservation. Women who had already established their careers were most likely to donate financially compared to younger women who contributed to conservation by working for a conservation organization after volunteering at CCF. Women's safety and credibility were highlighted as the main challenges that women face in conservation. Society needs to help women to overcome these challenges in order for them to be as successful as men in the scientific community as women's involvement in conservation is important at every stage. By mitigating these challenges, and removing the gender bias, more women could potentially be inspired to join conservation, thus being able to strengthen conservation strategies and benefit the conservation of species.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

LM was the senior researcher and developed the original concept. LP expanded the original concept with assistance from AP. The volunteer database was complied by LM, LP and TM. Data collection was completed by LP and LM with data analysis conducted by LP and TM. Manuscript writing was carried out by LP with editing assistance from LM, TM and AP. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The 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.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2022.1028851/full#supplementary-material

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The power of woman-to-woman mentorship in creating long-term changes in biodiversity conservation in Southeast Asia

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Growing evidence indicates that women's involvement and leadership are important to creating inclusive conservation programs, increasing likelihood of success, and achieving sustainability. Effective future women leaders can be created by providing them with dedicated mentorship, as in long-term support and dynamic learning that encompass the entirety of a person, not only their technical training. Mentorship by women is key to ensuring more women are empowered, can advance their careers, and become independent leaders in their domains. The ways mentorship contribute to a woman's career have been frequently studied in medicine, sports, and education, yet rarely in conservation. Providing real examples of long-term mentorships centered on the perspective of a mentee from the Global South will demonstrate an applicable roadmap towards recruiting and retaining women in conservation. We recount two sets of ten-year long mentor-mentee relationships—one with a foreign mentor and the other domestic—based on our personal experiences in Indonesia. We examined issues raised by Indonesian women in conservation and provided targeted solutions that may be applicable to a broader audience. The resulting group of empowered, capable women can rely on one another for technical and moral support, along with work together to shift social norms towards becoming more inclusive of women in more varied roles and at multiple career levels in conservation. In highlighting real examples, mentees can understand what they should seek out and expect from mentorship, and how women from the Global North and Global South can provide true mentorship to more women without access to the same opportunities. We hope to inspire more women from the Global South to continue their careers and be leaders in conservation.

KEYWORDS

conservation, diversity, equity, mentorship, Southeast Asia, women in STEM, Indonesia

1 Introduction

There is a geographic mismatch between conservation needs and expertise, in which experts for biodiversity-rich regions such as Southeast Asia are predominantly from the Global North instead of the region itself (Rodríguez et al., 2006; Campos-Arceiz et al., 2018). This is a form of scientific imperialism that makes it difficult for all stakeholders to participate in conservation. Unequal access to learning opportunities extends into a variety of technical and soft skills deemed essential for success in a conservation career. However, how skill gaps are framed is indicative of who the target audience a training activity is aiming to increase the comfort and ease of participation for in conservation. For example, a lack of English fluency of Global South scientists is often cited as the main barrier to advancing mentee careers instead of a lack of access to opportunities in science education. This places the responsibility more on Global South mentees to "fix" the issue even though an equivalent solution for solving the communication gap is for Global North mentors to have a basic grasp of the local language. Requiring English is only one of many examples where conservation science prioritizes the needs of the Global North mentor instead of the needs of the Global South mentee. This type of neo-colonialism must be challenged to produce effective local leadership for long-term conservation impact.

Competencies for effective leadership cannot be fulfilled by the existing institutional structures in Southeast Asia; these skills need more dedicated, long-term guidance to mature. Only 10% of available jobs in conservation are academic, while the other 90% are non-academic positions that require a greater variety of skills, many of them being soft skills indispensable for securing a job (Lucas et al., 2017). These required skills that are often not fully covered by standard undergraduate or graduate university training, such as strategic communication and leadership capabilities, leaving students unprepared for careers in conservation (Poor et al., 2021). All of these factors severely affect accessibility of education to students from rural areas in particular (including the mentee author, Sheherazade), despite these areas often being the ones that experience the impacts of biodiversity loss and habitat degradation (Sodhi et al., 2010). Formal or informal forms of professional development opportunities to address these gaps are rare in most of Southeast Asia, consequently resulting in a continued dependency on mentors or collaborators from the Global North for connectivity to the broader international network of conservationists or more resource-heavy protocols.

These challenges are even worse for women as historical gender imbalances continue to be perpetuated by inaction in addressing inclusivity issues, which is particularly acute for women in leadership (Liévano-Latorre et al., 2020). Here, we define women as individuals who internally identify as female regardless of external appearance, and/or have faced similar cultural or societal expectations and challenges associated with being female (APA, 2022). Women usually face challenges throughout their careers related to sexist prejudices, harassment, assumptions of inadequacy, and toxic power dynamics, which can result in a great degree of mental and/or emotional distress and demotivate them from staying in STEM (Jones and Solomon, 2019; Baker, 2020; James, 2020; Thornton et al., 2020). A recent study on mental health among conservationists showed that women are one of the groups with the highest risk of psychological distress (Pienkowski et al., 2022). With conservation continuing to be a male-dominated field (Poor et al., 2021), women often face difficulties finding suitable and safe emotional support because there are so few other women in similar careers.

In past discussions about capacity building in Southeast Asia conservation, women's perspectives were often excluded (Manolis et al., 2009; Poor et al., 2021). The issue we have repeatedly heard from Indonesian women is that past and existing efforts do not even bother to ask them for input and recognize their existence in the conservation space. Understanding where these issues of gender and colonialism intersect in Southeast Asia is important to developing effective strategies for increasing women in leadership roles. For example, racism and ageism are discussed at length as major forms of discrimination in the US (Jones and Solomon, 2019), whereas religion and local culture intersect more with gender issues in Indonesia. When the patriarchal nature of many Southeast Asian societal structures (Nilan and Demartoto, 2012) is combined with the lack of safe and/or inclusive spaces, women can be discouraged or demotivated from pursuing a career in conservation. This is often the first barrier that needs to be overcome. Even if affordable training became more available, the number of women applying would not necessarily grow and the expected positive impact would not be achieved equally across genders. Indonesian societal expectations deem women unsuitable for jobs that require strenuous activity, which conservation fieldwork often entails. Instead, they are expected to have a family and stay at home or have a job indoors. Given these expectations, young women are often not given any career advice that enables them to envision a career trajectory in conservation. Young women are often told that they are "going to be a housewife anyway," therefore getting more training is "useless"—an experience that is common to a significant majority of young women we have spoken to over the past decade. In Indonesia, the average age of marriage is 22 (The World Bank, 2017) and the importance placed on marriage is heavily tied to cultural and religious reasons, often leading to young women abandoning their education (The Economist, 2021). For example, the majority of undergraduates in the Biology Department at Andalas University in Sumatra were women, but many of them ended their careers in conservation after graduation due to cultural reasons (Havmøller et al., 2015).

This is a critical issue to address, as growing evidence indicates that women's involvement and leadership are important for creating inclusive conservation programs, increasing the likelihood of success, and achieving long-term sustainability (World Bank, 1995; UN Water, 2006; UNHCR, 2019).

Many of these societal and systemic inequity issues are likely better understood by a woman mentor who has experienced similar challenges, making a woman-to-woman mentorship an important relationship to nurture. Woman-to-woman mentorship can be an enabling factor to greater empowerment, career advancement, and independence and provide support to the mentee to better navigate the challenges embedded in existing social systems (Jones and Solomon, 2019; Larasatie et al., 2020; Thornton et al., 2020; Nocco et al., 2021). Yet, mentorship as an action and how it can support the next generation of conservationists has not been discussed thoroughly and leaves a great deal of untapped potential for how we can improve capacity building efforts for conservation. A truly equitable mentorship is a relationship that promotes growth of the mentee as a person in totality instead of only specific technical or professional competencies (Winston and Dahlbergh, 2019). Mentorship is often treated as only a complement to technical workshops (Chao et al., 2022), but it should be deemed an important component in its own right if the goal is to have more women in leadership roles in the future. The mentor is a stable force through which the mentee can receive long-term, regular feedback, and promote growth through guidance, intensity, reflection, and regulated learning. The mentor can also provide the mentee with an understanding of intangible aspects to attaining "success," such as the culture of the discipline, and help the mentee build a strong sense of personal identity in order to be confident and independent into the future—that is, be empowered. The scope of a contemporary mentorship thus expands outside of solely a career function and into psychosocial development of the mentee (Winston and Dahlbergh, 2019; Mullen and Klimaitis, 2021). By promoting woman-to-woman mentorships, the mentee can access relevant advice about how to overcome societally and culturally specific challenges.

In this article, we provide real examples of the impacts of two sets of long-term woman-to-woman mentorships (one foreign mentor and one domestic mentor), centered on the perspective of a mentee from the Global South along with anecdotal data from others to demonstrate an applicable roadmap towards producing and retaining future women leaders in this field. We first conducted literature reviews through Google Scholar to ensure we all references related to mentorship of women in conservation. We first used keywords on the discipline as a whole ("mentorship women biodiversity conservation"), and then more specifically on our regional focus ("Southeast Asia") and country ("Indonesia"). The combined insights from other Indonesian women were gleaned from the authors having worked with larger groups of students during training or professional development activities over the past ten years. Based on our literature review, there were few references that speak to the experiences and challenges faced by women in conservation in Indonesia. The voices of Global South mentees are largely under-represented in the literature about mentorship, and what is available is limited in scope (*e.g.*, Neils, 2015; Larasatie et al., 2020; Chao et al., 2022; Poor et al., 2021). Existing studies often analyze the experiences of mentees from the perspective of mentors from the Global North and do not fully capture the challenges early career conservationists may face (Poor et al., 2021). From a combination of the literature review and our past decade of experience and collected anecdotes, there are many factors that contribute to the continuing lack of scholarship on mentoring from Global South conservationists, such as the lack of capacity to write scientific articles in English, inadequate time to write amid busy schedules, and safety and security issues of disclosing their experience publicly. Additionally, it does not occur to many of them that writing this kind of case study based on their experience can be impactful for making a change.

We are not implying that men should not mentor women but are showing how women mentors can provide support that is particularly beneficial for young women mentees who are new to science, conservation, or academia. There are few existing examples of woman-to-woman relationships in Indonesia due to the rarity of truly non-exploitative mentorships between mentors and mentees, much less one that involves women only. We utilized our personal experiences as specific examples for those observations and recommendations in order to maintain the anonymity of others who have spoken to us about these issues in confidence. We examined challenges faced by Indonesian women which may be applicable to others in the Southeast Asia region and provided targeted solutions to fill in knowledge, skill, and mentoring gaps.

2 Recommended actions

2.1 Mentorship needs to address intangible needs of mentees

2.1.1 Provide emotional support

Through woman-to-woman mentorship, early-career women scientists can find long-term emotional and mental support that is needed the most by women to address challenges together (Stonewater et al., 1990). Studies on public and private organizations suggest that compared to mentors who are men, women provide more personal and emotional support, career development facilitation, and role modelling (Fowler et al., 2007). Building strong, positive relationships is critical for helping mentees become more resilient (*e.g.* Apriani and Zulfiani, 2019).

For mentors seeking to improve their ability to guide mentees, working on skills related to improving their own emotional intelligence will ultimately improve their ability to connect with mentees. This is particularly important to breaking down hierarchical barriers that act as obstacles hindering mentee desire to open up about their own struggles. Along with other existing

imbalanced relationships of professor and student, mentor and mentee, older and younger, a foreign mentor brings the additional pressure of the Global North to Global South relationship that can only be overcome by mentors being emotionally intelligent and capable at handling cross-cultural collaborations. Historical factors related to past colonialism and current forms of neo-colonialism (*e.g.*, scientific imperialism, "parachute" science) can create unintended barriers to mutual understanding between mentors and mentees.

Particularly in Southeast Asia, the power imbalance that exists between a foreign mentor and potential mentee makes it difficult for young women to ask something outright, and the mentor must be proactive in recognizing this in their interactions with their mentee (s). This observation is based on conversations that both the mentee and mentor authors have had with Indonesian students who have had varying degrees of experience with a foreign collaborator or mentor, ranging from brief interactions (less than one week) to sustained regular advising over multiple years. The mentor must ask specific questions about the mentee's circumstances or offer to do something specifically. A mentor should recognize that mentees are often unfamiliar with the types of support that can be given, and laying out those options explicitly to the mentee both reduces potential mentee hesitation in asking for assistance and sets expectations of what the mentor is willing to provide as assistance. Current expectations for mentees to make the first contact are misguided and counter to the cultural norms for young Indonesian women. For instance, when the foreign mentor (S.M. Tsang) and mentee (Sheherazade) first met, they talked about her interest in ecological research and conservation. However, the mentor encouraged the mentee to continue the conversation by following up with her regularly about her progress and studies, eventually evolving the conversation to be about her long-term career goals. With the domestic mentor (A.A. Lanusi), she could provide the mentee with guidance for how to navigate sexism, discrimination, and sexual harassment in Indonesia, and helped her address family issues that impacted her career. The domestic mentor also shared with the mentee her own past experiences in rural areas, where she faced more prejudice for being an unmarried woman.

2.1.2 Create an inclusive and safe working environment

The conservation sector needs to strengthen its efforts to create an inclusive working environment for women and reduce prejudice and stereotypes towards women. In Indonesia, this would include simple actions such as eliminating gender-specific requirements in conservation vacancy listings and assignments of responsibilities. For example, women are often tasked with administrative work because they are considered tidier, or field assignments are given to men because women are perceived as physically weaker. Since there is a paucity of women in leadership positions who can make hiring decisions, this requires more awareness of the issue on an institutional level and more involvement of male allies in speaking up about these existing biases, which mentors can help encourage.

In discussions over the past decade related to fieldwork with other potential mentees, personal safety was indicated as a major concern for women working in conservation, especially since Indonesian society tends to minimalize incidents of sexual harassment and sexual violence. While there is a growing women's rights movement on the national level in Indonesia (*e.g.* Dunstan and Bhardwaj, 2019), that does not necessarily provide practical protection to women in the field. Fieldwork presents conditions where young women may feel especially vulnerable—such as being the only woman on the team, in remote and unfamiliar locations, isolation for long periods of time, limited access to external communication, and more. When both the foreign mentor and mentee traveled together to the field, there were no incidences of blatant sexual harassment, but both have experiences when traveling alone. Having two people present made it more difficult to isolate one to harass, which afforded the mentee more protection. Mentors need to be proactive in letting mentees know that their personal safety is a priority so that mentees do not feel as fearful of reporting potential incidents.

Making safe spaces for young women to even speak about sexual harassment is an important first step when societal pressure has silenced many young Indonesian women. Having a woman mentor who is more likely to empathize with the mentee can give a greater sense of security, and women mentors can also act to prevent continued inappropriate behavior. The mentor can learn how to be an active bystander to interrupt incidences of harassment, which can not only help the mentee immediately but also establish that harassment will not be tolerated in general. If organizational disciplinary action against the perpetrator is an option, the mentor can provide a more authoritative voice to the report and assist the mentee with the bureaucracy of reporting. Mentors should not accept sexual harassment as a cultural norm and minimize or ignore incidents of harassment. Giving women mentees a safe space to exist ultimately helps them in their scientific endeavors, as it alleviates a great deal of mental distress.

2.1.3 Help mentees stay motivated despite social expectations

Having other women in a variety of family situations as role models and understanding that a conservation job is a viable career choice can motivate women to stay and advance in the field. Potential mentors can reach out to mentees and share their own career journeys in the context of personal struggles, while over time building a deeper connection so that the mentee feels comfortable sharing her struggles with the mentor. Once motivation is addressed, a mentee is more likely to put effort into planning for a future in conservation, and become more resilient in the face of challenges. In our past experiences with many early career Indonesian women, they suggested that these conversations should be done through regular, open contact in either formal

(*e.g.*, office hours) or informal (*e.g.*, instant messaging) settings to provide a reliable form of communication for professional advice or moral support. Similarly, seeing the normalization of women participating in scientific research and conservation was an important motivational force for the mentee author to pursue a career in conservation. In her personal experience, understanding her mentors' decisions to not center life goals around seeking a marriage partner (A.A. Lanusi) and to have potential life partners but reject the institution of marriage (S.M. Tsang) is already empowering in itself in the Southeast Asian context which so heavily values marriage for women. By overcoming this societal expectation, the mentee author was able to understand that her personal value can encompass a wider range of experiences, including working or continuing her education, thus providing her with the motivation to continue in a conservation career.

2.1.4 Provide long-term career advice and support

Motivation and willingness to work in conservation should be coupled by professional guidance to determine future goals and what steps are needed to achieve them, thus reducing mentee confusion about their career trajectories. Anecdotal evidence about the significance of having a woman role model being an important factor for attracting and retaining women in the forestry sector has also been recognized in prior studies (Larasatie et al., 2020; Thornton et al., 2020). Mentors can share resources on the wide variety of careers in conservation, or introduce mentees to other conservationists with different perspectives or narratives that more closely align with the mentees' needs. By creating a better fundamental understanding of what a career in conservation is, mentees can then work together with mentors more effectively to create her own path. The process of forming a clear vision for the future can take years and involve a lot of trial and error and reflection exercises; therefore, mentors need to be committed to providing long-term support for the mentee.

Currently, the mentorship provided by Global North scientists is often restricted to the field season (less than three months), and often only entails the data collection step without further mentoring in the scientific process. Based on our past discussions with Indonesian students, they often have only been invited to participate in data entry and subsequently added to the acknowledgements, but have not been given an opportunity to contribute to the scientific process and become a co-author. Even when students indirectly suggested they had an interest in further engaging with the research topic, the potential mentor did not follow up with them. The lack of guidance for these early-career women scientists led to a lack of clarity of how the learned experience contributed to their overall career plan and missed an opportunity for them to take that experience to inform further development of personal research interests.

Similarly, prior to being mentored directly, the mentee author lacked clarity in her career plan, had few opportunities to develop personal research interests, and had a lack of direction on how to pursue existing research interests. Through working with the foreign mentor, the mentee developed more focused ideas for undergraduate research and conservation projects and was able to articulate them as a framework for her graduate studies and subsequent research interests. The mentee found the exercises useful and modified them into capacity building activities that were delivered throughout Indonesia through Tambora Muda, a national network of young Indonesian conservationists founded by the mentee and her undergraduate peer study group. Training encompassed technical workshops and professional development to build lasting careers in conservation. In about five years, over 1,500 students and early career conservationists joined seminars, intensive training activities (e.g., Conservation Camp), discussions, and small-scale conservation projects hosted by Tambora Muda. Many alumni of the program continue to work in research and conservation, and a few have even started their own conservation programs.

