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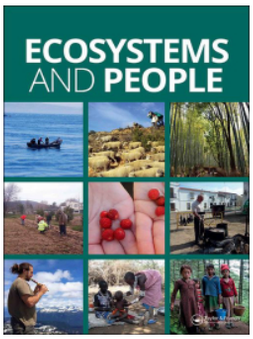

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REVIEW

The role of wetland birds in biocultural conservation: analysing global discourses and practices on species and ecosystems

Paola Araneda [a,b,c], Peter Bridgewater [d], José Cristóbal Pizarro [c,e] and José Tomás Ibarra [a,b,f]

[a]ECOS (Ecosystem-Complexity-Society) Co-Laboratory, Center for Local Development (CEDEL) & Center for Intercultural and Indigenous Research (CIIR), Villarrica Campus, Pontificia Universidad Católica de Chile, Chile; [b]Department of Ecosystems and the Environment, Faculty of Agriculture and Natural Systems & Center of Applied Ecology and Sustainability (CAPES), Pontificia Universidad Católica de Chile, Chile; [c]Instituto de Ecología y Biodiversidad, Santiago, Chile; [d]Centre for Heritage and Museum Studies, Australian National University, Canberra, Australia; [e]Laboratorio de Estudios del Antropoceno, Facultad de Ciencias Forestales, Universidad de Concepción, Concepción, Chile; [f]Cape Horn International Center for Global Change Studies and Biocultural Conservation (CHIC), Universidad de Magallanes, Puerto Williams, Chile

ABSTRACT

Biocultural approaches for conservation weave knowledge systems of both Indigenous Peoples and Local Communities (IP&LCs) with scientific insights to address environmental justice and promote local and global sustainability. Enduring people-nature relationships, particularly through wetland birds, hold both ecological and cultural significance that can guide wetland conservation efforts. We conducted a systematic review of biocultural research literature published between 2000 and 2023, following PRISMA guidelines. This review identified 414 publications that addressed taxa, ecosystems, and biocultural discourses. The publications spanned 96 countries, with Mexico, the United States, and India having the highest numbers of studies. This is consistent with the ethnobotanical research tradition from the dominant anthropological discourse. Post-2010, an ethico-political dimension emerged from intergovernmental agreements and advocacy by IP&LCs, particularly from Latin America and Australasia. As essential socio-ecosystems and culturally significant taxa, wetlands and birds possess profound ecological and cultural values. The tangible and intangible meanings of wetland birds for IP&LCs highlight the importance of integrating biocultural approaches into conservation policies, strategies, and management to encompass diverse discourses, species, and ecosystems. Diversifying biocultural conservation discourses can address research and practice gaps, helping scholars and policymakers adapt to regional contexts, develop effective conservation strategies that support community welfare, and uphold IP&LC rights. By embracing diverse worldviews, conservation science and practice can become pluralizing and just, and assist thus the world in transformative change.

KEY POLICY HIGHLIGHTS

- Wetland birds biocultural conservation research lacks sufficient representation in academic literature, resulting in poor knowledge-policy links, neglecting the ecological and cultural relevance of people-bird relationships in wetlands for sustainability.
- Biocultural conservation that addresses research and practice gaps, enables adaptation to diverse contexts, develops community-supportive conservation strategies and advances IP&LCs rights.
- To ensure equitable representation of both species and socio-ecosystems in conservation, biocultural approaches must be implemented.
- Discourse diversification can help fill pending research and management gaps, improving thus the pluralised and just conservation success.

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1. Introduction

People and birds have coexisted for millennia (Fjeldså 2007). As mobile species, birds perform essential ecological and cultural functions widely appreciated by people worldwide (Pizarro and Larson 2017). Seed dispersal, control of plague species, pollination, aesthetic delight and amusement, and ecosystem engineering are ecological, social, and cultural benefits that people obtain from birds (Whelan et al. 2008; Wenny et al. 2011). Birds that guide and facilitate people's search for food while benefiting from easier access to resources or being held as sacred within the people's knowledge system, exemplify close reciprocal human-bird relationships (Spottiswoode et al. 2016; Sault 2020; Ojeda et al. 2022; Levey et al. 2023). In these and many other ways, birds reflect the state of environmental conditions across landscapes and the diversity of local knowledge systems these landscapes encompass (Echeverri et al. 2020).

CONTACT Paola Araneda paola.araneda@uc.cl
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A crucial ecosystem that embraces both people and birds is wetlands, which are permanent or transient habitats connecting landscapes, biodiversity, and human experiences (Pizarro and Larson 2017). Wetlands support a considerable number of terrestrial and aquatic bird species, providing habitats for breeding, nesting, feeding, and rearing young (Ramsar 1971; Kleijn et al. 2014). In addition, wetlands are social-ecological systems as their biophysical components (e.g. water, biodiversity, and ecosystem function) interact regularly and at different scales with socio-cultural elements (e.g. human settlements, food and shelter) (Redman et al. 2004). Wetland birds play vital biocultural roles in diverse cultural beliefs worldwide (Green and Elmberg 2014; Rahman et al. 2022). Human perceptions of these birds aid in comprehending ecological, socio-cultural, and population dynamics (Tarakini et al. 2018), as well as informing spiritual, traditional, and symbolic practices and meanings (Alcántara-Salinas et al. 2022).

