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Environmental justice gaps in human-wildlife conflict research from a social-ecological systems perspective

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ABSTRACT

Human–wildlife conflicts (HWCs) are increasingly prevalent and complex phenomena that often result in social tensions and environmental injustices. While the social–ecological systems (SES) perspective has been recently applied to understand the dynamics of HWC, little attention has been paid to how environmental justice is addressed in this field. This study presents a systematic review of 85 studies that analyse HWC using a SES lens, with the aim of examining to what extent these studies incorporate the three dimensions of environmental justice: distributive, procedural, and recognition justice. We assessed how social actors were identified, how benefits and cost were distributed, and how these actors were involved in both decision-making and research processes. Our findings reveal that most studies focused on mammals (58 %), and those human–human conflicts caused by human activities affecting wildlife populations and/or their habitats were the most frequently studied category (54 %). While local communities were commonly identified as social actors and resource losers, their participation in research was mostly limited to consultation, with few cases of collaboration or engagement. Moreover, the social actors identified as most affected by conflicts—those experiencing resource and livelihood losses—were not the same as those most involved in decision-making processes. These findings highlight the need to adopt more context-sensitive and justice-oriented approaches to address HWCs, enabling more equitable and effective conservation strategies. A social–ecological perspective helps to recognise the role of shifting social norms in conflict dynamics, while integrating environmental justice enables a deeper understanding of power imbalances.

1. Introduction

During the Anthropocene, it is estimated that around 50–70 % of the Earth's land surface has been modified by human activity (Lehman et al., 2021). The expanding human footprint is causing habitat loss, and alterations in wild species, thus increasing the potential for human-wildlife conflicts (HWC) (Bombieri et al., 2023). HWC arise primarily when the presence or behaviour of wildlife poses real or perceived threats to human interests and causes disagreements between social actors (IUCN, 2020). These situations often generate social conflicts between parties over wildlife management, and such conflicts are often diverse, complex, dynamic, and multi-layered (Sidaway, 2013).

Conservation conflicts, including HWC, are sometimes addressed without adequate consideration of the rights, responsibilities, needs, or perspectives of the local people (Bennett et al., 2019). For example, wildlife conservation projects, such as the creation of protected areas or the reintroduction of wildlife species, can lead to HWC by creating risks of physical injury as well as damage to the basic livelihoods of people (Tan, 2021). This shows that conservation conflicts often generate burdens that are unevenly distributed among different social groups, often harming the most vulnerable (Orrick et al., 2023; Tan, 2021).

This underlines the need to include the changing social context in the

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study of HWC as an essential step to better understand the injustices that arise from them (IUCN SSC, 2023). When dealing with HWC, equity must be considered not only in terms of allocating costs and benefits, but also in reflecting the role of specific social groups as relevant actors for decision-making (Strzelecka et al., 2021). This is particularly important to find a way forward that sheds light on how to equitably share the costs and benefits of HWC as well as responsibilities among stakeholders in HWC.

A possible way to address some of the key challenges of HWC is the comprehensive application of the environmental justice framework (McInturff et al., 2021). Such a framework provides an understanding of power imbalances and differences in attitudes and values between diverse parties involved in a conflict (Fraser, 2009; Strzelecka et al., 2021). In addition, it helps to identify unfair burdens that can lead to conservation conflicts in communities and to understand which worldviews are recognised and which are ignored (Carmenta et al., 2023; Figueroa, 2015). The environmental justice framework comprises three dimensions of justice, including distributive, recognition and procedural. Distributive justice refers to how resources, costs, and benefits are allocated to social actors. Recognition justice focuses on recognising the identity, values, and knowledge of each social group. Finally, procedural justice examines how decisions are made and the extent to which different social actor can influence, reflect, or incorporate their perspectives (Kosanic et al., 2022; Leach et al., 2018; McDermott et al., 2013).

Recent studies recognise the potential of applying the environmental justice framework to foster transformations towards sustainability and equity (Kosanic et al., 2022; Martin et al., 2020). In fact, the connection between environmental justice and transformations towards sustainability is also recognised in global policies. For example, the environmental justice framework aligns with Sustainable Development Goals of the UN 2030 Agenda, which places equity at the heart of sustainable development. It emphasises reducing inequalities and commits to leaving no one behind (United Nations, 2015). It is similarly aligned with the 2030 Global Biodiversity Targets embodied in the Kunming-Montreal Global Biodiversity Framework (CBD, 2022).

While environmental justice can be applied to a wide variety of conservation conflicts, studies framed within the social–ecological systems (SES) perspective offer a particularly suitable ground for its evaluation. SES approaches explicitly link human actors with ecological components, enabling the systematic mapping of who gains and who loses from conservation decisions (distributive justice), who participates in decision-making (procedural justice), and whose identities, values, and knowledge are acknowledged (recognition justice) (Kosanic et al., 2022; Leach et al., 2018; McDermott et al., 2013). This integrated view facilitates the identification of justice gaps that may remain invisible in studies addressing social or ecological aspects in isolation. Moreover, a social–ecological perspective aligned with environmental justice provides a valuable framework to navigate the complex interactions and feedbacks between social and ecological systems (Leach et al., 2018; Orrick et al., 2023)—particularly in contexts such as HWCs—by recognising and integrating diverse interests, values, and knowledge systems often marginalised in conventional management approaches (Mason et al., 2018). It also helps to uncover the underlying decision-making processes and structural constraints that impede equitable and effective conflict resolution. Despite this potential, the integration of environmental justice into SES-based research on human–wildlife conflicts remains underexplored, representing a promising avenue to advance transformative pathways towards sustainability that are both ecologically resilient and socially just (Martin et al., 2020).

This manuscript systematically revises literature to understand the scientific landscape of HWC research using the SES perspective in order to assess to what extent this scientific knowledge has considered the environmental justice perspective. To do so, we first characterised HWC studies according to their spatial distribution, scale, and ecological factors (e.g. biomes and species involved). We identified the diversity of frequently investigated HWC and their relationship with animal groups. We then analysed the impact of HWC on the identified social actors, at what level they are included in HWC research, and to what extent, in the decision-making regarding the management of the conflict. Finally, we explored the similarities and differences between the studies in terms of the species studied and the types of conflict across the three dimensions of environmental justice.