Through working with the domestic mentor, the mentee author learned how to address challenges that she and other women in Indonesia commonly faced, from being derided as an unmarried Indonesian woman past the age of 25, to being treated as being less competent or lacking in expertise because of her gender or lacking a higher-education degree, despite having 20 years of practical on-the-ground experience in conservation proving otherwise. The benefits of the mentor-mentee relationship can be bidirectional—the mentee learned how to be resilient through the mentor's advising, and the attentiveness and respect the mentee showed to the mentor helped the mentor gain confidence in her own abilities as well. The strength of this relationship led to the founding of a conservation NGO that is jointly led by the mentor-mentee pair (PROGRES, or in English, Sulawesi Regional Ecological Conservation Initiative, [https://progressulawesi.id/]), allowing for propagation of a collaborative and emotionally intelligent mindset towards doing conservation that is inclusive of local community concerns. Learning how to navigate a career in conservation and address challenges together built mentee self-confidence and certainty about her career choices. These feelings of certainty and self-efficacy reinforces personal determination to help in retention of women students and early-career scientists and practitioners.

2.2 Mentorship needs to increase technical competencies and equip early career-scientists with the necessary skills to advance in their careers, not just contribute to mentor projects

2.2.1 Provide higher quality feedback on writing

In past conversations with other mentees, mentors, and potential mentors (both foreign and domestic collaborators), English fluency of Global South scientists is often cited as the

main barrier to advancing mentee careers but is still left unaddressed in most training plans. In Indonesia, English language learning is more accessible in well-resourced, more developed areas (*i.e.* the cities and the western part of the country) (Liem and Marcella, 2021). Consequently, students at top universities in Java and or Sumatra can speak English more fluently than in other parts of Indonesia, allowing them to apply for more training activities, which are offered mainly only in English. Being unable to speak English fluently should not be a barrier to being able to do science. It highlights the need for foreign mentors to work more with domestic mentors such that training for scientific work can be delivered in a manner that is able to reach a larger trainee audience who live in biodiversity hotspots. For example, Tambora Muda aimed to address this linguistic and geographic barrier by choosing to conduct professional development and training activities in Indonesian instead of English, holding the event in eastern Indonesia (*e.g.*, Conservation Camp in Sulawesi), and actively recruiting for participants from historically under-served areas (*e.g.* Maluku).

In our past discussions with other Indonesian students, reading more scientific papers to increase exposure to English and gain more familiarity with scientific writing was often suggested as a way to improve the mentee's writing skills. More frequent exposure to English is an important aspect of improving English proficiency (Sulistiyo, 2016). But students in the Global South often cannot even access subscriptions to scientific journals. Thus, the support that mentors can provide can be as simple as responding to paper requests from students or sending papers that may interest them to ensure consistent exposure to scientific writing in English, which ultimately helps the mentee increase her self-confidence for facing an international audience. The potential downstream impact of increased confidence is increased likelihood that she will join training workshops available only in English, attend and present at scientific conferences, write scientific publications, and apply for jobs or graduate school programs.

For mentees to be able to be independent scientists in the future, addressing the language barrier and a mentee's English skill level requires commitment from the mentor to provide more detailed feedback and resources. The mentors are not being asked to continuously teach their mentees English, but to provide higher quality forms of support and feedback, especially at earlier career stages, to address the mentee's writing skills like one would for other technical skills. Written feedback should be accompanied by a meeting specifically to go over the comments and ensure that mentees understand why the mentor made those edits or comments. By having a fundamental understanding of where and why errors may occur, mentees can practice on their own to improve. This also promotes an activity where the mentor and mentee will have more face time—either virtual or physical—together to help build mutual understanding and trust. In our experience, this method was able to improve the mentee author's writing over time since she could reference the detailed comments from the foreign mentor later on as well. By better understanding why these changes were made, the fundamental differences in syntax between the mentee's native language and English were internalized and created a stronger core command of scientific writing, reducing the need for these types of corrections or comments in the long-term.

2.2.2 Diversify the types of trainings the mentee has access to

Suggestions from past studies revolved around providing structured training to fill in skill gaps in critical competencies, such as in project management, scientific communication, interpersonal communication, and leadership (Barlow et al., 2015; Sanders et al., 2021). Particularly in Southeast Asia, both formal and informal professional development programs are rare in many disciplines (*e.g.* Phan et al., 2020), and direct mentorship may be the only way to provide training. These improved competencies would help evolve the mentor-mentee relationship into a more equal collaboration over time. Through finding a variety of mentors in both formal and informal settings, a mentee can learn about a broader range of available training activities, which can expose them to other career options in conservation.

Despite mentorship being deemed an essential complement to training programs to equip early-career scientists for future success (Sterling et al., 2021; Chao et al., 2022), we were often told by Indonesian students that they are unfamiliar with what "mentorship" entails. If a limited number of mentors are available, students may agree to work on advisor projects but never gain the ability to have one-on-one career-oriented conversations with the advisor, much less lead their own research projects and develop their own interests. When the mentee author started her career in conservation in 2012, there were not many training opportunities available. Through direct mentorship from the foreign mentor, the mentee was able to identify specific tasks she needed help with and learned both basic skills, such as how to write a cold-call email in English, to more complex skills, such as how to design her own field-based research. The critical technical skills she gained from direct mentorship in statistical analyses using R, research design, and scientific writing all contributed to her ability to resolve multifaceted project challenges, oversee her own research teams, and get a job.

Furthermore, having multiple mentors who come from different professional backgrounds can be beneficial when the mentor-mentee relationship evolves to encompass different interests (Stonewater et al., 1990), resulting in a need for skill training that a single mentor may not be able to provide. For example, the mentee author wanted to switch her career goals from a pure ecologist to a conservation scientist after becoming more involved with grassroots conservation action in Sulawesi. However, the primary focus of the foreign mentor's work is on systematics and biogeography. While conducting fieldwork, she met the domestic mentor, whose 20 years of practical conservation

experience aligned with what she needed at that time to expand her experience with community-based conservation, science education, and interpersonal communication skills. Furthermore, because the domestic mentor was able to provide more support to the mentee, it reduced the burden of work for the foreign mentor, which ultimately encouraged more participation in the conservation project from the foreign mentor. In having both mentors more involved, the mentee now has more opportunities to learn critical skills directly from either mentor.

2.2.3 Help mentees put together competitive packages for training, grant, or scholarship applications

Admittance to discipline-specific training in conservation is often competitive (Chao et al., 2022), as trainers usually have a limited number of spots in order to retain a low trainer-to-participant ratio to maintain higher training quality. In the many training advertisements the authors have seen in the past ten years, applicants are often asked to explain why they deserve the spot and how the training contributes to their career plans. In Southeast Asia, not only this is a rather uncomfortable task for the mentees, as written and formal self-promotion is not common, but women often downplay their own level of competence (Stonewater et al., 1990; Jones and Solomon, 2019; Poor et al., 2021). Mentees often require the support of mentors to understand how to present themselves and create a competitive package for pursuing other training opportunities. If a mentor were to guide the mentee in a self-reflection exercise as part of preparing personal statements, this can both help the mentee with a tangible need and be a way to strengthen mentor-mentee bonds. This exercise also acts as an opportunity for mentees to visualize a career trajectory and have someone to discuss their own vision for their futures.

Workshop applications are a good place for proposal development training to start. While applications to workshops are competitive, they have lower stakes and are shorter writing assignments compared to scholarship or graduate school applications, making it possible for this to become an opportunity to improve linguistic capabilities in a lower pressure situation. Even if mentees are applying to opportunities that do not fully align with mentor interests, mentors should still provide support to their mentees, such as through assistance with overcoming bureaucratic impediments or reviewing the mentees' applications. With the Indonesian students we have spoken to, they felt foreign mentors are only interested in them if it relates to the mentor's project or they were not clear that assistance of this sort was even available. Mentors therefore need to be explicit in letting mentees know that they are willing to offer a broader scope of assistance to help mentees reach their career goals and demonstrate that they are interested in the development of the mentee as an independent scientist, not just as their research assistant.

Mentors who understand their mentees better can better highlight the mentee's strengths and help the mentee stand out in a pool of applicants. Formal training activities often require at least one recommendation letter from a current or past supervisor, which may not exist outside of the classroom for many students. In our combined experience across multiple universities throughout the Indonesian archipelago, many Indonesian faculty members do not consider providing references for students as part of their pedagogical responsibilities. Faculty members will either ask the student to write a draft reference, which they will later sign, or use a standardized reference with generic information across students. For example, the foreign mentor has read two reference letters during the same review cycle for two Indonesian students from the same department and cohort that were exactly the same. In multiple references the foreign mentor has reviewed, the reference may be only a single sentence with some generic positive statement about the mentee's academic performance. The inability to provide a more detailed reference for the student stems from the minimal amount of interactions faculty with the student outside the classroom. Because the social relationships between advisor and student are very imbalanced, there is often a lack of respect for a student's time and needs from the advisor. Rarely are students given more attention to discuss career plans, even for those who are enthusiastic, top academic performers. The combination of students being unaware of the type of content to expect from a more thorough reference and minimal communication with their advisors results in uninformative references and, most likely, a rejection of their application. More communication between the mentor and mentee also allows for strategizing of what needs to be stated in the reference to support the rest of the application. These conversations result in greater clarity for both mentors and mentees about the mentees' strengths and weaknesses.

2.2.4 Make connections to the broader conservation network, both domestic and international

Mentorship can be an open gate for mentors and mentees to meet other similarly minded scientists and practitioners. This is an opportunity for both parties to expand their professional networks and strengthen woman-to-woman support systems. For example, the foreign mentor introduced the mentee to the broader international research and conservation community, which allowed her to meet many new collaborators, potential advisors, and potential sponsors. The mentee in turn introduced the foreign mentor to other Indonesian students, scientists, and collaborators who shared similar research and conservation interests. The mentee also acted as the connective node between the foreign mentor and the domestic mentor, resulting in higher quality relationships being built with local community conservationists and nature enthusiasts, and increasing the audience and network size for sharing knowledge and expertise on conservation. The mentee's strong relationship with both mentors allowed for trust to be built quickly between foreign and domestic parties who previously were not associated in any other way. Together, they created a

well-connected, transboundary system for women to reinforce and champion one another for the betterment of conservation.

2.3 Mentorship creates future leaders in conservation

2.3.1 Be role models and lead by example

Leadership is recognized as one of the five major focal areas in conservation capacity development (Elliott et al., 2018). This is a skill that can be learned (Black et al., 2011; Bruyere, 2015) and mentors can be a crucial way to deliver this to young students (Bhatia and Amati, 2010; Porzecanski et al., 2022) through being an example through their own actions and priorities. Having a role model to help build mentee confidence and self-efficacy with regards to creating transformational change is the strongest predictor of successful conservation action (Jones and Solomon, 2019; Porzecanski et al., 2022). Therefore, mentorship is beneficial for an individual's professional development, as well as creating meaningful long-term contributions in conservation (Black et al., 2011). In our case, the combined experience of both mentors provided the mentee with a variety of situations to learn about leadership, team management, and establishing partnerships on their respective scales (international and domestic) and in a variety of settings. Having both theoretical knowledge and practical skills equipped the mentee to expand conservation programs across Sulawesi through PROGRES. More importantly, throughout the decade of mentorship, the emotional support that the mentors provided helped the mentee feel empowered and confident in leading her conservation research and work.

Views of gender roles in conservation have slowly improved and changed for the better (Poor et al., 2021). Existing women leaders in conservation in the Global South have largely been unrecognized as leaders to the wider community, and that is a problem that is only being corrected slowly in recent years through invitation of these women into more professional spaces and more attention being given to their work (*e.g.* Fauconnier et al., 2018 in water governance). External affirmation of these women as leaders by the conservation community can help overcome some cultural barriers that make them reluctant to recognize themselves as such. The growing accessibility of the internet and broad adaptation of social media increases the visibility of the work of other women scientists in recent years, providing a wider range of examples of careers as wildlife scientists and conservationists, and providing visual evidence that women are routinely leading and participating in the physical activities required for fieldwork. Over the past decade, we have repeatedly heard from Global South women scientists and practitioners that non-traditional media have been essential platforms for them to feel connected to a broader community, providing emotional support passively either through visual evidence on social media or hearing about similar experiences on podcasts. This increasing exposure to women at work inspires other women to follow a similar path. There is an audience of young women seeking out these role models, and if more senior women scientists in both the Global South and Global North fill gaps in representation and provide support to these budding women scientists, the pool of candidates to becoming future leaders in conservation increases significantly.

3 Conclusion

The recommendations we have made above are a necessary first step for improving the mentoring of women in the biodiversity hotspot of Indonesia but covers a slew of issues that are applicable to others in the Southeast Asia region, along with more broadly in the Global South. We recognize that our experiences throughout Southeast Asia may be similar to those faced by other women in other parts of the Global South and our recommendations may prove valuable to address similar issues or modified to fit more sit-specific situations internationally. While we have presented our decade-long mentorships as primarily anecdotal evidence of how to improve mentorship, the importance of these narratives should not be underestimated. We reiterate that there are so few woman-to-woman mentorships to draw from within Indonesian science where the relationship constitutes a true partnership, but it is an important one to understand if we are to create a more equitable and inclusive future. Again, the reflections and observations here are not just the experiences of the authors, but the cumulative frustrations we have heard from countless other Indonesian young women in biodiversity science who we have both trained, mentored, or studied with. We will lose another generation of women conservationists if we continue to use the lack of robust data as an excuse to do nothing. While women mentors from the Global South are currently relatively rare, their inclusion can be invaluable to mentees and to the field of conservation. As the number of Global South women conservationists slowly increase, we encourage them to reach out to be role models for the next generation.

The narratives we have presented here is, to our knowledge, one of the only ones in the literature that center around the mentee's experience. The mentee's experiences are not only valuable to scholarship on mentoring in the context of being a mentee, but her thoughts on what has made her successful is very applicable to her more recent development into a local conservation leader and mentor herself as well. In writing this paper, she also gained more insight as to why her mentors made the choices that they did to mentor her and allowed her to grow more into the next phase of her career as well. This type of narrative illustrating how a Global South scientist grew from a naïve mentee to skilled mentor is rare in the existing conservation capacity building literature, despite the high need

for them to better understand mentee perspectives, priorities, and pressures to find solutions for recruitment and retention for the betterment of conservation in biodiversity hotspots. There is a need for more voices from Global South mentees to be included in the conversation around mentorship and collaboration, as these have long-term consequences for many global biodiversity hotspots.

Improving outcomes for mentee careers requires that mentors—both men and women—empathize more with the struggles of their mentees and communicate better with one another. The most important recommendation we can make to any potential mentor is to improve their emotional intelligence and cross-cultural understanding such that they can provide the emotional support their mentees need. Particularly in the Global South, as mentors and leaders, we should do our utmost to advance others, not only offer assistance to those who can help our own endeavors. The exploitation of mentees from the Global South purely for mentor career advancement will result in them being subordinate to the mentor from the Global North, even in the future, making the development of truly equal peer partnerships for transboundary conservation unlikely. This type of exploitation can easily develop in societies like Indonesia where women are usually not given as many opportunities to add their viewpoints, and mentors must try to make a safe space where mentees feel that they can share their own concerns. Mentors need to remember that the success of their mentees is a reflection of their own success as mentors and celebrate mentees who become independent leaders. Over time, empowered women will inspire other women to work in conservation, creating an inclusive and diverse field of conservation to secure biodiversity into the future.

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

S and SMT conceptualized the case study. All three authors listed have contributed substantially to the writing of this manuscript.

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Conflict of interest

The 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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Cool cats and communities: Exploring the challenges and successes of community-based approaches to protecting felids from the illegal wildlife trade

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Implementing community-based approaches to countering illegal wildlife trade is important to not only improve the effectiveness of strategies to protect wildlife, but also to promote equity and justice. We conducted an international exploratory review of interventions that aim to address the illegal trade in wildlife using a variety of community-based approaches. We focused our study on Felidae species in particular, as they factor centrally in the illegal wildlife trade, and have received significant conservation attention due to many being charismatic species. We searched for case studies that have been or are currently being implemented, and that were published between 2012-2022 in scholarly or grey literature databases. We extracted data on 40 case studies across 34 countries, including information on the approaches used, successes, challenges, and recommendations using a Theory of Change framework for community action on illegal wildlife trade. Initiatives to protect Felidae species from illegal trade could consider using multi-pronged approaches, consider historically underrepresented groups within communities - including women - in their design, and should evaluate the social and ecological outcomes to improve future efforts.

KEYWORDS

community-based conservation, wildlife trafficking, Felidae, justice, gender

1 Introduction

The blame for biodiversity loss is often attributed to the extractive practices of impoverished, local, or Indigenous communities, despite increasing demand and wealth in international consumer markets for illegal wildlife products (Duffy et al., 2015; Domínguez and Luoma, 2020). Approximately 15% of the global population depends on

wildlife harvesting to support their livelihoods (Brashares et al., 2014). The harvest of wildlife and wildlife products is an important component of rural and Indigenous people's nutritional (e.g., Kuhnlein et al., 2008; Haq et al., 2022) and cultural (e.g., Ngoufo et al., 2014; Kumera et al., 2022) identities and have proven to be sustainable, even ecologically beneficial (e.g., Bodmer et al., 2020). The persistence of traditional subsistence socio-ecological systems has been jeopardized by conservation-related injustices, such as the criminalization of subsistence hunting, that disproportionately affect Indigenous peoples and local communities (see van Vliet et al., 2015; Vlasova et al., 2017). Subsistence hunting typically is exercised by local hunters, and involves the snaring or trapping of less at-risk animals for the intention of consumption (Witter, 2021). Instances in which subsistence hunting begins to shift into commercial hunting, in which the animals being targeted have an at-risk status and are being targeted for commercial trade, does the hunting become considered a part of the illegal wildlife trade (IWT). The illegal wildlife trade (IWT) refers to the process "from killing and kidnapping of wildlife, through alteration into products if necessary, then smuggling within or between countries, and selling to the final buyer in person or online" (Wyatt, 2022, p. 9).

Socioeconomic drivers of IWT have a significant impact at the local level which is often omitted in legislative intervention strategies (Liew et al., 2021). However, the legality of hunting, particularly at the subsistence level, is deeply connected to colonial histories of displacement and criminalization of Indigenous peoples for the sake of conservation (Bardey, 2020; Snook et al., 2020). For example, Nicaragua's *saneamiento territorial* (territorial cleaning) policy prioritizes the territorialization goals of the state. In doing so, it dispossesses Indigenous peoples of their territories and natural resources (Sylvander, 2021). These injustices can increase the likelihood of a conservation intervention strategy failing, exacerbate unwanted behaviors, and undermine the legitimacy of conservation initiatives to succeed (e.g., Duffy et al., 2019). Efforts to mitigate IWT that uphold local rights and that support a community's assets and livelihoods can create an enabling environment for effective enforcement and prevent unintended consequences (Cooney et al., 2017). Further, Jones and Murphree (2004) suggest that providing for human needs must be tangential to any conservation effort, which involves the lives and livelihoods of local communities. Community-based approaches to addressing IWT are slowly gaining attention and can be effective in preventing wildlife crime and supporting communities (Roe and Booker, 2019). Identifying how measures to protect wildlife from IWT can counter conservation injustices necessitates a deeper investigation into how these strategies translate socially.