2. Methods

2.1. Data collection

We conducted a systematic literature review of scientific articles published on HWC that use a SES approach. We used the Scopus database because of its broad interdisciplinary coverage and recognition as a standardised database for meta-analyses (Gusenbauer and Haddaway, 2020). The review procedure followed the guidelines of the Environmental Collaboration (Haddaway et al., 2016). We developed the searching string based on the systematic review of Alba-Patiño et al. (2025), seeking to combine terms related to SES frameworks (e.g., "human-natural system"), conservation (e.g., "protection"), conflict (e.g., "dispute*") and wildlife (e.g., "biodiversity") (see Appendix A for the full search string). The search was applied to title, abstract, and keywords of peer-reviewed articles published until December 2024, resulting in 1263 articles. We excluded book chapters, conference papers and other grey literature and limit the language to English (Martín-López et al., 2019a; Gross et al., 2023). These criteria were defined to ensure that our systematic review included the most available scientific content (Haddaway et al., 2016). To identify relevant papers, we screened them in two steps: first, a combined selection of title and abstract and the subsequent screening of full text. We selected those articles that followed three inclusion criteria: (1) they were empirical, place-based studies, (2) they addressed at least one HWC, and (3) they applied a SES framework. Conflicting screening decisions were resolved through collective discussion among the co-authors. The final number of articles selected for the in-depth screening was 190.

Each article was coded according to the sets of variables that represent the main topics of this review: (1) meta-information of the publication; (2) geographical information of the case study; (3) ecological information (e.g., biome); and wildlife species involved in the conflict (i.e., taxonomic group and the threatened category of the species based on the International Union for Conservation of Nature's (IUCN) Red List); (4) type of HWC according to Peterson et al. (2010), (5); wildlife use as specified in the published paper; (6) social actors involved in the conflict; and (7) the dimensions of environmental justice researched -recognition, distributional and procedural justice (Kosanic et al., 2022; Leach et al., 2018). Appendix B presents a detailed description of the variables used for coding.

Regarding HWC, we unpacked human-human conflicts -i.e., conflicts that occurred among humans when deciding how best to address potential damage by wildlife on human property, health, safety or other development objectives (Peterson et al., 2010). Among these, we distinguished three types of conflicts: (1) conflicts caused by *human activities* affecting wildlife populations and/or their habitats, (2) conflicts arising from social actors' disagreements or divergent interests in the wildlife *species' management*, and (3) conflicts arising from *lack of governance*. The rest of HWC categories refers to the damage that wildlife can cause to human activities (i.e., ranching, agriculture, tourism, and fisheries), infrastructure, human safety, and ecosystems, as considered by former literature (Lozano et al., 2019; Pascual-Rico et al., 2021; Peterson et al., 2010).

In order to know the impact of HWC on social actors, we examined whether or not the studies used, directly or indirectly, the environmental justice framework and whether they integrated its three dimensions. For this purpose, we extracted information from the studies based on the following questions: 1) which social actors were identified as parties

involved in the conflict. 2) Which social actors were affected by the distribution of benefits and costs arising from the analysed conflict (i.e., distributive justice)? Given that conflicts are, by definition, negative for both the involved social actors and wildlife species (Redpath et al., 2015), we considered winners those actors who improved or preserved their income and livelihoods, and losers those who did not. 3) Which social actor were included in the decision-making processes related to conflict management (i.e., procedural justice)? and; 4) Which social actor participated in the research, and what was their level of participation according to the categories: consultation, collaboration, and engagement (i.e., recognition justice).

It is important to highlight that evaluating recognition justice in the scientific literature is a methodological challenge, as it involves relational and epistemic aspects—such as respect for diverse worldviews, values, and knowledge systems—that are often not explicitly described in academic articles. Therefore, we evaluated whether actors were acknowledged in the research process and the extent of their participation. This approach is a practical indicator of recognition justice, based on the idea that meaningful inclusion and participation of historically marginalised groups are fundamental expressions of recognition (Schlosberg, 2007). It also aligns with previous studies that assess justice and knowledge co-production through actor participation (Pascual et al., 2021; Turnhout et al., 2020)

2.2. Data analysis

First, we carried out a descriptive analysis to characterise the trend of HWC research through a SES lens. Second, we analysed the distribution of articles by animal group, proportion of threatened species studied, and proportion of animal groups (mammals, birds, fishes, herpetofauna and invertebrates) involved in each HWC category. Among mammals, we differentiated hoofed animals, carnivores, marine and freshwater mammals, and other mammals; the latter category consisted of primates, rodents, lagomorphs and pholids. It is important to note that a single article could focus on one or more species studied, as well as address one or more HWCs. Third, we analyse descriptively the distribution of papers in each dimension of environmental justice. Finally, we conducted a correspondence analysis to explore the relationship between animal groups and HWC categories using the vegan package in R version 4.3.1 (R Core Team, 2022) and then, we fitted, as contour lines, the number of justice types mentioned in the articles using penalised splines (Oksanen et al., 2013).

3. Results

3.1. Distribution of HWC research and species involved

The in-depth screening of 190 articles yielded 85 articles that were included in the review, while 105 studies were excluded for not meeting the inclusion criteria (see Methods). Selected articles were published worldwide between 2004 and 2024 and covered 49 countries (see Appendix C for a list of all reviewed articles). Most of the studies were conducted at the regional and local scale (42 % and 32 %, respectively) and mostly in Africa and Asia-Pacific (Fig. 1). The USA accumulated the highest number of articles (21 % of the articles), followed by Namibia (9 %). Most of the countries (57 %) were represented by only one article (Fig. 2). The study areas were mainly located in tropical biomes (i.e., forests and grasslands) and coastal-marine ecosystems (29 % and 24 %, respectively, Fig. 1).

Mammals were the most studied taxonomic group across all continents with 58 % of the articles; hoofed and carnivore species stood up among mammals. In contrast, invertebrates yielded the lowest number of articles (9 %), and included the classes holothurians, malacrustaceans, gastropods, bivalves, and scyphozoans, which occur in

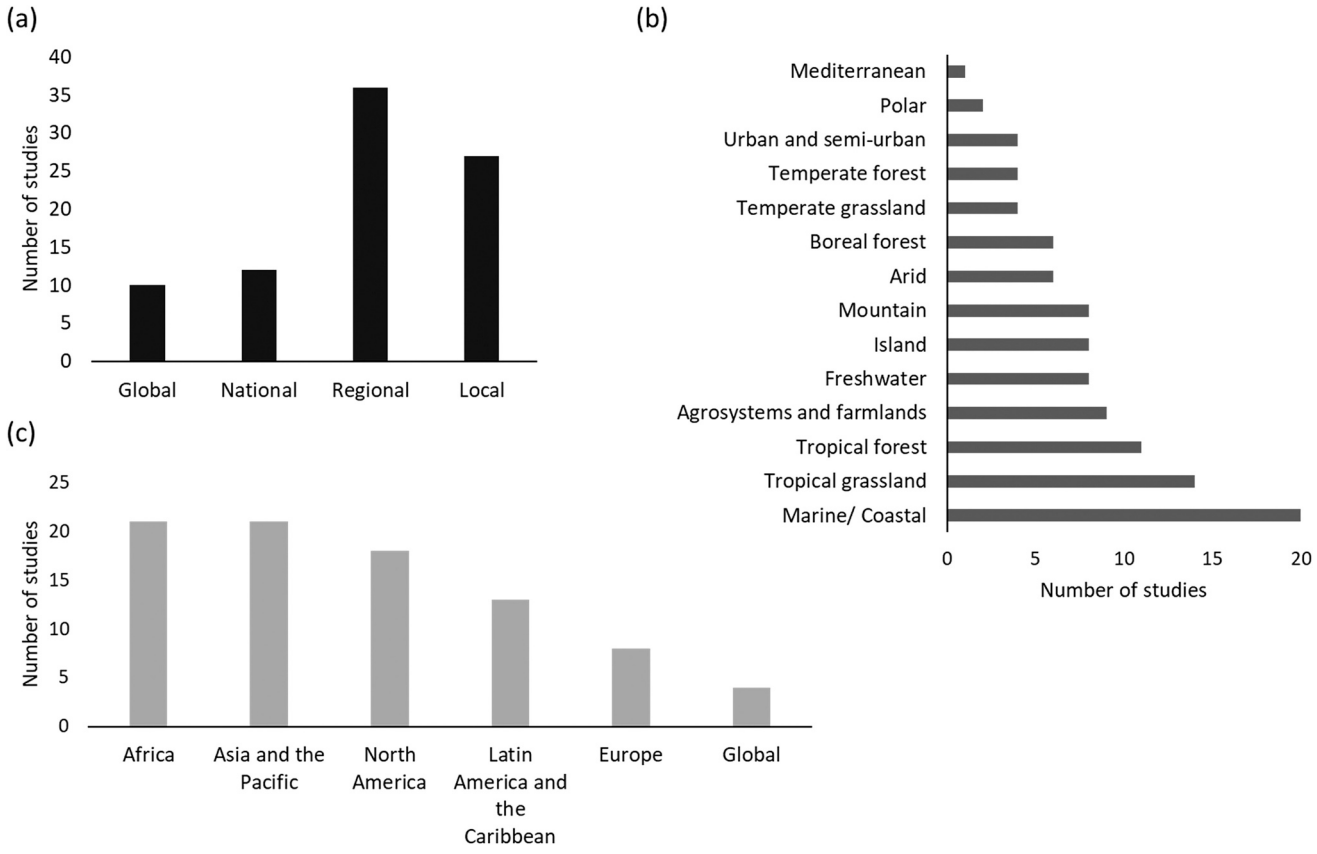

Fig. 1. Number of reviewed articles grouped by (a) scale, (b) biome, (c) continent.

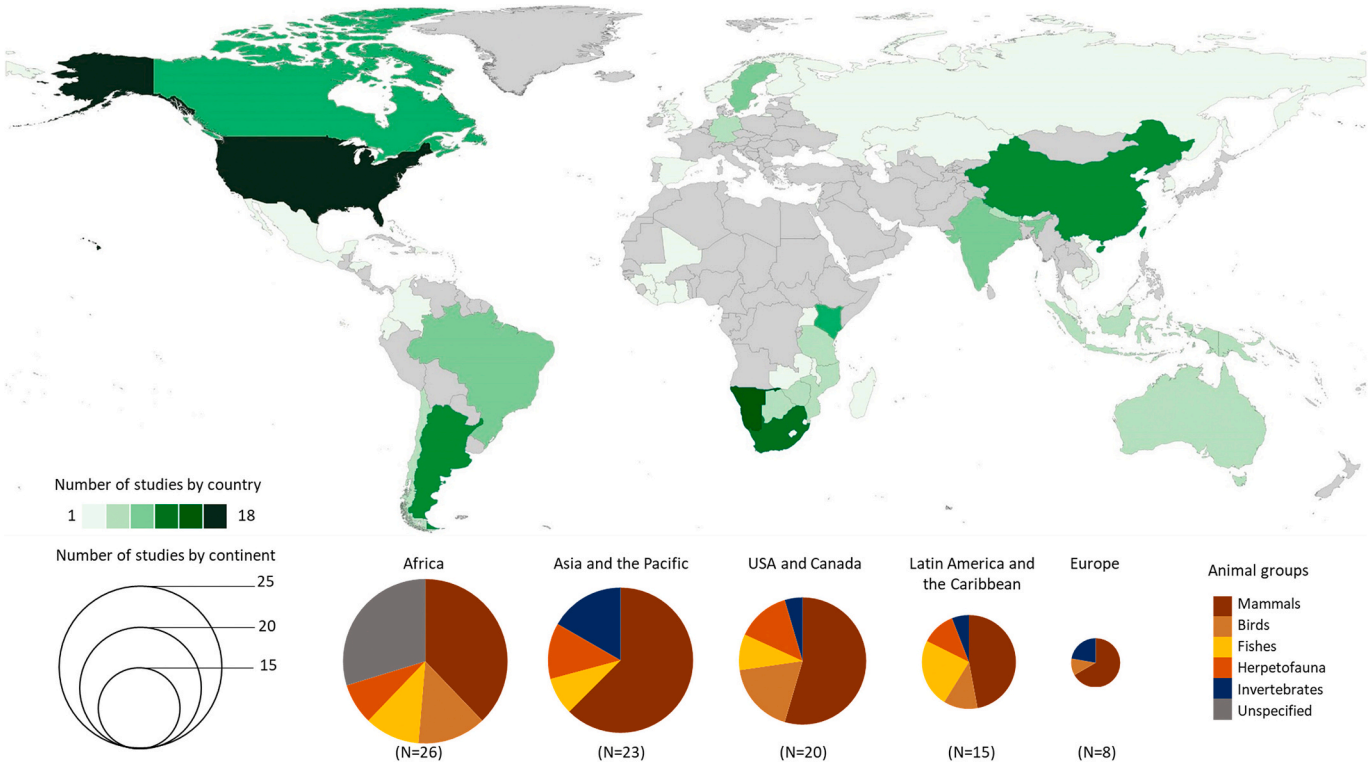

Fig. 2. Number of reviewed articles by country. The pie charts represent the proportion of studies by continent (i.e., pie size) and animal groups (i.e., slices). N is the total number of articles per continent.

aquatic-marine ecosystems. In Africa, 19 % of the articles did not mention the species studied, possibly because they dealt with issues such as the bushmeat trade and consumption that relate with several wildlife species. USA and Canada were the countries with the highest number of articles on birds, Asia had more articles on invertebrates than other regions and European articles (8) focused only on mammals, invertebrates, and birds (Fig. 2).