It is also important that consideration of communities in efforts to address IWT is not homogenized. In particular, women are increasingly being recognized as critical actors for IWT prevention (Graham, 2022). However, women's roles within this sector are often undermined due to patriarchal power dynamics, which affect women's access to and participation in conservation initiatives (Kahler and Rinkus, 2021). The gendered dimensions of IWT are a critical consideration for species conservation because gender dynamics can influence both IWT operations (Agu and Gore, 2020; Mrosso et al., 2022) and community-based conservation initiatives (Keane et al., 2016; Abebe et al., 2020; Mashapa et al., 2020). IWT relates to distinct gender disparities, which are important to recognize if any IWT response measure is to be successful (Seager, 2021). For example, women generally participate in IWT in different ways than men, receive less economic benefit from IWT than men, and suffer a higher burden of the negative consequences, such as zoonotic disease (Seager, 2021). Women can also play an important role in supporting efforts to mitigate IWT (Agu and Gore, 2020; Anagnostou et al., 2020; Kahler and Rinkus, 2021). Both overlooking women's roles in IWT and failing to integrate women in interventions to address it creates major blind spots for practitioners, deepens existing gender inequalities, and ultimately limits the effectiveness of responses (Seager, 2021). Thus, when grappling with the complexity of illegal trade in species and conservation, it is imperative that we have an understanding of women's role within community-based responses.

Many previous works signal alarm for the conservation status of global carnivores facing uncertainty in their persistence due to the synergistic effects of pressures (e.g. Ingeman et al., 2022; Ripple et al., 2014). These pressures include changes in climate, habitat availability, land use, disease exposure, and invasive species. Prey depletion is arguably amongst the most significant drivers of vulnerability in carnivore populations, where overhunting and habitat loss degrade the prey stock to disrupt predator-prey dynamics (Carter, Levin, and Grimm, 2019; Wolf and Ripple, 2016). In addition, overexploitation by humans is of high concern, and contributes to carnivore declines across scales. According to the International Union for Conservation of Nature (IUCN) Redlist, biological resource use threatens all 38 species of the Felidae family either directly through hunting and trapping or indirectly from habitat degradation and modification (IUCN, 2022). Felids are of high conservation priority and interest, which results in increased conservation efforts, communication campaigns, and research attention (Albert et al., 2018). Therefore, Felidae species present a useful sample for researching efforts to address IWT.

In this paper we present an exploratory study on community-based approaches to mitigating illegal trade in felid species. We do this by conducting a review of case studies of community-based approaches to counter IWT using a Theory of Change (ToC) framework. This study is a review of specific case studies of community-based approaches to counter the illegal trade in wild felids, and provides insight into research gaps that could be addressed. We were looking broadly at the types of community-based approaches used, as well gender and justice oriented conservation solutions. Our study contributes to the literature on the gendered dimensions of IWT, community-based conservation, and justice-oriented conservation.

Objective 1: Identify the types of community-based approaches which are being used to stop the IWT of Felids.

Objective 2: Identify the factors which reportedly contribute to the challenges and success of anti-IWT initiatives.

Objective 3: Identify the means in which gender and justice are integrated within community-based approaches to prevent illegal trade in Felidae species.

Specifically, we outline the ToC for community-based anti-IWT efforts; we detail our methods for an analytical framework to assess

case studies on the challenges and success of measures to protect felid species from illegal trade; we provide a qualitative explanation of gendered and justice-centered approaches to highlight the human dimension of IWT prevention; we discuss the outcomes, both positive and negative, of these community-based practice, as well as state the broader conservation implications; and we conclude by providing suggestions for future research.

2 Theory of change

The communities closest to wildlife should play a central role in deterring IWT. Biggs et al. (2016) developed the first ToC for countering IWT based on feedback garnered from stakeholders, including IWT experts, conservation organizations, funders, and government officials. ToC articulates the activities and inputs needed to achieve a particular outcome in a given context. When properly implemented, a ToC is a participatory stakeholder-driven process that examines assumptions associated with the context in which the outcomes are associated (Biggs et al., 2016). The ToC process can foster organizational reflection and learning, and adaptive management (Archibald et al., 2016). ToCs have been widely used in international development, outreach, agricultural extension systems, and wildlife conservation, and most recently, IWT (e.g., Wallen and Daut, 2018; Balfour et al., 2019; Skinner et al., 2020; Donaldson and Franck, 2021).

Four key pathways for community action on IWT were identified by Biggs et al. (2016): 1) strengthen disincentives for illegal behavior, 2) increase incentives for wildlife stewardship, 3) decrease costs of living with wildlife, and 4) support livelihoods that are not related to wildlife. These pathways all represent key conditions that enable communities to take action, while taking into account the needs for capacity-building and proper governance structures (Biggs et al., 2016). Community contributions to the first pathway, "strengthen disincentives for illegal behavior," include normative sanctions against poachers as well as more formal means such as being hired to aid law enforcement as game guards or scouts (Biggs et al., 2016). More robust formal means of law enforcement are also needed so that violators are penalized and there are staff members to monitor for illegal behavior. The second pathway entails "increasing incentives for stewardship." This is a crucial approach for including the community in IWT solutions since it involves securing the ownership and use rights for wildlife at the local level. As a result, IWT is discouraged and individual and societal capacity for wildlife conservation is built (Biggs et al., 2016). The third pathway for community action on IWT is to "decrease the costs of living with wildlife" as a means to foster improved co-existence. This can be achieved by improved fencing to protect livestock, which can decrease livestock losses and dampen animus by hopefully preventing attacks (Biggs et al., 2016). Local communities are less likely to support wildlife protection when people are harmed by wild animals (Lamichhane et al., 2018). The fourth pathway, "creating alternative sources of income," can reduce IWT by enabling and promoting alternative livelihoods. Supporting diverse sources of income, such as crops, tourism, or artisanship, can reduce livelihood dependence on wildlife resources. Given the utility of ToC for understanding community involvement in the IWT, we apply the four pathways as a framework in our study to understand the socio-ecological dimensions of IWT prevention using felid species as a case study.

3 Materials and methods

3.1 Data collection

We used English-language search terms to identify case studies from publications in academic and grey literature between 2012-2022 to identify community-based anti-illegal felid trade interventions that have been implemented over the past decade or are currently being implemented. We identified 38 felid species from the IUCN Red List (see Table 1). Of the 38 species included in our search, case studies of community-based conservation efforts were available for 25 species and were thus included in our analysis (see Table 1). Of these 25 species, 9 are currently classified as Least Concern, 9 as Vulnerable, 5 as Near Threatened, and 2 as Endangered. The populations of the majority of the species (n=20) reviewed are decreasing globally, while 3 species populations are stable and the trends for 2 species are unknown.

We included case studies described in academic peer-reviewed publications, as well as case studies described in non-academic sources, including the People Not Poaching database (https://www.peoplenotpoaching.org/), non-governmental organization reports, and websites dedicated to the specific initiative, all of which are included in the reference list. We included case studies of IWT at domestic or international levels. Two case studies that emerged from the searches had English-language summaries and additional details in other languages (Spanish and Portuguese), which were included and the additional details were translated as needed using the Google Translate tool. We did not exclude studies based on geographic location, or the research design used (e.g., qualitative, quantitative, descriptive, mixed-methods, etc.). As our study was exploratory, we sought to find at least one, and up to three case studies for each species, in order to have a greater opportunity to identify trends in anti-illegal wildlife trade approaches for the species, as well as to generate a nuanced understanding of the problem and the specifics of the initiatives at the local level.

The databases that were used included Scopus, Google, Google Scholar, and the People Not Poaching database, as these are four comprehensive databases for both scholarly and grey literature sources. Our criteria for inclusion of the identified case studies were that the case study: (1) must cover at least one of the four community-based pathways; and (2) the anti-IWT prevention project must have been already implemented, rather than having been just proposed or suggested. If we were unable to find case studies in scholarly literature first, we would then attempt to find examples from the People Not Poaching database based on our two inclusion criteria. In identifying available literature for case study examples, we used various combinations of search terms such as "anti-poaching strategies", OR "anti-poaching", OR "local communities", "local community conservation", OR "community-led conservation", OR "community-based conservation," or

TABLE 1 Felidae species that were included or excluded from our study, along with their most recent IUCN Threat Status.

Species with Included Case Studies	Species with Excluded Case Studies
Cheetah (*Acinonyx jubatus*) Vulnerable	Borneo Bay Cat (*Catopuma badia)* Endangered
African Golden Cat (*Caracal aurata*) Vulnerable	Chinese Mountain Cat (*Felis bieti*) Vulnerable
Caracal (*Caracal caracal*) Least Concern	Black-footed Cat (*Felis nigripes*) Vulnerable
Asiatic Golden Cat (*Catopuma temminckii*) Near Threatened	Jaguarundi (*Herpailurus yagouaroundi*) Least Concern
Jungle Cat (*Felis chaus*) Least Concern	Southern Tiger Cat (*Leopardus guttulus*) Vulnerable
Sand Cat (*Felis margarita*) Least Concern	Northern Tiger Cat (*Leopardus tigrinus*) Vulnerable
Wild Cat (*Felis silvestris*) Least Concern	Canada Lynx (*Lynx canadensis*) Least Concern
Pampas Cat (*Leopardus colocolo*) Near Threatened	Eurasian Lynx (*Lynx lynx*) Least Concern
Geoffroy's Cat (*Leopardus geoffroyi*) Least Concern	Iberian Lynx (*Lynx pardinus*) Endangered
Guiña (*Leopardus guigna*) Vulnerable	Bobcat (*Lynx rufus*) Least Concern
Andean Cat (*Leopardus jacobita*) Endangered	Pallas's Cat (*Otocolobus manul*) Least Concern
Ocelot (*Leopardus pardalis*) Least Concern	Flat-headed Cat (*Prionailurus planiceps*) Endangered
Margay (*Leopardus wiedii*) Near Threatened	Rusty-spotted Cat (*Prionailurus rubiginosus*) Near Threatened
Serval (*Leptailurus serval*) Least Concern	
Sunda Clouded Leopard (*Neofelis diardi*) Vulnerable	
Clouded Leopard (*Neofelis nebulosa*) Vulnerable	
Lion (*Panthera leo*) Vulnerable	
Jaguar (*Panthera onco)* Near Threatened	
Leopard (*Panthera pardus*) Vulnerable	
Tiger (*Panthera tigris*) Endangered	
Snow Leopard (*Panthera uncia*) Vulnerable	
Marbled Cat (*Pardofelis marmorata*) Near Threatened	
Leopard Cat (*Prionailurus bengalensis*) Least Concern	
Fishing Cat (*Prionailurus viverrinus*) Vulnerable	
Puma (*Puma concolor*) Least Concern	

Species were included if we were able to find community-based case studies to mitigate illegal wildlife trade.

"conservation action plan" AND "[family name of Felidae species]", OR "[species common name]", OR "[species scientific name]". We used qualitative content analysis to identify key patterns and concepts within the included texts (Forman and Damschroder, 2008).

Members of the research team met biweekly for six months to categorize and identify the modes of anti-IWT approaches, as well as to establish the criteria for how each case example for each species (n = 25) met at least one of the ToC pathways. Further, we noted when we could not find an implemented community-based anti-IWT example for a given species. These species were not included in our analysis (see Table 1). We then explored the specific social and ecological outcomes that were reported in the case studies. Each case study was categorized by the lead and second authors, with discrepancies discussed, reviewed and resolved.

As our study was exploratory and descriptive, themes were identified inductively. The case studies were read first for familiarization with the context, then re-read to generate themes relating to the approaches used, and then re-read again to identify themes relating to the challenges and effectiveness of each intervention. The themes for the approaches used were centered around the four ToC pathways, and additional themes were added inductively (e.g., "Adaptive management"). The 'lessons learned' data were separated into the broad themes of "Challenges" and "Successes." Specific codes were then assigned to the identified themes (for example, one of our assigned codes was "Challenges: Lack of participation," or "Successes: Positive attitudes toward felids post-intervention"). The results are presented in descriptive terms, which collate the ideas and lessons learned across all the case studies. The results section is organized by themes.

3.2 Data analysis

We populated a database in Microsoft Excel to extract data from each reviewed initiative on the approach used, the successes, and the challenges, if reported. The spreadsheet includes columns for basic information on the species of interest, such as the species' common names, scientific names, family, IUCN Red List status, year of assessment, CITES status, IUCN Red List population trend, and whether it is threatened by IWT (yes/no; and if yes, in which countries). We also included more specific data in the spreadsheet relating to IWT, such as the known drivers of illegal hunting, and cultural significance. In addition, we recorded details on the identified case studies of initiatives to protect that species, such as where it is located, details of their approach, and its categorization within ToC framework. Lastly, we extracted data on whether it was evaluated, and the study/evaluation outcome. Data were analyzed qualitatively using Pivot Tables to measure counts of categorical data (e.g., count of case studies in each country, count of case studies that used each approach, etc.) and visualized using Python in Jupyter Notebook. Citations for the source of case studies supporting each of the themes are noted in the results section.

4 Results

Each included publication (n = 36) could consist of multiple case studies relevant for our analysis. As such, the number of case studies is higher than the number of publications included in this study. Of the publications included, 25 were retrieved from academic literature, 6 were retrieved from the People Not Poaching platform, and 5 were retrieved from grey literature sources. These publications gave us a total of 40 case studies for our investigation. These case studies were based in 34 different countries, in addition to one African-continent wide review study (see Figure 1). Despite searching all included case studies for any type of gender consideration, only 5 described gender dynamics.

According to our review, all 25 included felid species were illegally hunted and traded throughout their geographic range. Frequently reported drivers of illegal hunting of felids included human-wildlife conflict due to poultry or livestock depredation (n = 21), opportunistic/unintentional illegal harvesting (e.g., caught in indiscriminate trap; n = 10), targeted for illegal commercial trade in pets, skins and parts (n = 18), used in traditional cultural practices (n = 8), and unknown/not enough data (n = 9) (Figure 2). These drivers add up to more than the total number of species, as many

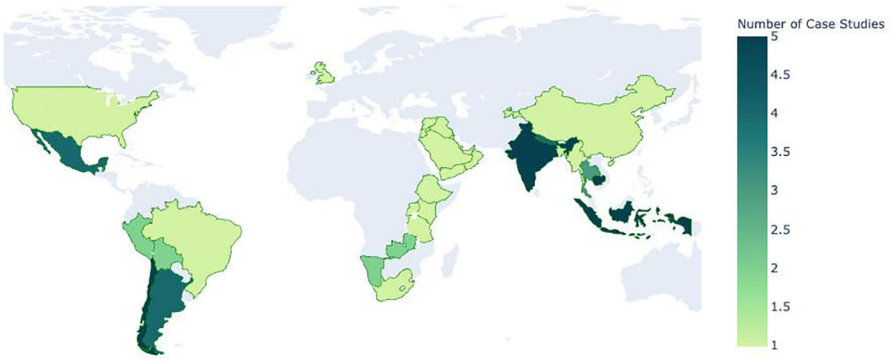

FIGURE 1
Global map of the countries where included case studies were located. Darker coloration indicates a higher number of case studies representing that country.

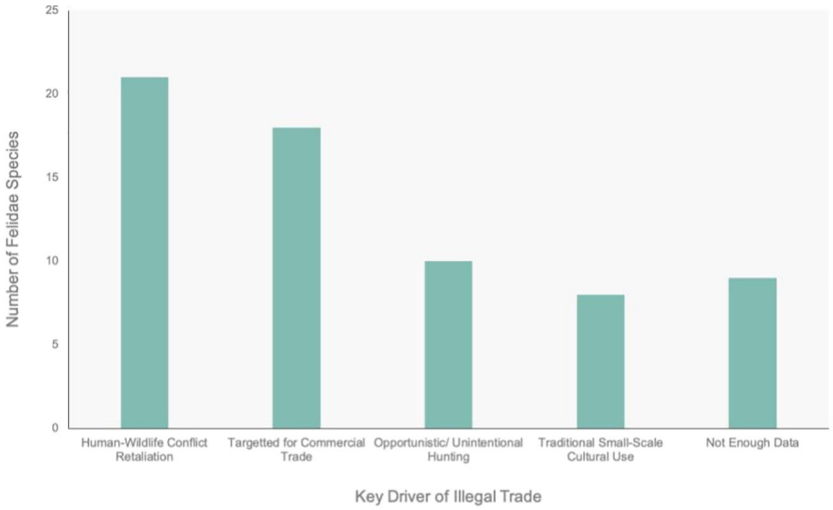

FIGURE 2
Reported key drivers of illegal trade in Felid species (n = 25) across the case studies. Totals exceed the number of included species, as some felid species are illegally traded due to a combination of these factors.

species experienced a combination of drivers of illegal hunting and trade. For the purposes of this investigation, we focused on the species who were targeted specifically for IWT.

4.1 Types of community-based initiatives

We coded case studies using the four pathways in the ToC framework (Biggs et al., 2016) and found that many community-led initiatives to stop the illegal trade in felids focused on increasing incentives for wildlife stewardship (n = 27). This was followed by decreasing the costs of living with wildlife (n = 23), supporting livelihoods that are not related to wildlife (n = 16), and strengthening disincentives for illegal behavior (n = 14) (Figure 3).

4.1.1 Comprehensive approaches

Several felid conservation projects used highly comprehensive approaches to address all four community-based pathways to reduce pressure on wildlife from IWT. For instance, Panthera's project, which aimed to mitigate IWT in the Greater Kafue Ecosystem, Zambia, focused on all four pathways for cheetah (*Acinonyx jubatus*), leopard (*Panthera pardus*), and lion

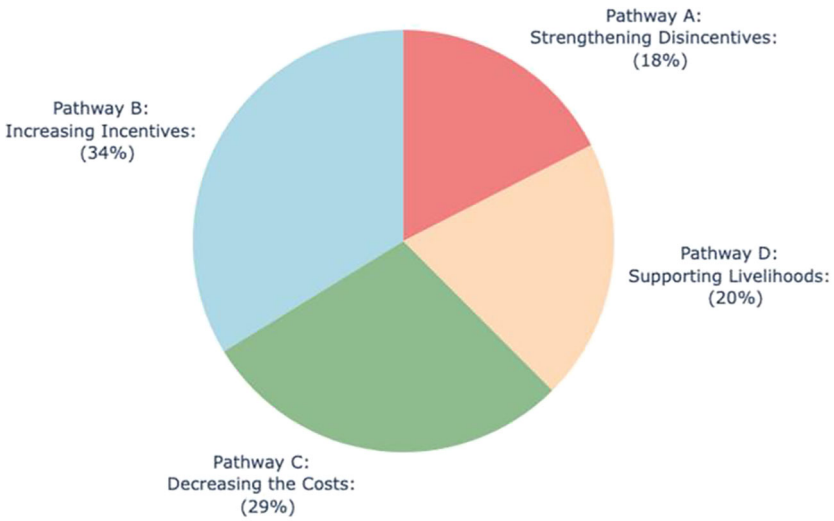

FIGURE 3
Distribution (%) of pathways used to address illegal wildlife trade in felids in our included case studies. The pathways are: **(A)** strengthening disincentives for illegal behavior (e.g., through community scouts and incentivizing patrols); **(B)** increasing incentives for wildlife stewardship (e.g., through tourism, resource access); **(C)** decreasing the costs of living with wildlife (e.g., physical barriers to protect livestock); and **(D)** supporting livelihoods that are not related to wildlife (e.g., enterprise support) (Biggs et al., 2016).

(*Panthera leo*) conservation (People Not Poaching, 2020b). Similarly, community-based projects in Kerala, India, Chitwan district, Nepal, and in Veun Sai-Siem Pang Conservation Area, Cambodia, took a comprehensive approach to protecting felids (i.e. leopards (*Panthera pardus*), clouded leopards (*Neofelis nebulosa*), fishing cat (*Prionailurus viverrinus*), Asiatic golden cat (*Catopuma temminckii*), marbled cat (*Pardofelis marmorata*), leopard cat (*Prionailurus bengalensis*), and tigers (*Panthera tigris*)) from wildlife crime by utilizing at least three ToC pathways in their prevention approach (e.g., People Not Poaching, 2018; Lamichhane et al., 2020; People Not Poaching, 2020a). Notably, many highly comprehensive conservation projects target the conservation of large felids, such as tigers, cheetahs, and leopards. The small felid species included in our review generally appeared to lack the same level of conservation attention. We were unable to find any evidence of community-based conservation projects for thirteen felid species and these were primarily small felids (Table 1).

4.1.2 Strengthening disincentives

Examples of initiatives to strengthen disincentives for illegal felid hunting behavior included programs that offered payment for community scouts and for patrolling and guarding (Foggin, 2012; People Not Poaching, 2018; Lamichhane et al., 2020; People Not Poaching, 2020a; People Not Poaching, 2020b; Embaka, 2022). Some initiatives also offered in-kind incentives for actionable information on wildlife crimes (e.g., People Not Poaching, 2020a). The most commonly reported strategies involved community outreach, workshops, training sessions, and raising community awareness about wildlife conservation concerns, and wildlife crime rules, penalties, and sanctions (McCarthy et al., n.d.; Foggin, 2012; Fishing Cat Conservation Alliance, 2018; People Not Poaching, 2018; Breitenmoser et al., 2019; Fishing Cat Conservation Alliance, 2019; Silva-Rodríguez et al., 2019; Lamichhane et al., 2020; Lavariega et al., 2020; Ramírez-Bravo et al., 2020; People Not Poaching, 2020a; People Not Poaching, 2020b; People Not Poaching, 2020c; People Not Poaching, 2020d; People Not Poaching, 2021; Geoffroy's Cat Working Group, 2022). In addition, a couple of studies that we reviewed focused on the power of social norms in reducing felid hunting practices, the impact of passively received information, and the use of hunting taboos and cultural proscriptions as culture-based tools for reducing unsustainable hunting and IWT (Marchini and Macdonald, 2020; Nijhawan and Mihu, 2020).

4.1.3 Increasing incentives

Examples of initiatives to protect felids from IWT by increasing incentives for wildlife stewardship included facilitating a shift to ethical ecotourism, conservation tourism, and trophy hunting (Mossaz et al., 2015; Thapa et al., 2017; People Not Poaching, 2018; Breitenmoser et al., 2019; People Not Poaching, 2020a; People Not Poaching, 2020b; Geoffroy's Cat Working Group, 2022), often emphasizing the need for transparency and fair sharing of benefits. One study in Tajikistan noted that implementing trophy hunting programs of snow leopard (*Panthera uncia*) prey species has the potential to support conservation efforts of snow leopards (Kachel et al., 2017). However, the researchers noted that these types of programs can be complex and more research is needed (Kachel et al., 2017). Other projects that increased incentives for wildlife stewardship promoted resource access and use for local community subsistence (People Not Poaching, 2020b). In addition, payment for ecosystem services projects were able to reward communities who supported conservation and monitoring initiatives of target felid species (Harvey et al., 2017; People Not Poaching, 2021). Job creation through reformed poacher/"Poacher to Protector" initiatives also emerged in our review to prevent re-offending and provide past offenders with the capacity and opportunity to participate in illegal wildlife trade mitigation and tourism efforts (People Not Poaching, 2020a; Embaka, 2022).

4.1.4 Decreasing the costs

Examples of initiatives to decrease the costs of living with wildlife - and therefore to decrease the likelihood of engaging in IWT - included the introduction of livestock guarding dogs with financial support and training on their care and the provision of veterinary support and vaccinations (González et al., 2012; Kebede et al., 2016; Marker et al., 2021). Similar initiatives under this category to help mitigate human-wildlife conflicts included livestock protection collars (McManus et al., 2015), and predator control lights to mimic human activity and act as a visual repellent for livestock depredation (Verschueren et al., 2019). Other repellents, such as fire, noise and chemicals, and irritating smells were also used in efforts to mitigate conflict with felids (Kebede et al., 2016; Megaze et al., 2017). Several projects aimed to decrease human-felid conflicts through the construction or predator-proofing/reinforcing of different types of physical barriers, such as bomas, chicken coops, and goat pens (McCarthy et al., n.d.; Lichtenfeld et al., 2015; Kebede et al., 2016; Megaze et al., 2017; People Not Poaching, 2020b; Geoffroy's Cat Working Group, 2022). Physical separation of people/livestock and wild felids through improved land use zoning plans is another reported strategy (People Not Poaching, 2020b). Finally, interventions have been implemented which offer financial compensation for property damage, livestock depredation, and human injury or death to facilitate equitable sharing of benefits from wildlife (Bauer et al., 2017; Chouksey et al., 2017; Karanth et al., 2018).

4.1.5 Supporting alternative livelihoods

Examples of initiatives to support livelihoods that are not related to wildlife included promoting alternative sources of income that do not rely on wildlife exploitation and involved the provision of community benefits, such as access to new employment opportunities, farming support, training in new skills (such as tailoring), and improving access to school (Fishing Cat Conservation Alliance, 2019; People Not Poaching, 2020b). A creative approach to supporting livelihoods and community benefits as a strategy is a project that aimed to protect the African golden cat (*Caracal aurata*) from illegal hunting in Uganda. Part of their strategy involved offering free oral health care and treatment to communities living near protected areas through the use of mobile dental units, in exchange for voluntary support with

detecting illegal hunting (Embaka, 2022). The project also supported pig farming to improve household income, dissuade wildlife crime, promote community policing and generate social pressure against IWT (Embaka, 2022).

4.1.6 Additional approaches

Some initiatives were focused at a higher level of governance and management structures for the implementation of policies for sustainable wildlife use, conservation, and management. Many initiatives emphasized the importance of collaborative and adaptive management approaches. These measures included reviewing legislation and law enforcement, engaging with stakeholders, ongoing data collection and monitoring of the species and threats, identifying gaps in knowledge and policy, and using this information to make recommendations to improve legislation, law enforcement, and public education and awareness (e.g., Foggin, 2012; Banfield and al Qahtani, 2014; Fishing Cat Conservation Alliance, 2018; Breitenmoser et al., 2019; Silva-Rodríguez et al., 2019; People Not Poaching, 2021; Gallina et al., 2022; Geoffroy's Cat Working Group, 2022). Lastly, although less aligned with the four key pathways for community-based responses to IWT, some studies described the focus on increasing law enforcement presence, arrests, and prosecutions, to reduce IWT of felids, though noted that this alone cannot stop wildlife crime (e.g., Jenks et al., 2012; Risdianto et al., 2016).

4.2 Effectiveness of community-based initiatives

Many of the initiatives reviewed in our study did not report undertaking formal evaluations of social or ecological outcomes of their community-based programs to address illegal wildlife trade. Nine projects described their approaches, but did not evaluate their effectiveness in benefiting communities or wildlife. The rest of the included initiatives reported on their effectiveness to some degree, which is what we used to glean insights into self-reported challenges and areas of success. The lessons learned from the reviewed initiatives are summarized below.

4.2.1 Challenges to community-based initiatives

4.2.1.1 Low uptake/participation

Some of the most notable challenges to community-based initiatives stem from a lack of enthusiasm, agency, or time by local community members. Despite the known success of livestock guarding dog initiatives in reducing human-wildlife conflict, one study in Argentina found that herders may not be willing or able to provide the ongoing care needed for livestock guarding dogs, and therefore be unwilling to become involved in these initiatives (González et al., 2012). Similarly, community-based anti-poaching units can be effective in raising awareness about wildlife crimes, gathering information, and reducing illegal hunting pressure (Lamichhane et al., 2020). However, local people's participation is central to the success of these programs, and uptake in some cases is low. One case study detailing the use of community-based anti-poaching units in Nepal reported inadequate participation because people felt they did not have time available for conservation activities, received insufficient direct benefits, and importantly, had low security assurances relating to encounters with illegal hunters (Lamichhane et al., 2020). Community-based conservation programs may be improved going forward with the provision of training, field gear and equipment, financial support, incentives, and strengthening security of members (Lamichhane et al., 2020).

4.2.1.2 Ineffective livestock loss compensation schemes

Compensation schemes have proven efficacy in reduced killing of predators, and are also a cost-effective option for conservation organizations to reduce the costs of living with wildlife (Bauer et al., 2017) and therefore reduce incentives for wildlife crime. However, livestock loss compensation schemes have failed in the past due to factors such as poor design, poor implementation, corruption, fraud, lack of transparency, or because of a lack of consideration for cultural values (Mossaz et al., 2015; Karanth et al., 2018). The other challenge for compensation schemes, and wildlife crime interventions more broadly, is ensuring that funding is stable and sustainable (People Not Poaching, 2018). Tourism surcharges, rather than a reliance on charity, is a viable alternative (Bauer et al., 2017). However, the funding for compensation schemes is still dependent on dynamism in tourism markets, broader economic trends, changes in leadership and priorities of conservation groups (Bauer et al., 2017). In addition, people in need of compensation may be unhappy with an overly lengthy and complicated process to submit claims, as well as high transaction costs (e.g., excessive documentation, visits to government offices), and the subsequent delays in payment (Chouksey et al., 2017; Karanth et al., 2018). This suggests that a simple compensation process that facilitates timely payment may improve efforts to mitigate human-wildlife conflict, improve attitudes toward predator conservation, and reduce IWT (Chouksey et al., 2017; Karanth et al., 2018).

4.2.1.3 Barriers to improving attitudes

Interestingly, one case study of a school-based education and communication initiative in the Brazilian Amazon reported that a few participants' negative attitudes towards jaguars were, in fact, reinforced by the project (Marchini and Macdonald, 2020). The researchers posit that this is possibly due to strong preconceived biases toward jaguars (*Panthera onca*) (Marchini and Macdonald, 2020). An alternative explanation is that some of the students involved in the school-based initiative had negative attitudes towards jaguars, which may have been reinforced by having to justify their opinions under peer pressure, since the majority of their classmates had more positive attitudes toward jaguars. Being forced to justify their negative opinions can make the students more convinced that they are right, their classmates are wrong, and that their freedom to choose how to think or feel is being limited (Marchini and Macdonald, 2020). This phenomenon, known as reactance, is an interesting and likely underreported issue in wildlife conservation programs and should be carefully considered in communication interventions to reduce IWT.

4.2.1.4 Gender dimensions and inclusivity

Gender is also important to consider when designing and implementing anti-IWT initiatives. Women may bear a disproportionate amount of the costs of human-felid conflict and illegal felid trade, and therefore barriers to their active participation and opportunities to benefit from initiatives must be eliminated (Harvey et al., 2017; Seager, 2021). However, only a few case studies discussed the importance of gender dimensions. For instance, we found a program in Chile and Argentina within the supporting livelihoods pathway that made special consideration for the gender dimensions of wildlife conservation (People Not Poaching, 2020d). This program focused on empowering women through their engagement as artisans to create handcrafted products to increase incomes, along with educational activities and capacity building (People Not Poaching, 2020d). This project is reportedly resulting in a reduction in carnivore hunting (People Not Poaching, 2020d). The lack of consideration for women and historically underrepresented groups within communities may present a significant challenge to community-based approaches to stopping IWT. In some contexts, gender can influence a person's tolerance towards wild felids, and in turn their intention to kill them (Harvey et al., 2017). By treating communities as a homogenous unit, this type of nuance will be left out of the planning and implementation of anti-IWT initiatives, and opportunities will be missed for targeted engagement that might otherwise maximize success. Much more research is needed to understand how to facilitate women's participation in anti-IWT initiatives (Harvey et al., 2017).

4.2.1.5 Lack of trust and open two-way dialogue

More broadly, one of the reported factors that hinders a project's effectiveness is not making an effort to genuinely and thoroughly consult communities and maintain an open two-way dialogue (People Not Poaching, 2020b). However, this can be challenging even when it is the intention. For example, one of our case studies noted that despite the importance of maintaining community partnerships and despite the success of their community-based collaborative monitoring program on jaguars, the reduction of donor/governmental financial support to continue the program was a setback (Lavariega et al., 2020). When this does not occur and when community participation is limited, it can lead to mistrust and indeed jeopardize the success of the initiative (People Not Poaching, 2020b). Further, ensuring transparency and accountability throughout project implementation is crucial (People Not Poaching, 2018; People Not Poaching, 2020b).

4.2.2 Successes in community-based initiatives

4.2.2.1 Education and awareness

We found that the most common (n = 16) type of anti-IWTproject uses education and awareness raising as a conservation tool. School-based education initiatives can be effective in influencing youth and parent attitudes towards felids, as well as a cost-effective strategy when working in rural communities. To maximize the amount of people reached, case studies used a variety of approaches, including a combination of in-person meetings, workshops, talks in schools, distribution of hard-copies of educational materials, radio broadcasts, and online through various social media platforms (e.g., Breitenmoser et al., 2019; People Not Poaching, 2020c). In many cases, it is important to not only build awareness around conservation initiatives, but to also foster a sense of stewardship and capacity within communities that share spaces with wildlife (People Not Poaching, 2020b).

4.2.2.2 Community partnerships

Many rural communities also suffer from frequent human-felid conflicts that are not responded to in time, or adequately (e.g., in terms of compensation), thus blocking a key pathway of the ToC (decreasing the costs of living with wildlife). Many human-felid conflict interventions are implemented with the main goal of minimizing the negative effects of living with wildlife. However, bottom-up approaches that actually bring benefits to communities are necessary (Kebede et al., 2016). Building strong partnerships of all stakeholders, including communities, conservation non-governmental organizations, academic institutions, government agencies, and park managers and rangers, are an important factor for success as each group can offer support and share their own unique knowledge, skills, and capacities with their partners (Foggin, 2012; People Not Poaching, 2018; People Not Poaching, 2020b). Partnerships should consider economic opportunities for rural communities who are providing conservation services, such as monitoring, anti-poaching patrols, providing information on illegal activities, or changing their land use practices in favor of ecological sustainability (Foggin, 2012; Lavariega et al., 2020). Therefore, it is also important for the establishment of adequate "financing structures at the community level for ensuring the transfer of payments that are equitable, transparent, and practical" (Foggin, 2012).

4.2.2.3 Tourism as a conservation tool

Though there are many ways that tourism can be a useful tool for felid conservation and mitigating IWT, tourism-based approaches can be complex (Mossaz et al., 2015). The proceeds from tourism can support research and wildlife monitoring, and help to mitigate human-wildlife conflicts, offset livestock losses, and shift perceptions toward conflict species (Mossaz et al., 2015). Factors for success generally include community involvement and benefits, for example, through the creation of employment opportunities (various tourism-related jobs), as well as livestock compensation programs (Mossaz et al., 2015). Thapa et al. (2017) echoed that financing from tourism is a critical component to ensure that communities are able to benefit from tiger tourism through long-term sustainable employment, upgraded health and sanitation facilities, improved opportunities for education, and improved infrastructure development. All of these benefits resulted in greater motivation towards conservation and tiger stewardship (Thapa et al., 2017). It is also recommended that project managers have a clear idea of the type of tourism they would like to use in their projects - ecotourism, community tourism, nature-based tourism, etc. (Foggin, 2012). Overall, tourism has the potential to support the ToC pathway that underlines increasing incentives for stewardship of felids, and therefore to possibly reduce pressure from illegal trade.

4.2.2.4 Reformed poacher initiatives

In one of the reformed poacher initiatives that we reviewed, the majority of participants were successful in not reverting back to offending, and able to remain involved in conservation efforts (Shaji, 2020). Although building trust was the initial challenge, these individuals were able to receive a stable income and provide their children with better education. In addition to the social benefits, these groups have now become an important part of participatory forest management, including through the establishment of an intelligence network and have helped dismantle wildlife trafficking networks in the area (Shaji, 2020).

4.2.2.5 Ongoing community engagement

Further, *continual* engagement with partners, namely the affected communities, is essential for long-term success of anti-illegal wildlife trade initiatives (Foggin, 2012; People Not Poaching, 2018; People Not Poaching, 2020b). One of our case studies is a long-term project that has resulted in ongoing community-led monitoring and protection of snow leopards in the Tibetan Plateau (Foggin, 2012). Communities were empowered to create plans for conservation and development, selected community conserved areas which account for their cultural and traditional beliefs, and the community members were in fact the ones promoting education with the wider public on the importance of conservation (Foggin, 2012). The threat of illegal hunting has since been reduced through the introduction of collaborative management with the pastoralist communities (Foggin, 2012). At a higher policy level, strengthening land tenure rights and government support for devolved/decentralized governance of wildlife is also important for the success of community-based conservation, as this reassures local communities of their long-term land 'ownership' (People Not Poaching, 2018; People Not Poaching, 2020b).

5 Discussion

Measures to stop illegal felid trade can involve a variety of community-based strategies. Exploring the types of initiatives that are being used to stop IWT and reviewing the reported effectiveness of these initiatives is critical to inform fair approaches to protecting wildlife in ways that benefit and empower local communities. We reviewed community-based programs that have been implemented to prevent the illegal trade in felid species globally. We have identified key insights into the successes, failures, and recommendations of these programs. Though community-based approaches alone cannot solve the problem of IWT, especially considering the prevalence of sophisticated organized crime groups in some contexts (Anagnostou, 2021), our study further illuminates the need for IWT mitigation strategies to consider local communities and the various social dimensions.