The articles analysed HWC that involved 136 species, of which 51 % were mammals. Hoofed mammals and carnivores were the most studied species (45 species in total), and they showed a high percentage of threatened species (68 % and 52 %, respectively). On the other hand, aquatic and marine mammals included 60 % of threatened species, and primates, rodents, lagomorphs, and folivores included the highest proportion of threatened species of all animal groups (93 %) (Fig. 3).

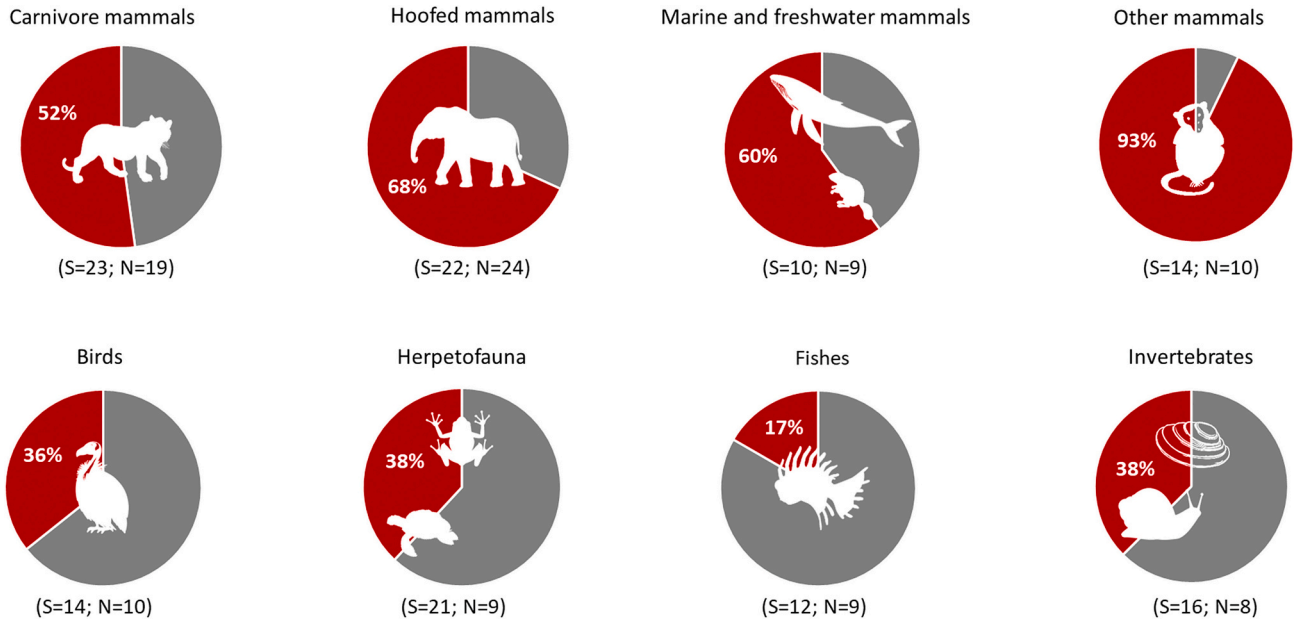

Fig. 3. Percent of threatened species across animal groups. Species are taxonomically grouped by carnivore mammals, hoofed mammals, marine/freshwater mammals, others mammals, birds, herpetofauna, fishes, and invertebrates. The percentages of threatened species according to the IUCN Red List are shown within the red slices. The total number of species (S) mentioned in (N) articles are provided per each animal group. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Herpetofauna (i.e., reptiles and amphibians) had 58 % of threatened species, while papers on fishes included only 17 % of threatened species (Fig. 3). Likewise, no studies involving arachnids, insects, or arthropods (in general, threatened and non-threatened) were present in our review.

3.2. Human-wildlife conflict categories

Human-human conflict was the most studied HWC category (Fig. 4). Due to the large diversity of conflicts grouped in this category, we regrouped them into three subcategories according to the conflict's origin (see Methods). The *human activities* subcategory was the most recurring conflict in the articles (54 %) followed by the *species' management* conflict, and the *lack of governance* conflict was the least studied (35 % and 22 %, respectively, Fig. 4). In these three categories, mammals accounted for more than 60 % of the conflicts followed by birds and fishes (Fig. 4). Regarding the rest of HWC categories, damage to livestock and crops was the most frequently reported (35 % of articles), followed by damage to human safety (15 %) and damage to ecosystems (14 %) mainly caused by invasive species (Fig. 4). Regarding animal groups, mammals accumulated the largest number of damage mentions and was the group most frequently associated with damage to crops and livestock. More than half of human-human conflicts (54 %) and 18 % of wildlife damage were related to the use of wildlife by social actors, whether for food, clothing, housing or income generation. From activities such as hunting, fishing, gathering, logging, trade or tourism (see Appendix D for more details).

3.3. Environmental (in)justice

In all articles, nine social actors groups were identified as relevant for shaping HWC. Managers and local communities were the most mentioned (51 % and 40 % of the articles, respectively), while hunters and the touristic sector were the least mentioned. Regarding distributive justice, most articles (35 % of the articles) mentioned local communities as the social actor whose resource distribution was most affected (both positively and negatively) because of HWC (Fig. 5). Social actors such as farmers, herders, and ranchers were mainly mentioned as resource losers (23 % of the articles, Fig. 5), that is, their livelihoods were negatively affected by the conflict. Both hunters and the tourism sector were identified as social actors who were mostly winners in the conflict (13 % and 12 % of the articles, respectively, Fig. 5). This was either because they increased their income, they engaged in illegal activities such as illegal hunting and illegal wildlife trade, or they were allowed to engage in tourism activities without taking responsibility for ecosystem, species or territory management.

When analysing procedural justice, we identified that managers, at different levels (e.g., local, regional, national), were the most frequently social actor included in the decision-making process regarding the management of HWC (45 % of the articles), and followed by NGOs and local researchers (15 % and 14 % of the articles, respectively). The rest of social actors (e.g., farmers, fishers, local communities) were only considered to be involved in the HWC management decisions in 8 % (or less) of the articles (Fig. 5).

Regarding recognition justice, we found that managers and local communities were the most commonly involved social actors in the research process (35 % and 31 % of the articles, respectively), followed by local researchers and NGOs (26 % and 25 % of the articles, respectively, Fig. 5). Although 83 % of the studies included at least one social actor as part of the study, most did so only at the consultation level, meaning that social actors participated solely as data providers through surveys, interviews, group discussions, and other forms of participation. However, 16 studies included social actors as study collaborators, as the results and conclusions of the research were discussed jointly with them. The main collaborators were managers (8 articles), local researchers and conservation NGOs (6 and 5 articles, respectively). Only three studies included Indigenous Peoples in all research phases (i.e., engagement level). They were partnered with local researchers, hunters (in two studies), and conservation NGOs (in one study). Appendix E shows the relationship between the levels of participation, ways of participation, and social actors.

Only two of the reviewed studies (Burt et al., 2020; Dalpaz et al., 2024) explicitly used the environmental justice framework in analysing

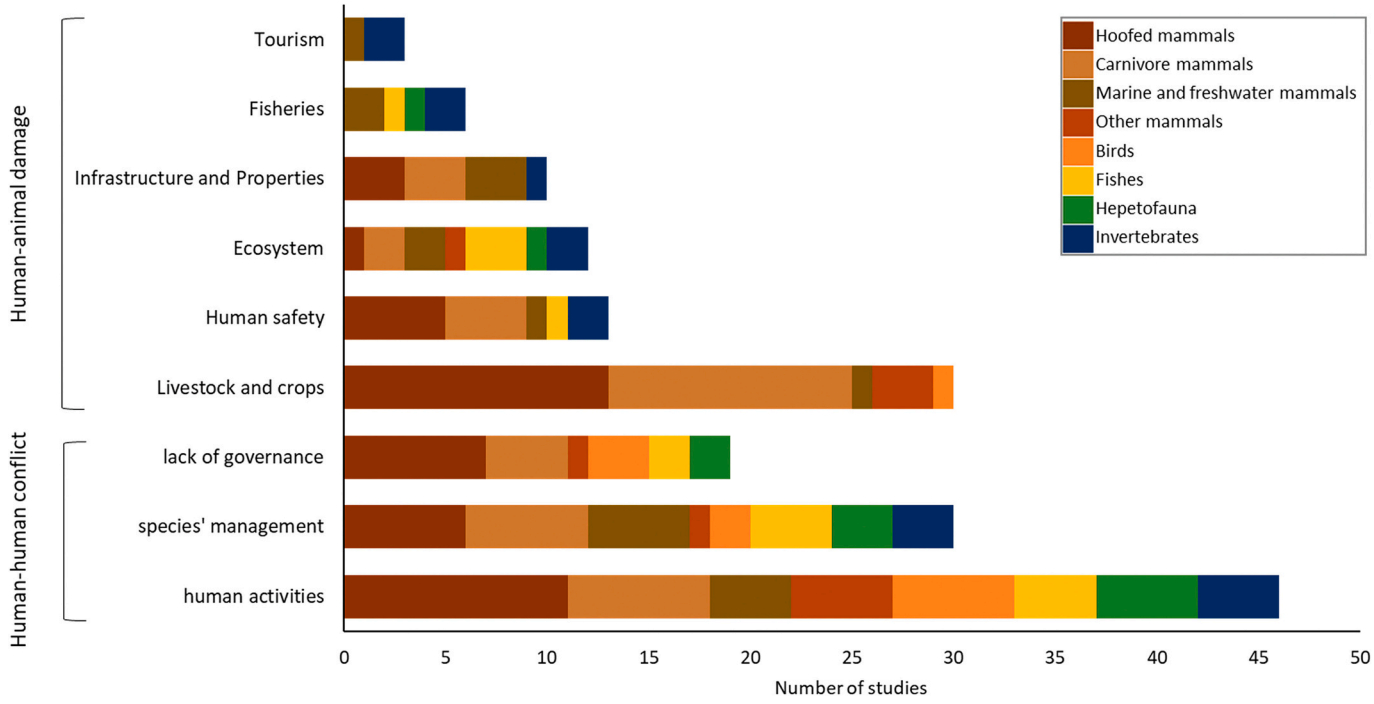

Fig. 4. Number of reviewed articles categorised by animal groups and nested in human-wildlife conflicts (HWC). HWC was regrouped them into three subcategories: human activities, species' management and lack of governance. The rest of HWC categories refers to the damage that wildlife can cause to human activities (i.e., ranching, agriculture, tourism, and fisheries), infrastructure, human safety, and ecosystems. Please refer to the main text for an explanation of these categories.