Although we initially sought to review and report on the gender and justice-oriented practices of initiatives, there was often not enough information available. Importantly, case studies frequently emphasized the need for more data collection and analysis on changes in rates of IWT pre- and post-intervention, as well as measuring possible confounding factors, and formally evaluating changes in local peoples' attitudes towards felids, before drawing definitive conclusions on the effectiveness of interventions (e.g., Kachel et al., 2017; Lavariega et al., 2020). In addition, where social norms are the focus of an intervention, it is essential to understand the motivations, origins, and meanings behind culture-based tools, such as taboos, in order to effectively incorporate them into conservation frameworks (Nijhawan and Mihu, 2020). Our results also suggest that determining which initiatives will be successful depends largely on the specific context. For example, a community that does not experience high rates of livestock depredation by felids, may not significantly change their attitudes toward wildlife through compensation schemes (Harvey et al., 2017). Instead, participation in a camera-trapping program (i.e., payment provided to landowners when camera traps record cat presence on their land), may be more likely to positively affect tolerance (Harvey et al., 2017). Overall, the incentives must align with the specific needs of the community (Harvey et al., 2017).

Many of the cases in our study did not report social outcomes, thus suggesting that social benefits were not accounted for or prioritized in the development or implementation of the strategy. This is akin to other studies on IWT prevention strategies (e.g., Wilson-Holt and Roe, 2021). Increasing consideration of social dimensions in the development of anti-IWT initiatives should similarly translate into consideration of social outcomes when evaluating their effectiveness. Ignoring the social dimensions of conservation can contribute to the likelihood of IWT practices to persist if the social inequities are not addressed (Lunstrum and Givá, 2020). Using justice-oriented strategies to protect Felidae species from illegal trade can result in measures which are more socially equitable, as well as more environmentally sustainable. This can also help address the systemic causes of poverty and inequalities that drive people to engage in IWT (Anagnostou et al., 2021). An important, yet still underappreciated, pillar of this is gender equity.

One of the most notable findings, or rather *lack* of findings, was the absence of gendered considerations within the majority of the community-based conservation initiatives. Kahler and Rinkus (2021) conducted a comprehensive analysis of identified literature which analyzed the role of gender in wildlife crime-related activities and studies which incorporated gender in their research implementation. They found that between January 1990-March 2020, less than 1% of wildlife crime-related articles mention gender identity. Therefore, enhancing community-based conservation approaches can simply involve evaluating the ways that gender dynamics influence both the challenges and the successes of the approach in the specific context (Seager, 2021). Community-based anti-IWTstrategies can contribute to the ability of people of all genders to realize their full rights, including having a voice in decision-making, and to not be unfairly negatively impacted by conservation initiatives. Further, the benefits and control over a legal and sustainable wildlife trade should be distributed in a way that counteracts gender imbalances.

Our findings contribute to discussions of the importance of building trust and relationships between conservationists and local communities for IWT mitigation measures to have beneficial social and/or ecological outcomes. A way to strengthen these measures is

by considering the nuanced cultural dimensions of local communities and their relationships with the natural world. For instance, some of the cases in our study were able to leverage their conservation efforts *via* the facilitation of already sustainable and wildlife-friendly conservation practices of the local people. The success of these measures may be enhanced by using context-specific, adaptive, and participatory approaches, including ensuring participation from historically underrepresented groups within communities, such as women. A deeper understanding of the existing and potential roles of Indigenous communities and women in mitigating illegal and unsustainable IWT and conserving Felidae species is needed.

5.1 Limitations

The fact that we were unable to find case studies for certain species (n = 13) does not necessarily mean that targeted conservation action is not being implemented for those animals. This could be due to a lack of reporting, a lack of academic research attention, or reports being published solely in non-English languages. For instance, the flat-headed cat (*Prionailurus planiceps*) is endemic to Sumatra, Borneo and the Malayan Peninsula, where two of the most widely spoken languages are Indonesian and Malay (IUCN, 2015; Britannica, The Editors of Encyclopedia, 2013). Additionally, one of the major inquiries that we could not readily confirm for some of the included case studies is how these reporting mechanisms are accomplished, specifically in studies extracted from the People Not Poaching database. We were not always able to identify who was reporting the success of an initiative; how they were reporting it; whether they were conducting an empirical or non-empirical assessment; and how or if they were measuring the illegal hunting rate for the study area. We also found that community-led monitoring efforts were recommended in the academic studies for some species, particularly small non-charismatic ones, but we were unable to find case studies where community-led monitoring was implemented, suggesting a research-practice disconnect.

6 Conclusion

In this study, we sought to evaluate the successes and challenges of strategies to prevent the illegal trade in Felidae species in the context of their social and gendered dimensions. To accomplish this assessment, we utilized Biggs et al. (2016) Theory of Change (ToC). We found a variety of community-based strategies to address the exploitation of wildlife and human communities, including opportunities for paid community scouts, support with alternative livelihood opportunities, provision of improved livestock protection, community benefits derived from wildlife tourism, payment for ecosystem services, and the use of cultural taboos as a conservation tool, among others. Overall, we found that the most comprehensive community-based conservation approaches often focus on conserving large charismatic felid species, such as lions, tigers, and cheetahs. We collated the lessons learned across all of the initiatives, including the implementation challenges and the critical factors for success. Given the gaps we have identified in the literature, there is a clear need for more research to understand the extent of illegal trade of felid species. Additionally, though an emerging topic for researchers, there is an urgent need for a deeper understanding of the successes and challenges of community-led anti-IWTinterventions. Importantly, systematically evaluating the social and the gendered outcomes of interventions will be useful for empirically informed decision making, and to inform fair and effective conservation programs. More broadly, conservation strategies for Felidae IWT prevention must more adequately account for social and gendered differences that surmount from community based initiatives. As conservation and social justice begin to be more frequently viewed in tandem, it is important for measures to be evaluated for their social and gendered impacts to ensure more equitable and sustainable conservation.

Author contributions

AG, MA, NH, and SA contributed to conception and design of the study. AG and MA organized the database. MA performed the analysis. AG wrote the first draft of the manuscript. AG, MA, NH, and SA wrote sections of the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The 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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Applying a gender lens to biodiversity conservation in High Asia

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Community-based conservation efforts represent an important approach to facilitate the coexistence of people and wildlife. A concern, however, is that these efforts build on existing community structures and social norms, which are commonly dominated by men. Some biodiversity conservation approaches may consequently neglect women's voices and deepen existing inequalities and inequities. This paper presents two community case studies that draw upon the knowledge and experience gained in our snow leopard conservation practice in pastoral and agro-pastoral settings in Mongolia and India to better understand women's roles and responsibilities. In these settings, roles and responsibilities in livestock management and agriculture are strongly differentiated along gender lines, and significant gaps remain in women's decision-making power about natural resources at the community level. We argue that context-specific and gender-responsive approaches are needed to build community support for conservation actions and leverage women's potential contributions to conservation outcomes.

KEYWORDS

gender, snow leopards, pastoralism, rights, decision-making

1 Introduction

The roles of women and men in the management and governance of natural resources differ between and within cultures and settings (Abdelali-Martini et al., 2008; Coleman and Mwangi, 2013). Across the world, rural households pursue multiple livelihood strategies with the participation of both women and men. The contributions of women are

significant, and in 2020, women comprised over 37% of the world's rural agricultural workforce (FAO, 2020). In particular, they comprise almost half of the world's small-scale livestock managers (FAO, 2020), yet women still face gender-based barriers that constrain their potential as economic actors and limit their benefits (Kieran et al., 2015; Fortnam et al., 2019).

Human rights principles mandate that development and conservation programs should strive to include the voices and address the needs of groups that are marginalized on the basis of gender, class, or other socio-economic factors (Keane et al., 2016; Kaeser et al., 2018; Secretariat of the Convention on Biological Diversity, 2019). Women are equally entitled to lend their voice to conservation decision-making so that their specific needs and risks are addressed and so that they can also draw benefits from ongoing conservation programming. There is also evidence that engaging women in environment and conservation efforts can lead to improved outcomes (James et al., 2021). However, a range of context-specific factors constrain women's engagement in decision-making about conservation activities, reflecting wider social, cultural, and gender dynamics (Agarwal, 2001; Kieran et al., 2015; James et al., 2021). Community-based conservation tends to rely on male-dominated local power structures in mobilizing support for and leadership of priority actions (Agarwal, 2001). In traditional rural settings, women tend to remain on the margins of most conservation and development initiatives, beyond those that explicitly target them (Torri, 2010). As a result, conservation activities are at risk of unintentionally deepening existing gender-based and social inequalities (Torri, 2010; Keane et al., 2016).

Gender can influence the management and use of natural resources and the conservation of biodiversity in complex ways (Agarwal, 2009; Torri, 2010; Khadka and Verma, 2012; James et al., 2021)—for example, women and men usually perform complementary gender-differentiated tasks in rural settings and therefore experience natural resources and wildlife from different perspectives and gain a distinct set of skills and knowledge (Fortnam et al., 2019). Addressing these gender dynamics requires an understanding of the broader historical and social context (Resurreccion and Elmhirst, 2012). More attention is required to incorporate such gender dimensions in biodiversity conservation and the sharing of its benefits (Alvarez and Lovera, 2016; Fortnam et al., 2019)

Conserving species such as the snow leopard *Panthera Uncia* across High Asia requires addressing the needs of men, women and wildlife that share the habitat (Mishra et al., 2017; Young et al., 2021). The snow leopard's distribution spans 12 very diverse countries and includes vast landscapes where human agro-pastoral and pastoral communities continue to co-exist with the snow leopard (Mishra et al., 2009; Murali et al., 2020). These are multi-use landscapes that people use for crop production and livestock grazing purposes (Murali et al., 2020). As a result, a range of human–wildlife interactions take place, some of which are negative, including depredation of livestock and retaliatory killings of carnivores (Mishra et al., 2003). Community-based conservation represents an important approach to promoting coexistence and empowering people to sustainably manage biodiversity resources (Mishra et al., 2003; Mishra et al., 2017). A concern, however, is that these efforts build on existing community structures and social norms. They may neglect the role and voice of women in program planning and implementation, thereby spurning women's rights and potentially curtailing the effectiveness of biodiversity conservation efforts.

While socio-economic, cultural, legal, and political contexts vary enormously across High Asia, women usually play important roles as economic actors in their communities (Khadka and Verma, 2012). Many rural populations across Asia's mountains are involved in crop production or pastoralism, in which women hold specialized functions (Anand and Josse, 2002; Verma and Khadka, 2016). Women also have a stake in the management of natural assets, such as water resources (Murali et al., 2021). Their access to and control of land and other natural resources, however, are uneven, compared with men, and are often constrained by legal, social, and cultural barriers (Murali et al., 2021).

This paper focuses on gender roles and responsibilities, along with women's rights and access to natural resources, as critical factors to ensure comprehensive, relevant, and equitable natural resource management and conservation programs. We present two community case studies that focus on our experiences with snow leopard conservation in pastoral communities in Tost, Mongolia, and the agro-pastoral village of Kibber, India. We highlight how gender roles and rights related to agro-pastoral activities in these two settings can intersect with biodiversity conservation and wider ecosystem service management. We identify opportunities for further engaging women in community-based conservation.

2 Approach and examples

The Convention for Biodiversity (2019) proposed a conceptual framework (Figure 1) that recognizes differences and inequalities in gender roles and responsibilities and in rights and access to resources, which all serve as powerful determinants of biodiversity and ecosystem services. Our case studies focus on how the two primary domains, gender roles and rights, underpin and influence decision-making for conservation programming in two diverse settings. For each setting, we first describe gendered pastoral or agro-pastoral roles and responsibilities. We then consider gendered rights and access to pastoral or agricultural resources. Finally, we highlight how gendered roles, rights, and decision-making can influence biodiversity conservation activities.

Snow Leopard Trust and its partners, the Snow Leopard Conservation Foundation and the Nature Conservation Foundation, have been implementing community-based conservation programs in the Tost mountains and Kibber Village for over 14 years. Our community conservation programs follow an inclusive conservation approach that values equity and justice and seeks improved outcomes for both biodiversity and local communities (Mishra, 2016). This implies a strong focus on developing partnerships with existing community structures to take forward conservation action and attention to address the needs and concerns of all community members. Our longstanding community conservation experience, together with strong attention

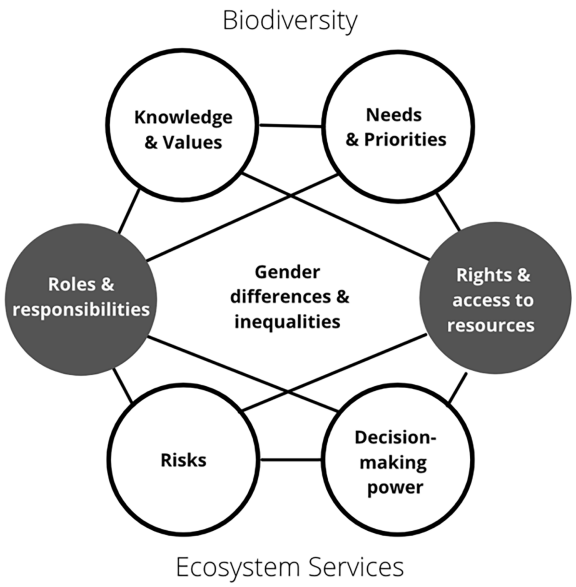

FIGURE 1
Gendered determinants of biodiversity conservation and ecosystem services based on the framework of the Convention on Biodiversity (Secretariat of the Convention on Biological Diversity, 2019). Gender differences and inequalities in roles and rights are shown as key determinants (dark gray) of biodiversity conservation and ecosystem services. These determinants are inter-related with other determinants: knowledge/values, needs/priorities, risk, and decision-making power (light gray).

to program documentation and monitoring, provides a useful basis for the community case studies presented in this paper.

Our first example focuses on the Tost–Tosonbumba (Tost) mountains of Southern Mongolia (43° N, 100° E), where we have been working with communities since 2008. The Tost mountains are located in Gurvantes soum (district) of Omnogovi aimag (Province) and form an extension of the Gobi-Altai mountain range, characterized by rugged mountains, desert steppe, and semi-desert grasslands. Snow leopard and other wildlife populations are known to inhabit the Tost area. In 2016, the Tost mountains and surrounding steppe were designated as a State Nature Reserve (in 2022 encompassing 8,965 km^2). Semi-nomadic pastoralists who rely on livestock (goats, sheep, camel, and horses) for their livelihood live in the area and derive most of their income from the sale of cashmere (Mijiddorj et al., 2020). The dominant religious beliefs in the area are based on Tibetan Buddhism and shamanism. Significant economic changes are taking place in the area. Notably, the number of livestock has changed in Tost, doubling from 31,400 in 2012 to 62,000 in 2019 and subsequently declining sharply to 43,000 in 2021 following a drought. In the same period, the district has also experienced a mining boom, primarily for coal and gold. Mining now contributes 90% to the district's overall gross domestic product.

Our second example concerns an agro-pastoral setting in Kibber Village, Spiti Valley, Himachal Pradesh, India (31°35′ to 33°0′ N and 77°37′ to 78°35' E), where we have been working since 1998. Kibber Village is situated at an elevation of approximately 4,200 m in the Indian Trans-Himalaya. Communities share space with a unique biodiversity assemblage such as the snow leopard, Tibetan wolf *Canis lupus chanco*, and blue sheep *Pseudois nayaur*. This setting is characterized by large temperature variations, a limited growing season, and limited precipitation, which restrict the availability of arable land and the type of crops that can be grown. Agricultural land is estimated to occupy 0.2% of the valley's area, with limited scope for further expansion due to the shortage of water (Murali et al., 2017). There are an estimated 80 agro-pastoral households in Kibber (Murali et al., 2022). Most households in the village are followers of Tibetan Buddhism. The main cash crop is green pea, *Pisum sativum*, which is grown alongside barley *Hordeum vulgare*, used primarily for household consumption. Crop production is the primary source of household income alongside livestock grazing (Murali et al., 2017).

We draw on published documents, data from the operations of our community-based snow leopard conservation programs, and relevant insights from key informants. In Tost, Mongolia, we organized key informant interviews with three program staff and five community members (including a senior government representative, a member of the Soum Women's Association, and three female herders). The key informants were identified based on their roles and interviewed by one of the authors (TNM). All were women. The key informants provided information on the participation of women in local decision-making processes and in livestock herding and natural resource management practices. We also accessed meta-data from the Gurvantes government records and the Women's Association, including campsite registrations and the number of women residents registered in the district. In Kibber, India, relevant information and insights on the roles and rights of women were available from two recent studies of gendered governance systems (Tsering, 2014; Murali et al., 2021). Additional data sources for Kibber comprised program records and a recent evaluation (Alexander et al., 2022). We also drew on the insights of the program staff (CL and DS authors), especially regarding pastoral roles. We focused on collating information relating to two domains of the conceptual framework: gendered roles and rights (Figure 1).

3 Pastoral rights and roles in Tost, Mongolia

3.1 Gendered pastoral roles and responsibilities in Tost

Women play an important role in Mongolian pastoral systems (Ahearn, 2018). The workload is shared among herder household members in a flexible manner, according to specific tasks, family and neighbor relations, availability of pastures, and critical events such as droughts (Voltolini et al., 2015; Ahearn, 2018). Nonetheless, a distribution of pastoral tasks along gender lines is found in Tost, as reported in the wider South Gobi area (Daley et al., 2018). In Tost, according to key informants, men are primarily responsible for herding livestock, fixing winter corrals, selecting pastures and campsites, moving between winter and summer campsites,

slaughter of livestock, and business management. The women's tasks are focused on milking and preparing dairy products, cashmere combing, and helping with livestock births.

The key informants highlight that the busiest period for herder households in Tost is between March and May, corresponding to the birth of young livestock and combing of cashmere goats. These activities require the effort of both men and women to ensure that the animals survive, and cashmere is combed rapidly in order to meet market demand. Women are also busy in the summer processing dairy products, while men have another peak of activity in the late fall when they move camp to winter locations and slaughter animals for sale.

Women with school-aged children usually stay in the district center, Gurvantes, during the school year (from September to June) (Ahearn, 2018; Mijiddorj et al., 2019). Women in Tost are increasingly taking on other town-based livelihood activities, such as those related to mining, trading, retail, and government work (Murali et al., 2020). The key informants described how most women in herder families continue to be actively involved in supporting livestock rearing in their spare time. Pastoral livelihoods in Tost, however, are changing related to livelihood diversification and resource shifts in response to multiple social, economic, and environmental factors (Mijiddorj et al., 2019). The trends towards increased herd size and a greater variety of animals, together with transitions into the market economy, have led women in Tost and the wider region to take on new tasks dealing with animal husbandry and cashmere production, often combined with other livelihood activities (Voltolini et al., 2015; Ahearn, 2018; Murali et al., 2020).