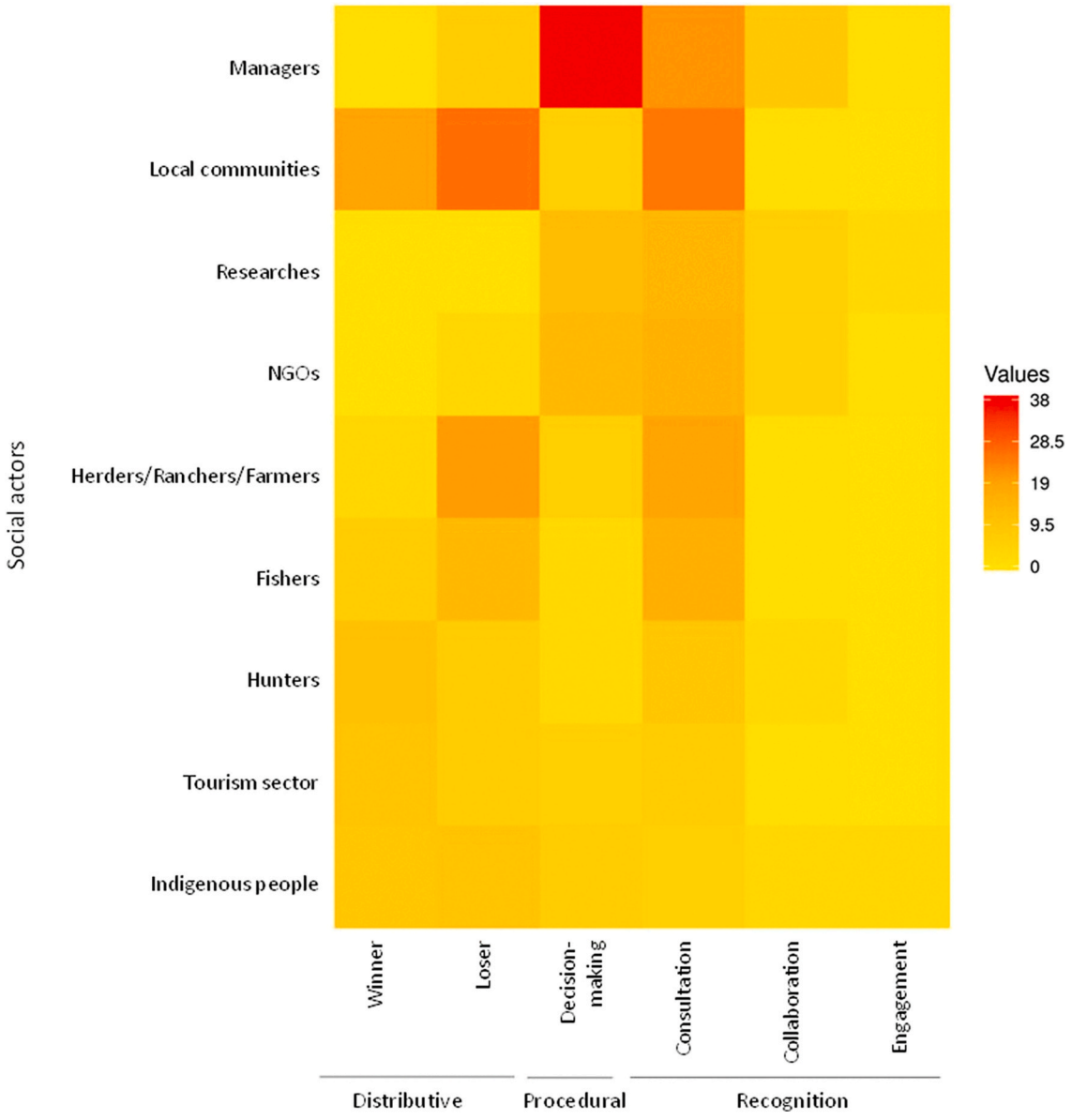

Fig. 5. Heat Map representing the association between the number of mentions of social actors and environmental justice dimensions (i.e., distributive, procedural and recognition) in the reviewed articles. Cells in red (yellow) represent a higher (lower) number of articles (i.e., stronger (lower) association). The distributive justice dimension has been split into two components: winners and losers. The procedural justice dimension was considered when the social actors were included in the decision-making process. The recognition justice dimension was associated with three levels of social actors' involvement: consultation, collaboration and engagement. Note that the range of the colour palette is different in each environmental justice dimension. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

HWC. In the first article, Burt et al. (2020) examined the effects of sea otter (*Enhydra lutris*) restocking in the northeastern Pacific on human communities. It specifically analyses the socio-ecological changes that have occurred in the territory and the environmental justice issues generated by the recovery of otter population for Indigenous peoples. This predator affects their main livelihood, fishing, and consequently, the food security of these communities, who ask to be compensated for the collateral damage of conservation and request that the inequalities of power in the management of the species be reduced. In the second article, Dalpaz et al. (2024) analyses the incidental capture of Lahille's bottlenose dolphins (*Tursiops truncatus gephyreus*) in local fisheries in a region of Brazil. They highlight the need to avoid increasing social injustices by overburdening local actors who already face socio-economic vulnerability, as fishing is their only income source.

3.4. Measuring similarities among animal groups, conflict type, and damage

The CA revealed a relationship between studies involving carnivores mammals and hoofed and damage to crops, livestock, and human safety. 'Other mammals' (i.e., primates, rodents, lagomorphs, and folivores) were associated with *human activities* and conflicts over *lack of governance* (Fig. 6). Birds, fishes, and herpetofauna were related to conflicts over *species' management*. When fitting the number of articles that mentioned the environmental justice dimensions to the ordination, we found a high and similar research effort between distributive justice and hoofed mammals, carnivores, damage to human safety, and damage to ecosystems (Fig. 6a). Similarly, the number of articles mentioning procedural justice was similar for hoofed mammals, carnivores, and damage to human safety (Fig. 6b). Finally, recognition justice, human safety, and

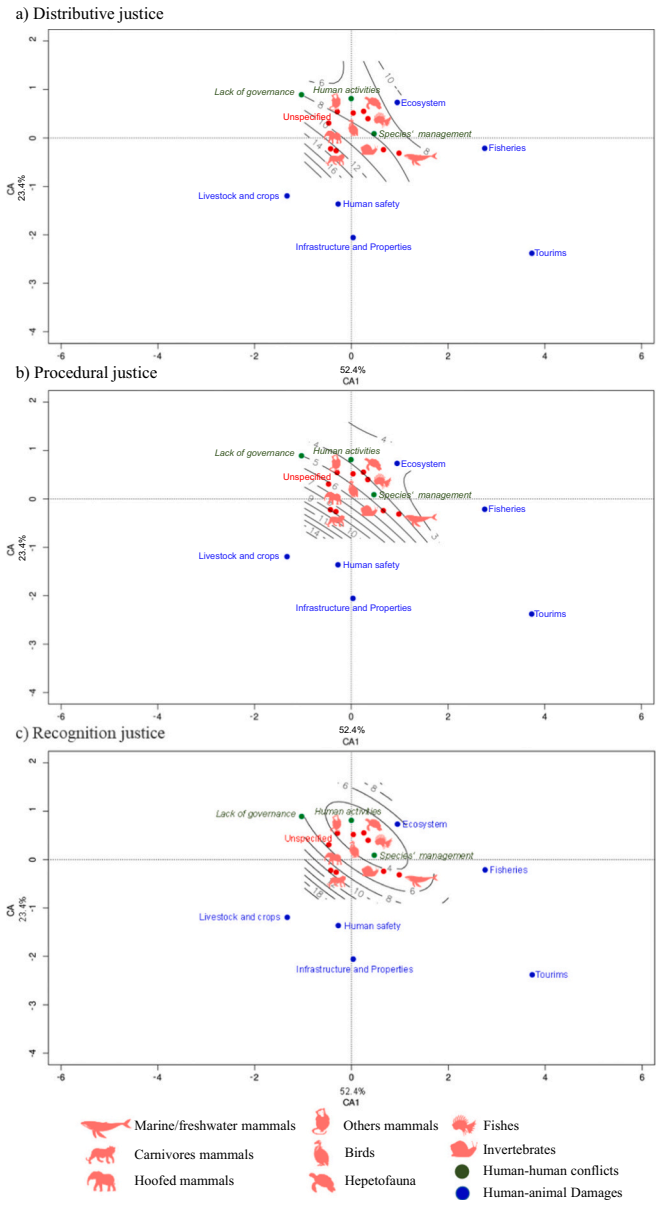

Fig. 6. Correspondence analysis biplot relating the human-human conflicts and human-animal damage (in green and blue, respectively) to animal groups (in red). A shorter distance between items means greater similarity between them, while a longer distance corresponds to greater dissimilarity. The percentage of variance explained by each axis is provided. For this ordination, the environmental justice dimensions (a) distributive (b) procedural, and (c) recognition were fitted as contour lines using penalised splines. The goodness-of-fit, measured as deviance explained, had values of 90.9 %, 89.6 %, and 95.5 % for each dimension, respectively. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

damage to infrastructure and property shared a similar research effort (Fig. 6c).