3.2 Gendered rights and access to pastoral resources in Tost

As in other parts of Mongolia, herders in Tost rely on a wide range of resources to sustain their herds, including seasonal pastures, shelters/corrals, campsites, water sources, and mineral licks (Appendix 1). The possession and access rights associated with each resource are varied and complex (Fernández-Giménez, 2002; Ahearn, 2016). Overall, the rights to possess and use pastoral resources are susceptible to gender bias associated with male-dominated collective structures, household structures, and land ownership and inheritance patterns (Fernández-Giménez, 2002; Daley et al., 2018).

Under the Mongolian Law on Land (2002), women and men have equal rights of access to land and assets. However, the law does not specifically address gender issues (Bagdai et al., 2009). Pastureland is given a special status, and the private ownership of pastureland and related water points, wells, and mineral licks is prohibited (Law on Land, Article 6.2.1). The Government allows collective possession and use of pastureland solely on the basis of a contract or land possession certificate (Law on Land, Article 27). The government also issues formal certificates of "possession" for seasonal campsites (Law of Mongolia on Land, 2002). The certificates usually only specify one name (typically the senior herder in the camp or male head of household). Herders whose names do not appear on formal certificates may have weaker claims to campsites and, consequently, nearby pastures (Fernández-Giménez, 2002; Ahearn, 2016). Corrals and shelters, on the other hand, can be privately owned by individuals or households (Fernández-Giménez, 2002). Herders tend to use the ownership of shelters to claim *de facto* rights to the surrounding campsites and pastureland.

Local authorities are responsible for the implementation of the law and preservation and use of pastureland. In Tost, government sources explained that the district and province authorities, in cooperation with the Tost Nature Reserve and relevant professionals, allocate land for possession and use, taking into consideration land use traditions, previous family use, rational land use, and conservation requirements. Individual herders or herder collectives can obtain land possession rights for winter campsites. The Tost data indicate that only 43 out of 211 campsites (20%) are registered under an individual woman's name (Appendix 1). These are mostly women who are in unofficial partnerships or widowed.

3.3 Links between gender and conservation efforts in Tost

The current legal frameworks in Mongolia protect women's rights to communal resources such as pastureland and water sources. In practice, however, women tend to be underrepresented in the registration process for the possession of assets. The gender bias in land possession certificates negates women's entitlements and may lead to positioning women in a secondary role in efforts related to the conservation of pastureland. Women also account for a small minority of livestock ownership registrations and, consequently, of ownership of predator-proof corrals built as part of the snow leopard community conservation program (Appendix 1).

Nowadays, women in Tost spend less time herding than men. The men's dominance in decisions is ascribed to their purported greater knowledge about herding resources, with women considered to be less familiar with and less interested in these issues, leading to the risk of excluding women from discussions and policies about natural resource management (Hawkins and Seager, 2010; Voltolini et al., 2015). There is evidence, however, that women in Tost show a keen interest in local livestock management and conservation. Our community conservation records show that women serve as active participants in community conservation planning, with a particular focus on the insurance of livestock against predator losses (a key snow leopard conservation intervention)—for example, 30% of livestock insurance program members are women. In addition, women have been assigned leadership positions for four out of the seven (57%) livestock insurance committees. This interest needs to be harnessed towards increased engagement in and sustainability of conservation programs.

In addition, women have taken on formal roles in local affairs, including biodiversity conservation, through their engagement as elected representatives of the district government (Hawkins and Seager, 2010). The participation of women in such processes reflects

Mongolia's progress over the last 20 years to enhance the education and political representation of women (Sachs et al., 2022). The responsibilities of these representatives include taking decisions on the local application of regulations for the protection of biodiversity and natural resource management and overseeing their implementation. It is notable that women make up 11 out of 33 (33%) of the district government representatives. The Gurvantes district governor is a woman who has been in a position of authority since 2012. In addition, a new female Tost Nature Reserve director was appointed in 2022. In 2022, eight out of 34 (24%) directors of protected areas managed by the Ministry of Environment and Tourism across Mongolia were women. This number has increased from three women in 2017. The representation of women in formal structures can serve as an oversight mechanism for women's concerns to be taken on board in the management of natural resources and conservation at the local level.

The trend for women taking on town-based income-generating activities can also support community-based conservation—for example, women may provide important support for improved pastoral practices such as sustainable cashmere production, building on their active roles in cashmere production and trading. The support of women for the further diversification of household livelihoods in Tost will be critical for increasing community resilience to environmental shocks, such as severe climatic events that lead mass livestock to die off.

4 Agro-pastoral rights and roles in Kibber Village, India

In Kibber, social hierarchies remain strong determinants of property rights and access and shape the distribution of agricultural tasks (Murali et al., 2021). A minority of households are recognized as *Khangchen* households, which means that they are considered to be the descendants of the original inhabitants of the valley (Tsering, 2014; Murali et al., 2021). They own most of the arable land and largely control the water resources. Other households, including the historically landless and other socially marginalized households, have less control over these resources (Murali et al., 2021).

4.1 Gendered agricultural roles and responsibilities in Kibber

Gender-differentiated agricultural roles and responsibilities are embedded in local social and family structures and power relations (Tsering, 2014; Murali et al., 2021). In the *Khangchen* households, women do most of the farm labor (in terms of the time spent in the field), especially managing the water resources and weeding. Men from *Khangchen* households are mainly involved in ploughing and harvesting of the crops. Thus, the involvement of men in agricultural activities is time-limited, and many are involved in other livelihoods such as jobs in offices, tourism, infrastructure industry, and entrepreneurship. A similar gendered division of labor is observed among other non-*Khangchen* social groups. Women from these groups tend to work as laborers, with a focus on the irrigation system, on behalf of *Khangchen* households. Many men from non-*Khangchen* social groups also work as laborers, with a focus on ploughing and carrying manure to the fields. Harvesting of peas and barley is done by men and women together (Tashi Tsering, 2014).

The pastures are primarily managed by men (Murali et al., 2022), who are responsible for herding livestock (yaks, horses, cow–yak hybrids, cattle, donkey, sheep, and goat). In the experience of the program staff, men from all livestock-owning households take turns to accompany the village *Lugzi* (herder) in herding the livestock. Women are responsible for corralling the livestock in the evening, and during the winter months they milk, feed, and water the livestock when they are in stalls. Men and women both collect fodder used for feeding livestock. Women are also responsible for collecting dung from the pastures to be used as fuel for heating and cooking. Men manage finances related to agriculture and livestock rearing such as sale of produce, procurement of seeds and herbicides, and wages for agricultural laborers. Women manage certain decisions in the pastures, which the community considers of "lesser" importance, such as the harvest of plants.

Women, as a group, play a critical role in the management of the area's complex irrigation system—for example, women build embankments to guide the flow of water to the fields and manage the irrigation process (Murali et al., 2021). Women from *Khangchen* households are in charge of inspecting and monitoring the condition of water channels and of informing the village head when repairs are needed (Murali et al., 2021). Women from *Khangchen* households are also involved in decision-making related to the time and duration of the irrigation cycles. Both men and women from all households provide labor to maintain the irrigation channels (Tsering, 2014; Murali et al., 2021).

4.2 Gendered rights and access to agricultural resources in Kibber

The Indian Constitution asserts non-discrimination on the basis of sex as a fundamental right. Property inheritance and ownership laws, however, are complex and vary based on religion, region, type of property, and the relationship to the deceased. Such laws can directly or indirectly propagate gender inequality (Agarwal et al., 2021). In Kibber, agricultural roles and land inheritance are based on traditional social structures. Men from the historically privileged *Khangchen* households hold the rights to most of the arable land and irrigation sources (Tashi Tsering, 2014; Murali et al., 2021). A system of male primogeniture prevails. If there are only daughters in a family, the husband of the oldest daughter acquires the property. Other social groups have access to land that they own or rent or are gifted by the village (with the Himachal Pradesh Nautor Land Rules Act of 1968, which extended land rights to the landless, thus marking a major shift) (Tashi Tsering, 2014; Murali et al., 2021).

As with the property rights, the rights for use and control over key agricultural resources are socially determined (Murali et al., 2021). The *Khangchen* households own most of the draft animals (yaks) and ploughs (Tsering, 2014). Similarly, control rights over

irrigation water reside with the women of *Khangchen* households (Murali et al., 2021). Women from all households have use rights. It is the responsibility of the women from the *Khangchen* households to ensure that land rented from them by the other households is also irrigated. In practice, the land belonging to the *Khangchen* households is usually irrigated first, after which the land rented by the other households is irrigated. In this system, women from the *Khangchen* households are involved in formulating collective choice and operational choice rules—for example, deciding the days and amounts of irrigation (Murali et al., 2021).

4.3 Links between gender and conservation efforts in Kibber

Overall, *Khangchen* men in Kibber remain the key decision-makers at the village level—for example, at the village council—and manage farming-related activities (Tsering, 2014). They also wield power in terms of agricultural labor relations as they are responsible for hiring laborers, men as well as women (Tsering, 2014). While agricultural tasks are generally distributed to both men and women, the timing of these activities is decided mostly by men (again especially men from the *Khangchen* households)—for example, the date of plowing is decided in a village meeting attended by a male representative (Tsering, 2014). Men thus appear to be the primary decision-makers about most matters related to the management of the environment at the village level.

Notwithstanding longstanding power structures biased in favor of men, women's agricultural and pastoral responsibilities provide them with unique knowledge and skills that can be leveraged in conservation activities (Abdelali-Martini et al., 2008)—for example, women have specific experiences and interests related to crop production. These formed the impetus for the intervention to prevent crop-raiding by ungulates in Kibber, a key component of the community-based snow leopard conservation program. Similarly, women's stake in protecting livestock has been instrumental in taking forward the building of corrals for the prevention of carnivore depredation. In addition, women's role as primary managers of the irrigation system gives them specialized knowledge on cropping patterns, the creation and maintenance of water channels, and weather changes (Upadhyay, 2003; Tashi Tsering, 2014; Murali et al., 2021). Their role in this regard is critical given that agricultural production in Kibber remains largely dependent on the waters of snow melt (Murali et al., 2017). Women can, therefore, serve as essential partners in planning and managing climate-resilient ecosystem services.

At the same time, it is important to recognize the interactions between social structures and gender roles—for example, the dates of the irrigation cycles after the first cycle are collectively decided by the women under the leadership of the historically privileged *Khangchen* households (Murali et al., 2021). In addition, two water managers are selected on a rotation basis from the women belonging to the *Khangchen* households. Consideration of these gender–power structures is essential to ensure that the benefits of community-based conservation accrue to all community members, especially those with the greatest needs.

While women's concerns have formed the basis of certain snow leopard conservation interventions in Kibber, the participation of women in formal decision-making about such interventions remains limited—for example, the program records show that no women are part of the livestock insurance or crop raiding program committees. To address this gap, opportunities are underway to promote dialogue with women, including those of socially disadvantaged groups, in a culturally sensitive manner—for example, the Shen program, a conservation-linked social enterprise effort, has reached out to women to involve them in conservation work in Kibber and neighboring villages (Mishra, 2016; Alexander et al., 2022). Gender-sensitive and flexible approaches were successful in mobilizing a broad section of women (23%–37% of all women in these villages) in local conservation action over the last 10 years (Alexander et al., 2022). Program-derived income is low relative to overall household income but remains under the control of women (Alexander et al., 2022). The program staff suggest that this is valued given that women do not generally manage finances related to agriculture and livestock. The Shen program also addresses the concern that women give less value to wildlife than men in line with their roles largely within the village (Murali et al., 2019).

5 Discussion

Our experiences around the conservation of snow leopards in two specific settings in High Asia illustrate the diversity of women's roles and rights with respect to the management of natural resources. The two community case studies presented underline the importance of context-specific approaches to engage women as equal partners in biodiversity conservation (Mishra et al., 2017) in order to protect their rights and enhance conservation program uptake and sustainability (James et al., 2021). Improved conservation outcomes are also expected as has been demonstrated in other settings (Agarwal, 2009; Leisher et al, 2016). It is difficult, however, to demonstrate that specific measures to engage women are correlated with improved program outcomes in the absence of dedicated evaluation efforts (Woodhouse et al., 2015).

Our case studies underscore that different approaches can be followed to leverage women's specific experiences, knowledge, and skills for biodiversity conservation in snow leopard landscapes—for example, the role of women in Kibber Village in controlling irrigation systems puts them at the center of snow-related ecosystem services that are under threat from climate change. In Tost, women's engagement can serve to shore up the community's resilience to livestock losses related to carnivore depredation or weather shocks through recognizing and strengthening their share in diversified livelihoods.

Governance arrangements for conservation at different levels are important arenas for promoting gender-responsive conservation. The Kibber Village example underlines how the participation of women in decision-making about natural resources takes place within a social

structure that is shaped by gender relations and also class status, ethnic group, age, and other social identities (Agrawal and Gibson, 1999; Murali et al., 2021; Murali et al., 2022). Women are not a homogenous group, and different social identities can result in different lived environmental experiences and power asymmetries (Murali et al., 2021). In designing conservation interventions in such settings, the intersections between gender and social identities must be identified and opportunities offered to all women to participate with a view to promote relevance and inclusiveness (Agarwal, 2010). In Tost, as elsewhere in Mongolia (Mijiddorj et al., 2019), there are encouraging signs that women are in key positions to influence snow leopard conservation. In such settings, changes in women's status through improved education and increasing participation in governance structures provide opportunities to involve them in community conservation affairs. Further focused research efforts on factors that influence women's decision-making power would serve to support efforts to engage women more purposively in conservation programs.

The situation, status, and role of women in High Asia are changing, requiring flexible approaches to mobilizing women's potential contributions to community conservation efforts. Agro-pastoral and pastoral communities are being exposed to globalization, changes in land use, new market forces, and new information and ideas. New aspirations, opportunities, and challenges for conservation and development are emerging (Khadka and Verma, 2012). In particular, climate change is putting additional pressures on high mountain ecosystems and exacerbating risks to livelihoods and wellbeing (Mijiddorj et al., 2020; Murali et al., 2022). Ongoing changes are profoundly affecting how people view and value their environment and how they use, control, and manage natural resources (Anand and Josse, 2002; Jodha, 2005). Similar shifts are expected in Tost and Kibber; these require tracking so that community-based conservation can respond and adapt. As new conservation opportunities emerge, care should be taken to adopt inclusive approaches that respect and protect women's rights and address their specific interests and needs.

6 Conclusion

In this article, we applied a gender lens to explore differences and inequalities in relation to roles and rights that might influence conservation efforts in snow leopard landscapes. Drawing on our conservation practice in two specific settings, we demonstrate the diversity of women's roles and rights related to local pastoral and agro-pastoral resources in High Asia. We explore how these roles and rights can influence priorities and decision-making processes related to community-based conservation. We propose leads for leveraging women's potential contributions to snow leopard conservation efforts at the local level, in ways that take into account underlying social and political structures and gender–power relations. We argue that a better understanding of gender dynamics related to rural livelihoods can serve to improve inclusion and equity and to increase relevance, acceptance, uptake, and sustainability of conservation programs. It can also help avoid exacerbating existing gender and social biases. Such efforts are particularly relevant for large carnivore conservations programs that seek to secure harmonious wildlife–human co-existence in multi-use landscapes.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

In accordance with the local legislation and institutional requirements, key informants were informed of the aims of the research and provided verbal informed consent for the use of the data. Participation was voluntary and anonymisation was guaranteed at all points of the study. No incentives or rewards were provided to participants.

Author contributions

JA and RM designed the study. JA, RM, TM, BA, and KS led the data acquisition and interpreted the results. JA, RM, and JY wrote the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The 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.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2023.1006052/full#supplementary-material

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Gender differences in wildlife-dependent recreation on public lands

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Different groups of people may desire and respond to social and ecological conditions in myriad ways (e.g., increased engagement, avoidance). Thus, managers of nature-based recreation sites open for public use (i.e., "public lands") would benefit from understanding how people with different lived experiences respond under new conditions brought about by regulatory changes (e.g., infrastructural improvements, reduction of access) or environmental changes (e.g., drought, population declines). From a survey of visitors to public lands, specifically National Wildlife Refuges (i.e., refuges) in the United States, we examine gender differences in (a) participation in wildlife-dependent recreation, (b) visitor experiences, and (c) the effect of regulatory and environmental changes on future participation in preferred activities. Our sample (n = 9,918; 40% who self-selected female) included visitors to 69 refuges during 2018 and 2019. Results indicated that people who self-selected female were more likely to indicate that they don't like being in nature by themselves, and that people close to them enjoy nature-based recreation. People who self-selected female were less likely to engage in hunting or fishing as their primary activity and noted that regulatory changes supporting these activities (specifically, fewer regulations on fishing, fewer regulations on hunting, and more acreage open to fishing/hunting) could decrease their future participation in their primary activity. Thus, respondents who self-selected female may be displaced or alienated from visiting a site if consumptive activities (e.g., hunting) are prioritized as regulatory mechanisms (e.g., for controlling abundant wildlife populations). Adaptive processes that anticipate - in advance of decisions being made - the potential ramifications of regulations on different subgroups of visitors to public lands can identify differential and inequitable impacts, and thus lead to inclusive management decisions when those impacts are preemptively addressed.

KEYWORDS

women, consumptive, wildlife refuge, hunting, fishing, inclusion, participation, adaptive management

1 Introduction

Managers of public lands and natural resources are facing numerous ecological and social changes that challenge traditional approaches. Example ecological challenges include shifts in species ranges, biodiversity loss, increased habitat fragmentation, changing climate conditions (e.g., prolonged drought, increased temperatures), catastrophic flooding and fires, and more, all of

which may be hard to detect at the frequency and geographic scale in which decisions are typically made (Burns et al., 2003; Davis and Hansen, 2011; Monahan and Fisichelli, 2014). Additionally, social changes such as demographic shifts, increased desire for participatory processes, and conflict over management decisions have challenged the decision authority of experts (e.g., scientists, public land managers) and raised questions as to who should have a voice in decision-making processes – given those processes inequitably impacts groups of people – and whether those voices are respected when heard (Manfredo et al., 2019; Manfredo et al., 2020; Manfredo et al., 2021). For example, governing authorities may bar access to protected areas or prohibit local people from engaging in traditional practices of take (e.g., hunting for sustenance), ostensibly to protect site resources or threatened and endangered species; however, these decisions can also disrupt people's daily lives and livelihoods without leading to conservation successes (Stevens, 2014). In other contexts, lands remain open to the public for purposes of wildlife-dependent recreation (e.g., hunting, fishing, observation of wildlife and birds, environmental education), and management approaches that allow specific recreation activities (e.g., hunting) can reinforce expectations of who belongs – or not – in these public spaces (Byrne, 2012). As an illustration, protected areas in the United States (U.S.) often depict western European-descendent (white) males as noted explorers who "discovered" an area or a resource, often ignoring the diversity of people who have lived in these lands – and the relationships they have cultivated and maintained with flora and fauna – long before such explorers arrived (Colchester, 2004; Kantor, 2007; Taylor, 2018). Therefore, a deeper understanding of how people are differentially impacted by public lands decision-making (i.e., what conservation and policy actions to prioritize) is necessary for arriving at equitable solutions to ecological and social changes.