4. Discussion

Our results show that there exists a global emerging scientific interest in addressing human-wildlife conflicts (HWC) using the SES perspective. However, this research indicates some bias exists and identifies important knowledge gaps.

First, most studies displayed a taxonomic bias towards mammals (58 % of the articles reviewed), which is consistent with previous research showing scientists' preference for studying mammalian HWC (Anand and Radhakrishna, 2017; Basak et al., 2023; Ridwan et al., 2023). This indicates the scientific preference and sensitivity towards charismatic fauna and species (Fazey et al., 2005; Martín-López et al., 2009; Velasco et al., 2015). Second, one of the most glaring knowledge gaps is the lack of studies on herpetofaunal conflicts in Europe, despite existing evidence of damage caused by some of these species to human safety. For example, snakebites cause harm to human safety, with an estimated annual incidence of 7992 bites in Europe, and with a more widespread distribution in Mediterranean countries (Amate Blanco and Conde Espejo, 2012). Only considering Spain, there are between 100 and 150 admissions per year due to ophidian accidents (Estefanía Díez et al., 2016). Another aspect to consider here is the properties of reptiles and amphibians as potential reservoirs of several zoonotic agents, which may exacerbate conflicts in livestock areas and in places where reptiles and amphibians are still allowed to be kept as pets (Durand et al., 2013; Mendoza-Roldan et al., 2021).

Third gap reflects on the overall lack of studies on insects and terrestrial invertebrates. We attribute this gap to two main reasons. The first is that insect damage is addressed from the realm of pest management, where the focus is on eliminating species and controlling their populations, which does not generate conflict (Anand and Radhakrishna, 2017). However, this particularity in our review may also be a product of the use of SES perspectives to address HWC in the reviewed articles. The SES perspective integrated in this review may also have led to an increase in the analysis of human-human conflict studies (a subcategory of HWC), contributing to unpacking the diversity of conflicts between people and the social roots that shape HWC. This highlights the importance of addressing the underlying human dimension shaping each conflict (Redpath et al., 2015) and not just studying the damage resulting from human-wildlife interactions. By unravelling the social relations underlying HWC, particularly who is recognised as a relevant social group involved in HWC, who is considered a winner and loser in the conflict, and who has a stake in decision making, social-ecological approaches provide insights into the environmental justice of HWC.

Beyond geographic biases, the taxonomic gaps we identified (e.g., the underrepresentation of invertebrates and herpetofauna) also may have implications for environmental justice. By focusing predominantly on mammals and other charismatic species, the literature tends to prioritise conflicts that are more visible to conservation science and policy (Martín-López et al., 2009), while overlooking contexts where less studied taxa play critical roles in local livelihoods and cultural values. This imbalance may reinforce whose experiences of conflict are recognised and whose remain marginalised, ultimately shaping the justice landscape of HWC research (Colléony et al., 2017).

4.1. Environmental justice unravelling human-wildlife conflicts

Our findings suggest that SES-based research holds considerable potential for integrating environmental justice analyses. By jointly considering ecological dynamics and social actors, SES frameworks can generate valuable insights into distributive, procedural, and recognition justice (Leach et al., 2018). This dual focus positions them (SES and Environmental justice) as promising tools for identifying and addressing inequities in conservation governance (Ruano-Chamorro et al., 2022). However, in the studies we reviewed, social and ecological dimensions were often addressed in parallel rather than in a fully integrated manner. This points to an opportunity for SES approaches to move beyond describing conflict dynamics towards more explicitly diagnosing and responding to the justice gaps that underpin them. A central aspect of realising this potential lies in examining how different social actors are identified, valued, and engaged in research and decision-making—issues that our review explores through the lens of recognition justice.

Our review allowed us to unravel how social actors were recognised as involved parties in scientific studies addressing HWC and their level of participation in the research. Although, as noted above, our analysis

of recognition justice does not fully capture all the relational and epistemic aspects of this dimension, it nonetheless offers a practical approach that helps shed light on the issue. Interestingly, it became clear how science uses power to give voice to specific actors, such as managers and local communities, even if the latter are only recognised as consultees. However, our results also showed that other social groups that could be relevant to fostering coexistence between humans and wildlife are less considered in the literature, such as Indigenous peoples (recognised as involved parties in only 13 % of the studies). Recognising Indigenous peoples' forms of knowledge, values, and human-nature relationships, gives them the opportunity to have their voices heard (Dawson et al., 2023; Lau et al., 2021; Lecuyer et al., 2019; Ruano-Chamorro et al., 2022) in the management and conservation of wildlife. In fact, Sze et al. (2023) found that Indigenous peoples provide critical support for the conservation of vertebrates in tropical forests, which highlights the need to include them when designing and implementing conservation programs. Furthermore, ignoring these different worldviews may increase the risk of reproducing environmental injustices, which are often rooted in the imposition of Western scientific thinking on other forms of knowledge about the natural environment (Barnhill-Dilling et al., 2020; Martin et al., 2016). Different studies have called for the recognition of Indigenous peoples as co-authors of scientific publications, and not just consultees or collaborators, because of the wide variety of contributions they have made to biodiversity conservation research (Castleden et al., 2010; Cooke et al., 2021; Koster et al., 2012).

Remarkably, although the recognition of local communities in the articles reviewed was particularly important, in most cases, their involvement did not go beyond the level of consultation. Local communities are key knowledge holders with the capacity to contribute to all the stages of research (Cooke et al., 2021). Rethinking and improving their inclusion in science should be the first step for addressing environmental injustices that intersect with local-scale conservation conflicts (Burke and Heynen, 2014). In addition, assigning roles in research to other less considered actors, such as fishers, hunters, herders, and farmers, can improve these studies as the heterogeneity of social groups and their level of involvement affects the quality of information produced and the methods used to produce it (Djenontin and Meadow, 2018; Vogel et al., 2022). Moreover, this increased public exposure to research will generate more support for science-based conservation decision-making (Bickford et al., 2012; Burke and Heynen, 2014; Kadykalo et al., 2021).