Understanding recreational participation in response to regulation is important for public land management approaches. For example, fishers who identified as women from Minnesota, U.S. reported wanting to keep all the legal fish they caught whereas men were more likely to practice catch-and-release; in terms of motivations to fish, women were more motivated to catch fish for food, whereas men were more motivated to fish to develop skills and catch "trophy" fish (Schroeder et al., 2006). These decisions could be reflective of societally reinforced gender differences[1] in which species are viewed as "valuable" (and for what reasons) which can lead women to target different habitats or animals. For example, in Samoa, women were more likely than men to rank shellfish (a staple subsistence resource in the region) as an important species to catch (Purcell et al., 2020). Thus, regulatory changes regarding fishing behaviors can shape who has access to these sites and who accrues benefits from the associated activities. Specifically, if managers limit the activity of fishing only to catch-and-release (and disallow the consumption of fish or other marine species for food), that decision may prioritize the interests and behaviors of men at the expense of women's needs and interests. Alternatively, managers could close a site altogether to reduce fishing pressure on a population, which would seemingly bar access equally; however, some people may be able to substitute a similar site elsewhere to engage in the same activity while others may be constrained by travel distances and associated time or financial burdens of that travel.

In addition to differences in recreational activity, research has shown that women generally differ from men concerning preferences for wildlife management strategies and regulations (Anthony et al., 2004; Schroeder et al., 2006; Loyd and Miller, 2010). For example, women typically favor wildlife reintroduction efforts (Hermann et al., 2013) and find lethal control of wildlife less acceptable than men do (Dougherty et al., 2003; Agee and Miller, 2009; Loyd and Miller, 2010; Draheim et al., 2019). These preferences may stem from wildlife value orientations, where women tend to score higher on mutualism (related to a higher protective intention) and men score higher on domination (which prioritizes human uses of wildlife) (Liordos et al., 2021). If true, this could also explain why women place more importance on unbiased facilitation and open exchange of ideas in wildlife management decision-making compared to men (Anthony et al., 2004), and why women support funding measures that contribute to conservation; for example, in Michigan, U.S., women were more likely to favor dedicating a portion of state lottery proceeds to conservation (Henderson et al., 2021). However, that same study indicated women were less likely than men to support a "backpack tax" on outdoor gear (e.g., hiking boots, packs, tents). This finding may be due in part to such a tax placing an inordinate burden on recreationists with lower incomes or those financially responsible for family members unable to purchase items themselves (e.g., children, siblings, elders without income). In this example as well as others globally (e.g., Keane et al., 2016), women regularly support conservation efforts in creative ways while attempting to mitigate economic losses, highlighting the importance of understanding the ways in which women think about decision-making and how the decision-making of others (whether about conservation, restoration, or recreation and environmental policy) can differentially affect women.

Women and their experiences on public lands also remains underrepresented, particularly in the context of wildlife-based recreation. For example, women in Brazil and the U.S. – despite indicating a stronger connection to nature and tending to prefer outdoor recreation more than men do – were less likely to actually engage in nature-based recreation (Rosa et al., 2020). This lower engagement levels can result in men's interests being more accounted for in recreation planning and policy, as managers attempt to meet the needs of the group of recreationists they more often seen using recreation sites (Chakrabarti, 2020). In addition, many natural resource agencies, including those that manage wildlife, are predominantly led by men, which can further reinforce beliefs about what recreation should look like; such beliefs are reinforced by survey research that tends to be dominated by male perspectives or through oversampling of male recreationists (Jacobson et al., 2007). Since women are particularly

1 We understand the distinction between biological assignment of sex at birth (e.g., female, male) and gender identification (e.g., woman, man, nonbinary, two-spirit, non-conforming). However, our own survey measurement only offered 'female' and 'male' as categories that people could self-select or opt to skip. Because of this self-selection, we focus throughout our writing on gender identification as a socialization process and do not assume any differences found are due to biological sex. Regardless, we regret reinforcing inadequate use of terms to represent core aspects of one's identity and encourage the research and practitioner community to learn and apply these important distinctions going forward.

underrepresented in consumptive forms of wildlife activities, such as hunting and fishing (Anthony et al., 2004), the distinction between consumptive and non-consumptive (e.g., wildlife observation, photography) activity participation is of special pertinence in the framework of gender. As another example, funding for conservation in the U.S. commonly stems from license and equipment sales for activities such as hunting and fishing (Arnett and Southwick, 2015), which not only strengthens how agencies perceive their stakeholders (e.g., "hunters pay our bills"), but also socializes people (e.g., agency employees, members of the public) into who is perceived as experts and who can engage in recreation activities (Bilgic et al., 2008). This funding structure replicates a system in which authorities govern access to public lands in ways that facilitate use by certain groups (e.g., hunters) and excludes participation (purposefully or not) from other segments of the population, such as women (Stedman and Heberlein, 2001). There is also continued pressure on this funding structure because of consistent declines in hunting license sales (Robison and Ridenour, 2012). Therefore, integrating perspectives and preferences of groups historically excluded from decision-making processes is more important than ever for inclusive wildlife management practices, as well as for state and federal agencies seeking to secure alternative funding mechanisms for conservation (Winkler and Warnke, 2013; Larson et al., 2014; Price Tack et al., 2018).

In this paper, we approach differences in experiences associated with gender (as well as other demographic variables) as reflections of socialization (and/or institutionally based bias, whether explicit or not) rather than inherent biological differences. One of the key ways in which outcomes (e.g., recreation participation) gets reinforced is through socialization by others and society more broadly. Gender can interact with beliefs about who belongs on public lands, what activities are allowed (e.g., the expansion of hunting over non-consumptive recreation), and who has a voice – and a voice that is respected – in decision-making processes. Such socialization can lead certain groups to avoid participating in opportunities on public lands (Evans et al., 2020), or to only engage in certain forms of recreation. Additionally, socialization around intersectional identities often marginalized (e.g., a woman who is also racialized as Black) can further impact how people perceive access and opportunity. For example, Powers et al. (2020) found increased identification with a number of marginalized groups resulted in people being less likely to visit parks and to perceive park-based recreation activities as being close to their home, even if recreation opportunities were nearby. Thus, an understanding of how these demographic characteristics are related to public land experiences is needed.

In addition, the inclusivity of a wide range of recreationists is essentially linked to adaptive management of public lands. Adaptive management simultaneously incorporates *managing* and *learning* about (e.g., through visitor feedback) natural resources. Applications of adaptive management typically involve a system that is dynamic, that responds to social and environmental conditions and management choices, and which is characterized by variation that is only partially predictable (Williams, 2011). Under these conditions, adaptive management provides an opportunity to incorporate uncertainty and complexity into management, continuously monitor the system, and evolve along with the system through iterative decision-making. The anticipation of the responses of diverse stakeholders is beneficial to avoiding "surprises" that can undermine wildlife management planning and strategies. For example, a crucial feedback component of adaptive management is overlooked when wildlife or fisheries management is insensitive to how people are differentially impacted across demographic groups (Fröcklin et al., 2013). Due to the substantial role gender can play on preferences for wildlife management strategies and regulations, there have been increased calls for gender inclusiveness in nature-based recreation (Rosa et al., 2020) and management (Staples and Natcher, 2015; Gharis et al., 2017; Seager et al., 2021). In addition, there is a particular need to examine how both gender and other demographic variables such as race influence opportunities for outdoor recreation outside of cities, as much of this literature tends to focus on urban parks and green spaces (Gentin, 2011).

Our objectives in this paper were to examine how gender and other demographic variables relate to (a) wildlife-dependent recreation participation, (b) the visitor experience, such as feeling safe and welcome, and satisfaction with one's visit, and (c) intended (future) participation in preferred activities given regulatory or environmental changes on public lands.

2 Methods

We analyzed data collected from visitors to 69 refuges during 2018 and 2019 as part of a nationwide survey of visitors to U.S. National Wildlife Refuges (i.e., refuges). Participating refuges had at least 50,000 annual visits and were selected for participation in the overall study by the Human Dimensions Branch of the U.S. Fish and Wildlife Service (FWS). The methodological approach and survey instrument were approved by the Office of Responsible Research Practices at The Ohio State University (OSU) as study number 2018E0221, deemed exempt with limited IRB review, according to 45 CFR 46.104.

2.1 Sampling

Sampling occurred over two time periods (e.g., spring, autumn) of two consecutive weeks per period with a goal of inviting approximately 400 total visitors at every refuge to complete a survey. OSU staff developed (in consultation with FWS staff) and provided a sampling protocol to the onsite survey recruiters employed by American Conservation Experience, which detailed a script for inviting one visitor per group to participate in the survey and to select every n^{th} group depending on visitation levels (e.g., higher levels of visitation may have equated to every 5^{th} group whereas lower levels of visitation may have resulted in contacting every group). Visitors who agreed to participate provided their

name and address and subsequently received up to four postal mailings (postcard, survey package, reminder postcard, and second survey package) in either English or Spanish (self-selected during onsite contacts). The invitation encouraged completion of the survey online through Qualtrics (a web-based survey platform) or by paper, and all responses were password-protected. Additional description of the overall methodology and final reports for individual refuges are accessible at go.osu.edu/NVSresults.

2.2 Measurement

The survey asked visitors about their experience at "this refuge" - the refuge where they were contacted - in numerous domains, including recreation activities, transportation and other infrastructure features, economic expenditures, information sources, and more. This paper specifically focuses on questions related to demographics and recreational experience (Appendix 1).

For demographics, we focused on gender, education, self-identified distance from the refuge (i.e., local or nonlocal), age, and race (Appendix 1). The survey measured gender as a dichotomous variable ("Are you…? Selection options: "male" or "female"). Due to our survey methodology, we only know that respondents self-selected either male or female (or they could skip the question). Therefore, we do not distinguish between sex assigned at birth and gender identity and did not at the time of data collection accommodate non-binary, two-spirit, or other diverse identities. The survey also asked respondents to self-identify their race/ethnicity from several listed categories consistent with how the U.S. Census Bureau (2020) measured race and ethnicity (Appendix 1). Respondents could select more than one race/ethnic category. Respondents also self-selected "local" or "non-local" based on living within a 50-mile radius of the refuge, and being "local" to this refuge was analyzed as a control variable since local visitors tend to have different preferences and levels of satisfaction with recreation than nonlocal visitors (Palso et al., 2009; Lindberg and Veisten, 2012). Education and age were both measured on a continuous scale in terms of years (e.g., 12 years of schooling typically represents completion of high school and 16 years of schooling typically equates to having a bachelor's degree in the U.S., though variation exists in educational experiences).

Regarding recreation-related variables, respondents wrote one primary activity they participated in during their most recent visit to "this refuge" following a list of 21 activities from a preceding question about recreation participation at this refuge during the last 12 months. This write-in response represented an individual's primary activity (Appendix 1). Aspects of visitors' experiences at this refuge included variables measured on a Likert scale related to satisfaction with opportunities related to one's primary activity, or a three-point scale (agree/disagree/neither) measuring feelings of safety and being welcomed, and perceptions of treatment by others while onsite (Appendix 1). Additionally, general preferences related to group dynamics (e.g., being alone in nature, having other close contacts who engage in nature-based recreation) were measured on a three-point scale (agree/disagree/neither), see Appendix 1.

2.3 Analysis

To begin our analysis, we linked responses of primary activity (e.g., hunting) to satisfaction with opportunities related to that specific activity (e.g., "to what extent are you satisfied with the hunting opportunities at this refuge?"). Respondents who did not indicate a primary activity or answer the related satisfaction question did not receive a recreation satisfaction score and thus were excluded. We also excluded from our analysis any primary activity in which less than 150 respondents participated (e.g., trapping, which had an n of 2). This criterion allowed for adequate statistical power – a hypothetical distribution of at least 50 respondents per dependent variable category (future recreation activity will 1) decrease, 2) remain the same, or 3) increase) in the multinomial regression models. We excluded primary activities that did not have a related satisfaction variable and/or were not overtly wildlife-dependent, including art, miscellaneous water activities (e.g., swimming), general observation (e.g., of a lighthouse or mountain scene), activities with dog, picnicking, camping, and more. This approach yielded the exclusion of 688 participants (or 6% of the original sample). The final sample included 12 primary activities that had a direct match to a satisfaction variable (Appendix 1), including the "Big Six" wildlife-dependent activities (hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation) that have traditionally been acknowledged as being of primary importance to wildlife conservation on public lands (Keatinge, 2017; Arnett, 2020).

Since the sample was predominantly white (86.6%), in our regression models we classified people as either white or a person of color (which included biracial individuals); this prevented the generalization of results based on too-small sample sizes of each racial category, yet has limitations given that the lived experiences of people with racialized identities can significantly differ.

Analysis (of data aggregated across all sampled refuges) proceeded in three stages using SPSS 27.0. In the first stage (Table 1), we used binary regression models to analyze how gender, race, age, and other demographic variables affected the odds of a respondent *selecting a particular activity as their primary form of recreation*. In the second stage, we used regression models to analyze how gender, race, age, and other demographic and recreation variables influence *aspects of the visitor experience* (Table 2), specifically 1) satisfaction with primary recreation activity, 2) dislike of being in nature by oneself, 3) feeling that people closest to oneself enjoy participating in nature-based recreation, 4) feeling welcomed and safe while at the refuge, and 5) thinking that people who look like you are treated differently when participating in nature-based recreation. We used linear regression to analyze satisfaction with primary recreation activity and binary logistic regression to model the other dependent variables.

In the third stage, we used multinomial logistic regressions to examine how gender, race, age, and other demographic and recreation variables affect the *relationships between intended participation in a primary activity on a refuge given a regulatory or environmental change* (Table 3). We ran eight models, one for regulatory change and one for environmental change. For each

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TABLE 1 Odds ratios from separate binary logistic models of primary activity participation on wildlife refuges (n = 9,125).

	Demographics					
	Female	Age	Education	Local	White	Nagelkerke *R*-squared
Consumptive recreation activities						
Hunting	**0.03***	**0.96***	**0.53***	**0.62***	1.64	0.22
Fishing	**0.21***	1.00	**0.38***	**2.01***	0.70	0.19
Nonconsumptive recreation activities						
Bird watching	**1.79***	**1.03***	**1.63***	**0.59***	1.20	0.09
Bicycling	0.84	1.01	1.29	**1.54***	1.39	0.01
Driving	1.18	1.01	**0.75***	0.80	0.91	0.01
Education	**2.35***	1.00	1.46	1.16	0.65	0.03
Hiking	**1.83***	**0.99***	**1.49***	**1.84***	0.95	0.07
Jogging	1.13	**0.96***	**1.76***	**4.05***	0.76	0.08
Motorized boating	0.88	0.99	0.80	**1.71***	2.23	0.02
Nonmotorized boating	1.11	0.99	**1.44***	**0.65***	1.72	0.02
Photography	0.91	**1.02***	0.99	**0.76***	0.82	0.02
Wildlife observation	**1.28***	1.00	0.91	**0.57***	1.03	0.02

*Bold values are statistically significant at the p <.001 level.
Values are Exp(B) values; values greater than 1 indicate increased odds and values lower than 1 indicate decreased odds.

model, "participation remains the same" was the reference category, and we compared this category with the other two ("participation increases" and "participation decreases"). These multinomial logistic models produced two sets of coefficients (one for participation increases and one for decreases). We also controlled for demographic variables and participation in various primary activities. In these models, exp(B) values of less than 1 indicated decreased odds, whereas values greater than 1 indicated increased odds.

3 Results

3.1 Sample

Our sample consisted of 9,918 respondents (40% of whom self-selected as female) from 69 refuges, including sites from all the regions managed by the Refuge System. Nearly 58% of the sample consisted of locals living within 50 miles of a refuge. The mean age of respondents was 56.5 years and the mean years of school completed was 16 (typically equating to a 4-year college degree). 86.6% of the sample identified as white, 2.3% as Hispanic, 1.3% as Asian, and 1.2% as African American (other racial/ethnic groups each constituted less than 1% of the sample). Of the 12 primary activities examined, the most common were hiking (23.7% of the sample), bird watching (17.6%), wildlife observation (14.8%), and fishing (11.4%). Less common primary activities included photography (6.6% of the sample), hunting (6.5%), driving (3.9%), bicycling (3%), nonmotorized boating (2.8%), motorized boating (2.2%), jogging (2.1%), and education (1.8%).

3.2 Recreation participation

Respondents who self-selected female were less likely to indicate consumptive recreation (hunting or fishing) as their primary activity; however, self-selecting female increased the odds that a respondent engaged in birdwatching, wildlife observation, education, and hiking as a primary activity (Table 1). Increased age lowered the odds of hunting, hiking, or jogging as a primary activity, but increased the odds of bird watching and photography as a primary activity. Visitors with increased levels of education were more likely to select bird watching, hiking, jogging, and nonmotorized boating, and less likely to select driving, hunting, or fishing as a primary activity. Local respondents were more likely to indicate that fishing, bicycling, hiking, jogging, or motorized boating was their primary activity, and less likely to choose hunting, bird watching, nonmotorized boating, photography, or wildlife observation. There were no statistically significant differences between white respondents and people of color in terms of primary recreation.

3.3 Visitor experience

In the model of recreation satisfaction (not displayed), self-selecting as female increased satisfaction with one's primary activity

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TABLE 2 Odds ratios from separate binary logistic regression models of visitor experience on wildlife refuges (n = 9,125).

	Felt welcomed during visit	Felt safe during visit	I do not like being in nature by myself	People close to me enjoy nature-based recreation	People who look like me are treated differently during nature-based recreation
Demographics					
Female	0.93	0.81	**3.74***	**1.31***	0.77
Age	0.99	0.99	1.01	**0.99***	**0.98***
Education	0.99	1.13	**0.77***	**1.17***	1.05
Local	**0.77***	0.72	0.99	**0.76***	1.03
White	0.97	1.23	0.73	1.31	**0.39***
Primary Activity					
Hunting	1.11	0.91	0.83	1.91	1.46
Fishing	0.96	0.91	1.09	1.29	0.87
Bird watching	**1.82***	**2.81***	0.62	**2.32***	0.95
Bicycling	**2.26***	1.60	0.87	1.17	1.47
Driving	1.35	1.48	1.25	1.37	1.02
Education	**6.85***	2.57	1.19	1.35	0.59
Hiking	**1.92***	1.58	1.01	1.51	0.85
Jogging	1.19	1.30	1.03	1.02	0.72
Motorized boating	1.06	1.05	0.95	2.34	0.81
Nonmotorized boating	2.04	1.24	1.40	2.26	0.92
Photography	1.33	2.29	0.63	0.89	1.20
Wildlife observation	**2.73***	**2.58***	1.03	1.69	1.08
Nagelkerke *R*-squared	0.03	0.03	0.08	0.03	0.03

*Bold values are statistically significant at the p <.001 level.
Values are Exp(B) values; values greater than 1 indicate increased odds and values lower than 1 indicate decreased odds.

(B = 0.10, t = 4.91, p<.001), as did selecting bird watching (B = 0.13, t = 4.37, p<.001). Respondents who reported hunting (B = -0.19, t = -4.28, p<.001), driving on an auto-tour route (B = -0.54, t = -10.72, p<.001), or wildlife observation (B = -0.23, t = -7.19, p<.001) as their primary activity had decreased satisfaction. Respondents who self-selected female were more likely than those who self-selected male to indicate that they don't like being in nature by themselves, and that people close to them enjoy nature-based recreation (Table 2). Increased age lowered the odds that a respondent didn't like being in nature by themselves and also lowered the odds that a respondent felt that people who look like them are treated differently while they participated in nature-based recreation. Respondents who self-selected white were less likely than people self-selecting a race or ethnicity other than white (i.e., people of color) to indicate that "people who look like me are treated differently during nature-based recreation." Local respondents were less likely to feel welcomed during their visit and to have people close to them who enjoy nature-based recreation.

3.4 Impacts of regulatory and environmental change on future activity participation

Regulatory changes focused on consumptive activities (i.e., fewer regulations on hunting, fewer regulations on fishing, and more acreage open to both these activities) differentially affected visitors' expected future participation. For example, visitors who self-selected female were more likely than those who self-selected male to report that the three regulatory changes would decrease their participation in their primary activity at this refuge (Table 3). Older visitors were less likely to indicate that the three regulatory changes would increase their participation in their primary activity at this refuge. Visitors whose primary activity was photography also reported that more acreage open to hunting and fishing would lead to their decreased participation. In contrast, visitors who engaged in hunting or fishing as their primary activity indicated that

TABLE 3 Odds ratios from separate multinomial logistic regressions exploring impacts of environmental and regulatory changes on different visitor groups' self-expressed future recreation compared to no recreational changes (i.e., referent group).

Outcome *Category* Explanatory variable	Environmental changes					Regulatory changes		
	Wetlands improve	Other habitat improves	Biodiversity increases	Preferred species decreases	Less water	Less hunting regulations	Less fishing regulations	More acreage open to hunt/ fish
Increase in future recreation activity due to changes based on…								
Demographics								
Female	0.92	0.90	0.99	0.87	0.67	**0.38***	**0.67***	**0.41***
Age	**0.99***	**0.99***	**0.98***	0.99	1.01	**0.97***	**0.98***	**0.98***
Education	**1.37***	**1.36***	**1.39***	0.85	0.84	1.04	0.90	0.89
Local	1.01	0.98	0.88	1.12	0.95	**1.39***	1.20	**1.56***
White	1.05	1.05	0.93	0.76	0.72	0.85	0.70	0.90
Primary Activity								
Hunting	**1.90***	1.62	0.67	1.37	2.09	**4.18***	1.76	**7.48***
Fishing	0.94	0.78	**0.59***	1.43	2.67	1.43	**3.18***	**2.82***
Bird watching	**3.47***	**2.86***	**3.70***	1.06	0.75	0.72	0.65	**0.34***
Bicycling	**0.52***	0.56	0.79	0.42	0.85	0.58	1.18	**0.35***
Driving	1.15	1.14	1.23	0.63	0.73	1.08	2.14	0.83
Education	1.22	1.09	1.22	0.40	0.17	0.53	1.55	0.34
Hiking	1.03	1.06	1.22	0.61	0.59	0.60	0.90	**0.36***
Jogging	**0.39***	**0.38***	0.67	0.93	0.12	0.67	0.57	**0.34***
Motorized boating	0.65	0.58	**0.49***	0.49	1.95	0.83	1.89	0.78
Nonmotorized boating	1.26	0.98	0.98	0.45	0.72	0.57	0.94	**0.38***
Photography	**2.38***	**2.23***	**3.54***	0.91	0.89	0.49	0.58	**0.32***
Wildlife observation	1.35	1.39	**1.94***	1.48	0.86	1.26	1.38	0.74
Decrease in future recreation activity due to changes based on…								
Demographics								
Female	0.53	0.72	0.65	0.91	**0.83***	**1.29***	**1.24***	**1.53***
Age	1.01	1.03	1.01	0.99	0.99	1.00	0.99	**1.01***
Education	0.67	0.79	0.93	**1.22***	**1.25***	**1.35***	**1.32***	**1.44***
Local	1.20	0.89	0.88	0.89	1.02	**1.18***	1.11	1.13
White	0.79	0.53	0.69	1.06	1.03	1.05	0.91	1.02
Primary Activity								
Hunting	2.00	2.20	0.65	**2.25***	**2.08***	0.71	0.48	**0.23***
Fishing	1.15	1.72	1.16	**2.00***	**3.14***	**0.36***	0.75	**0.11***
Bird watching	0.51	0.94	1.18	**1.84***	1.43	**2.07***	1.79	**2.12***
Bicycling	0.56	0.44	0.92	0.68	**0.45***	0.83	0.42	0.79
Driving	0.96	1.07	0.56	0.96	0.87	0.68	0.72	0.61
Education	1.43	1.89	<.001	0.84	1.17	0.95	1.01	0.82

(Continued)

TABLE 3 Continued

Outcome *Category* Explanatory variable	Environmental changes					Regulatory changes		
	Wetlands improve	Other habitat improves	Biodiversity increases	Preferred species decreases	Less water	Less hunting regulations	Less fishing regulations	More acreage open to hunt/ fish
Hiking	0.72	0.82	0.48	0.71	0.75	1.41	0.99	1.33
Jogging	0.41	<.001	<.001	0.41	**0.36***	1.46	1.09	1.26
Motorized boating	0.67	1.69	0.97	0.89	**4.13***	**0.28***	0.41	**0.13***
Nonmotorized boating	0.44	0.61	<.001	0.85	**5.03***	0.91	0.59	0.62
Photography	0.86	1.23	1.04	**1.99***	1.53	1.62	1.48	**1.95***
Wildlife observation	0.84	0.82	0.89	1.53	1.14	1.15	1.11	1.14
N	8,633	8,638	8,637	8,506	8,657	8,546	8,578	8,636
Nagelkerke R-squared**	0.11	0.09	0.15	0.06	0.11	0.18	0.10	0.37

*Bold values are statistically significant at the p <.001 level.
**This refers to the model as a whole, which includes values related to both increased and decreased participation.
Values are Exp(B) values; values greater than 1 indicate increased odds and values lower than 1 indicate decreased odds.

regulations to expand consumptive activities would increase their participation (Table 3). Local visitors indicated that less hunting regulations and more acreage open to consumptive recreation would increase their participation.

Environmental changes (i.e., wetland and habitat improvement, increased biodiversity, decrease in preferred species, and less water in lakes, rivers, or streams available for recreation) also differentially affected views about future activity participation. For example, visitors who primarily participated in water-based activities (fishing, motorized boating, and nonmotorized boating) reported that less water would dampen their participation; however, visitors who self-selected female were less likely than those self-selecting as male to note that less water would decrease their participation (Table 3). People who identified bird watching or photography as their primary recreation activity noted that three environmental improvements (wetland improvement, habitat improvement, and increased biodiversity) would amplify their primary activity participation (Table 3). As levels of education increased, so did the likelihood that three of the five environmental changes (wetland and habitat improvement, and increased biodiversity) would increase their future participation in primary activities.

4 Discussion

Our results have several implications for gender-inclusive adaptive management related to wildlife-based recreation on public lands. First, our results suggest that there is no "generic" visitor to U.S. wildlife refuges, meaning a "one size fits all" approach to management could lead to differential impacts on visitor subgroups. How visitors participate in and experience recreational activities on public lands is influenced by their lived experiences, which we explored as differences among gender, racial, educational, locality- and age-based groups. Thus, decision-makers who (intentionally or not) view the typical visitor as synonymous with a traditional wildlife user (e.g., a white man who hunts/fishes) may miss key elements of the full social-ecological system in which people interact with wildlife on public lands. For example, our finding that people who self-selected female preferred non-consumptive activities (e.g., bird watching, hiking, and wildlife observation) more often than those who self-selected male comports with other research; for example, Heberlin et al. (2008), found that across 50 U.S. states, 13 European countries, and 6 Canadian provinces/territories, only 8% of hunters self-selected female. However, even certain nonconsumptive activities, such as competitive birding (Cooper and Smith, 2010) and thru-hiking (Howard and Goldenberg, 2020), can be dominated by a masculine culture that is further reinforced in media (McNiel et al., 2012) in ways that can (whether purposefully or not) alienate women. Even when women are more likely (based on count) to participate in a particular activity, the culture and decision-making processes surrounding such an activity can still be dominated by men (e.g., the masculine "hiking trail culture" discussed in Howard and Goldenberg, 2020), which may affect the interest and participation in recreation opportunities of people identifying as a woman, non-binary, non-confirming, two-spirit, or otherwise.

Second, our finding that visitors who self-selected female are less comfortable engaging in recreation alone yet have close confidantes who enjoy nature is consistent with other studies that reinforce the safety and security of group-based recreation for people of marginalized identities. For example, women-only outdoor groups can increase social bonding and confidence in one's physical abilities (Bosteder and Appleby, 2015), improving recreation satisfaction. Preference for group recreation may also be partly due to women being socialized toward "other-oriented" care (e.g., to plan trips around the activity interest of children and/or

elders) while men are often socialized to outdoor activities that emphasize rugged individualism (McNiel et al., 2012; Warren, 2015). Alternatively, the discomfort of some women with solo wildlife-dependent recreation may be reinforced by perceptions about violence occurring in outdoor settings, which in part results from societal expressions of the outdoors as primarily a male space in which female competence is undervalued and socially-reinforced stories that women "need" to be "protected" (Wesely and Gaarder, 2004; McNiel et al., 2012; Ouellet and Laberge, 2021). Even if women are equal or majority participants in nature-based recreation, tourism promotion is typically infused with the "male gaze" (or a male-oriented perspective, Pritchard and Morgan, 2000; McNiel et al., 2012). For this reason, our findings that people who self-selected female are *more likely* than those who self-selected male to participate in wildlife-dependent, non-consumptive activities (e.g., wildlife observation) has significant implications for nature-based tourism promotion. Publicizing high levels of involvement by women in these activities challenges the prevalent narrative that men are the primary participants in and audience for solo or physically-rigorous recreation opportunities.

Third, our findings regarding racial differences in how visitors experienced wildlife refuges is congruent with historically entrenched patterns of discrimination and oppression that has shaped racial disparities within nature-based recreation (Taylor, 2018; Dietsch et al., 2021). The white respondents in our study being less likely than people of color to feel that people who looked like them were treated differently while participating in nature-based recreation is consistent with other research that found, even among non-consumptive users, that members of minority ethnicities often experience more constraints to nature-based recreation (Metcalf et al., 2013). Specifically, self-identified Black recreationists may be both ostracized by family and friends for engaging in what is often perceived as Eurocentric activities while also being marginalized or stereotyped by other public lands visitors (e.g., Dietsch et al., 2021).

Fourth, our results highlight differentials in consumptive recreation. Not only are people who self-selected female less likely to participate in fishing and hunting as their primary activity (as other studies have found, see Stedman and Heberlein, 2001) than people self-selecting male, but our regression models suggest that the expansion of consumptive recreation (fewer regulations on fishing, fewer regulations on hunting, more acreage open to hunting/fishing) could lead to *decreased participation* of females in the activities they already engage in. Therefore, an overemphasis on these activities in wildlife management might alienate women from participating in outdoor recreation and accessing public lands. The expansion of consumptive recreation could (based on self-reports) also decrease the future participation of other non-consumptive recreationists (specifically those who engaged in bird watching and wildlife observation). To promote gender-inclusive adaptive management and accurate measurement of stakeholder preferences (e.g., cumulatively, people who participate in bird watching and wildlife observation make up a third of our total sample), it is important to expand wildlife management decisions beyond traditional consumptive recreational uses. Adaptive management processes can benefit from anticipating how the regulations aimed at one group (e.g., people who participate in hunting or fishing) might affect other stakeholders; this analysis is essential for adaptive management of public lands where visitors have diverse environmental values and where their perceptions of other recreationists impact the quality of their own visitor experience (Rossi et al., 2015; Hunt et al., 2016). However, it is important to note that both the prevalence of consumptive recreation and the associations between gender and consumptive recreation differ between countries (see Heberlein et al., 2008), so our results may not generalize outside of the United States.

Further, our work found that gender had a more significant impact in scenarios of regulatory change than in those of environmental change. This result requires further research, as other scholars have found that certain forms of environmental change, such as climate change, are gendered in their impacts (Pearse, 2017). However, prior research has also found high levels of visitor flexibility to non-ideal recreation settings in a sample that was primarily (65%) female (Parry and Gollob, 2018). Although the link between flexibility and gender requires further examination, it may be that the broader experiences of women with various constraints in recreation (e.g., physical restraints or microaggressions; McAnirlin and Maddox, 2020) has forced them to be more "realistic" or to adapt to various hurdles (such as environmental change) in order to participate.

Our emphasis in this work reflects the importance of visitor participation in wildlife and public lands management and to social-ecological systems more broadly. People who engage in wildlife-dependent recreation may have a more complete view of or influence on the social-ecological system (e.g., in the context of fishers, see Hunt et al., 2016), which could lead to a range of benefits, including:

- Reduced uncertainty related to changing conditions in the environmental or social milieu if understanding is shared (Berkes, 1999; Olsson et al., 2004)
- Sharing of novel social, ethical, and political insights about the system under scrutiny (Briggs and Sharp, 2004);
- Increased legitimacy of the adaptive management process among included community member (Colfer, 2005)
- Empowerment of previously marginalized groups (Henderson, 2000); and
- Increased social learning, which can foster new ideas, solutions, and directions (Stringer et al., 2006).

Despite these important benefits, increased participation in wildlife-dependent recreation can also yield more complexity and challenges for wildlife management. For example, increased participation of diverse recreationists can amplify social conflict between stakeholders over wildlife practices (such as culling), requiring wildlife managers to explore alternative ways to address overpopulation of wildlife (if that's why culling is needed) and find a way to resolve social conflict in a constructive manner (Chase et al., 2004).

There are also numerous forms of participation that have different implications for wildlife and public lands decision-making. These forms of participation include nominal participation (membership in a group), passive participation (being informed of decisions after the fact or listening in on a decision-making process without speaking up), consultive participation (being asked one's opinion on a matter without a guarantee that one's opinion will influence decisions), active participation (expressing opinions or taking initiatives of other sorts),

and interactive/empowering participation (having voice and influence in the decision) (Agarwal, 2001). This typology of participation is important because it differentiates between recreationists as users of public lands versus influencers of public land use policies. For example, people who occasionally participate in birdwatching might be different from people who seek to impact policies related to bird reintroduction or which acres are open for bird hunting; while both are forms of participation, the priorities of each group can have differential impacts on decision-making related to wildlife.

Even if exclusion is not the goal, management that ignores or marginalizes the perspectives of particular recreationists can dampen their participation (Byrne, 2012; Sánchez et al., 2020). Thus, an overemphasis on consumptive activities can overlook visitors who primarily engage in non-consumptive activities of various forms and perhaps overly ignore women or other gender non-confirming identities, which could be detrimental to adaptive management – an important tool for reducing uncertainty around environmental changes and identifying opportunities for equitable access to natural resources.

5 Conclusion

This paper provides insights into the gendered nature of wildlife-dependent recreation experiences across the Refuge System, an important public lands system in the U.S. We have demonstrated gender differences in recreation participation as well as gender variation in how regulatory and environmental changes may affect intended participation in nature-based activities. There are several mechanisms to promote gender-inclusive adaptive management (and gender-inclusive engagement with public lands more broadly) such as including people of diverse gender identities in recreation decision-making, increasing recreation opportunities favored by women, and surveying diverse groups of people about the obstacles they encounter to involvement in recreation. Accounting for and respecting non-traditional stakeholders in decision-making will improve understanding of public lands and provide more complete, accurate data about how visitors engage with the myriad activities available on these sites. There is also a need to examine gender alongside other demographic variables because experiences in nature-based recreation can be influenced by race, age, education, and geographic location, as well as the intersection of these identities. Considering gender as a construct in adaptive management will not only engage a wider range of recreationists to participate in activities on public lands but will help wildlife management reflect on the diversity of its stakeholders.

Data availability statement

All relevant data is contained within the article. The original contributions presented in the study are included in the article/supplementary files. Requests to access the data that underlie this study should be directed to AD.

Ethics statement

The Federal Lands Transportation Generic Clearance approved all survey and administration procedures (OMB Control # 0596-0236). In addition, the Office of Responsible Research Practices at The Ohio State University approved the methodological approach and survey instrument as study number 2018E0221, deemed exempt with limited IRB review, according to 45 CFR 46.104. Respondents provided their informed consent to participate in this study by completing a survey online or by mail.

Author contributions

AD oversaw data collection. JR wrote the first draft of the manuscript. All authors edited the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The 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.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2023.1006150/full#supplementary-material

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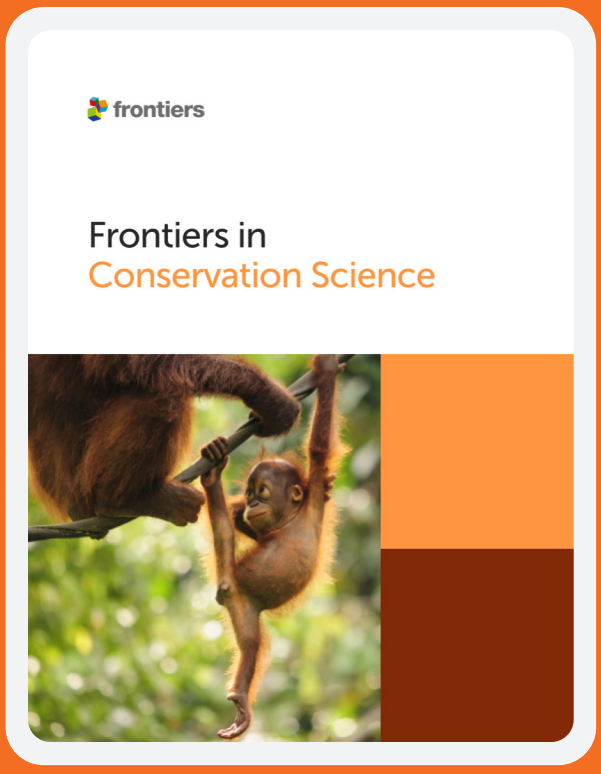

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