The recognition of diverse social groups in research on the policy and justice dimensions underlying conservation and the inclusion of diverse knowledge systems is necessary to achieve the new 2030 Global Biodiversity Targets embodied in the Kunming-Montreal Global Biodiversity Framework (CBD, 2022). Specifically, goals 21 and 22 of the CBD, 2022 framework stress the need to improve accessibility to all types of information and knowledge (including traditional, Indigenous and Local Knowledge) to achieve fair and participatory management of biodiversity. It also guarantees full, equitable, inclusive, effective, and gender-sensitive representation and participation of Indigenous peoples, local communities, women, children, youth, and people with disabilities (CBD, 2022). International initiatives such as the Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), already recognise the importance of including non-Western worldviews and knowledge in research, making them part of their reports (IPBES, 2022a, 2022b, 2019), and building synergies with Indigenous peoples and local communities who have participated in multidisciplinary expert panels on biodiversity and ecosystem services (Hill et al., 2020).

4.2. Who bears the brunt? Who makes decisions in human-wildlife conflicts?

By connecting our findings on distributive and procedural justice, we can deduce that social actors identified as most affected by conflicts, in terms of loss of resources and/or livelihoods, were not the same as those who were most included in conflict decision-making. On the one hand, studies identified local communities as the biggest resource losers, followed by farmers, herders, and ranchers. On the other hand, managers, local researchers, and conservation NGOs are more involved in the decision-making process. This can be interpreted as a mismatch between actors who benefit from decision-making processes and those who are subject to their determination. Here we argue that addressing power dynamics by redistributing power among marginalised social actors and managing unequal relationships is essential for improving their empowerment in HWC governance. Similar claims are made by Cumming et al. (2023) with regards to the importance of Indigenous people and local communities in managing their lands and waters and by Ruano-Chamorro et al. (2022) concerning to the need to ensure that social actors participation in decision-making in order to promote the legitimacy of conservation measures.

Other studies on environmental justice also pointed out that local communities are often the group most affected by alterations in the social-ecological systems they inhabit, whether as a result of extractive activities, land use changes or social system changes (e.g., Adger et al., 2005; Martín-López et al., 2019b; Hanaček et al., 2022; Bontempi et al., 2023). They are also unlikely to be involved in decision-making (Bourgeois et al., 2023), as our results revealed. For example, research on the effects of fracking in the United States has shown that those living near fracking wells (locals) are at risk of serious health problems owing to emissions and loss of resources due to ecosystem fragmentation (Clough, 2018). By contrast, those who generally decide on the territory are multinational companies that profit from this extractive activity (Clough, 2018). The same was reported in another study on protected area governance in the Global South, which found that conservation NGOs, national governments, and corporate funders mainly exercised decision-making, while the participation of local people and civil society was much lower (Boillat et al., 2018). Additionally, in studies on environmental justice and ecosystem services, fishers, farmers, and local people were identified as highly dependent on local ecosystem services since their livelihoods were strongly affected by ecosystem service changes. Whereas other social actors, such as local managers and environmental NGOs, who were not so affected, were the most influential in natural resource management (Martín-López et al., 2019b). These findings alongside those reported in this research repeatedly reveal the mismatch between the cost bearer and the decision maker.

Finally, it is important to note that the Environmental Justice Project has developed robust evidence of environmental injustices occurring around the world, at different scales, as a product of the emergence of different socio-environmental conflicts (Scheidel et al., 2020). These place-based studies analyse the actors involved in the conflict from the three dimensions of environmental justice. A common denominator in case studies is that local actors begin to have a voice and participation in decision-making when they decide to organise themselves in collectives such as unions, assemblies, or associations. This allows them to mobilise and give them the opportunity to be included in the governance of their territory (Bontempi et al., 2023; Hanaček et al., 2022; Walter and Wagner, 2021). It is noteworthy that although this global project addresses a wide range of environmental and conservation conflicts, it has neglected HWC. Thus, our findings are crucial to expand the analysis of environmental justice and call for including those (in) justices that happened as a result of HWC.

4.3. Methodological limitations

Our review also has several limitations that should be acknowledged. First, relying solely on the Scopus database may have excluded relevant studies published in regional journals or disciplinary outlets outside mainstream conservation, which often document community-led or Indigenous perspectives on justice. Second, our operationalisation of recognition justice was constrained to levels of participation in research processes. While this provides a pragmatic indicator, it is an imperfect

proxy that risks overlooking deeper relational and epistemic dimensions of justice, such as the quality of participation, the recognition of diverse worldviews, or the persistence of colonial legacies in conservation (Pellow, 2018; Schlosberg, 2007). Future research could address these shortcomings by explicitly engaging with epistemic justice concepts and by exploring how power asymmetries shape conservation decision-making regarding whose knowledge counts. Beyond the three widely used dimensions of distributive, procedural, and recognition justice, emerging strands of environmental justice scholarship — such as relational justice (Lejano and Ajaps, 2018), intersectionality (Di Chiro, 2020; Malin and Ryder, 2018), and transformative governance (Chaffin et al., 2016; Newell et al., 2021) — offer promising ways to expand the analytical scope of human-wildlife conflict research and better capture the complex, layered nature of environmental injustices.

5. Conclusions

This research contributes to the conservation literature by integrating emerging perspectives such as environmental justice and social-ecological systems. Viewing human–wildlife conflicts through a SES lens highlights the need to integrate social and cultural norms into conflict analysis. Furthermore, adopting an environmental justice perspective enables a deeper understanding of power imbalances and differences in attitudes and values between actors.

Building on these insights, future HWC research should move beyond identifying justice gaps and adopt more context-sensitive and justice-oriented methodological approaches. Specifically, approaches such as participatory action research and co-designing solutions can ensure that research not only identifies inequities (distributive justice), but also empowers communities in decision-making (procedural justice) and recognizes their knowledge and values (recognition justice). In this way, the study of HWC can become a tool for social change, helping to build conservation governance that not only protects biodiversity but also promotes more just and equitable outcomes. Transforming the way we research and manage conflicts means giving space to the voices and knowledge of those who live most closely with wildlife. This will allow us to design conservation strategies that are both ecologically sound and socially just.

CRediT authorship contribution statement

Daniela Alba-Patiño: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Berta Martín-López:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Miguel Delibes-Mateos:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Juan M. Requena-Mullor:** Writing – review & editing, Writing – original draft, Software, Formal analysis. **Antonio J. Castro:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.biocon.2025.111515.

Data availability

No data was used for the research described in the article.

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