Global wetland degradation threatens wetland species, but especially wetland birds that depend on several wetlands for their life cycle. Due to their ecological and cultural functions, for productive and spiritual interests (Pyke et al. 2018), wetland degradation also compromises the livelihood of Indigenous peoples and local communities (IP&LCs) in their cultural heritage and resource access (Verzijl and Quispe 2013). Biocultural approaches to conservation refer to actions targeting both the biophysical and sociocultural components of social-ecological systems (Gavin et al. 2015). These approaches emphasize the recognition of diverse worldviews that shape our understanding of nature and humanity while integrating efforts across local, regional, and global scales to sustain these attributes (Ibarra et al. 2023; Burke et al. 2023).

The importance of Indigenous and Local Knowledge (I&LK) in conservation science and practice has gained increasing recognition in the scientific literature (Hill, Adem, et al. 2020; Tengö et al. 2021). Furthermore, I&LK – sometimes more narrowly referred to as Traditional Ecological Knowledge – encompasses a broad spectrum of relevant knowledge and practices, beyond ecological science. This includes crucial insights into decision-making processes embedded within cultural governance systems, which are essential for conservation and the pursuit of sustainable futures (Fernández-Llamazares et al. 2015; McMillen et al. 2020). Furthermore, I&LK also reflects the agency of knowledge holders and aligns with intergovernmental platforms and organizations, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Tengö et al. 2017; Díaz et al. 2018). These knowledge systems also consolidate participatory development and bottom-up governance (Heckler 2009), while they offer a culturally grounded understanding of biocultural diversity (Oloriz and Parlee 2020). Co-production of knowledge embracing I&LK and scientific knowledge, with their similarities and differences, has increased the effectiveness of conservation plans. This approach fosters environmental justice and pluralisation, avoiding the erosion of biological and cultural diversity (Wengerd and Gilmore 2022; Ibarra et al. 2023).

The broad spectrum of knowledge, practices, and policies promoted by biocultural approaches has resulted in a growing body of literature, with different discourses varying across academia, practice, and governance (Merçon et al. 2019). In academia, there is a focus on understanding the dynamics and relationship between biological and cultural diversity and how they each contribute to conservation efforts (Ortega-Álvarez and Casas 2023). In practice, efforts are made to weave I&LK and cultural values into conservation actions and planning, often aiming for outcomes desired by IP&LCs (DeRoy 2019). Policy discussions frequently revolve around recognizing and weaving I&LK into biodiversity conservation programs (Wall et al. 2023).

These ideas can be combined into four primary biocultural discourses (Merçon et al. 2019): an epistemic dimension, namely (1) social-ecological and (2) anthropological perspectives, and an ethico-political dimension, encompassing (3) social rights (bottom-up) and (4) intergovernmental (top-down) approaches. These four discourses reflect different perspectives and priorities for conservation, converging in the local and global desire for sustainability and concern for the consequences of the biocultural diversity loss (Gavin et al. 2015; Parks 2018). Identifying the dominant discourses reveals an important part of biocultural conservation because such discourse shapes how social-ecological concerns are understood, and thus creates and limits spaces for collective and individual action (Cairns et al. 2014).

Despite conservation studies recently embracing biocultural approaches, based on a plethora of different discourses (Wolverton et al. 2014; Burke et al. 2023), the origin of these discourses has been scarcely addressed. Understanding the extent of the literature on biocultural conservation of wetland birds is a tool for academics and decision-makers to recognise the gaps and their challenges in conservation science and practice. In this study, we analysed biocultural approaches used for species and ecosystem conservation, with a particular focus on wetland birds. Specifically, we sought to (1) understand the spatio-temporal distribution of biocultural approaches in conservation research and which discourses have been used, (2) analyse the extent to which species and ecosystems were present in biocultural conservation research and (3) discuss how birds have been addressed within biocultural approaches to conservation in threatened wetland ecosystems. Accordingly, we reviewed the

representation of birds in typical ecosystems featured in global biocultural conservation research. Specifically, we highlight the disparity in attention given to birds and wetlands, compared to the attention given to other taxa and ecosystems. Additionally, our study emphasises the significance of adopting multi-dimensional discourse perspectives to resolve the challenges associated with biocultural approaches to conservation.

2. Methods

2.1. Literature review

We conducted an Internet-based search for peer-reviewed journal articles (hereafter publications) that examined species and ecosystems in biocultural research. Following the formal systematic review guidelines of Haddaway and Bayliss (2015), we combined English and Spanish keywords, including 'biocultural' (and 'bio-cultural'), 'species' and 'ecosystem'. We reviewed the literature published from 1 January 2000 to 20 August 2023 in the Web of Science (2023) and Scopus (2023) database. We also included other relevant papers that were not captured in the initial search. The systematic review was developed following the Preferred Reporting Items for Systematic Reviews (PRISMA) Statement (Page et al. 2021; Figure 1). PRISMA comprises a minimum set of items rooted in evidence for transparent reporting in systematic reviews. The search identified 859 publications, of which 790 were screened. Subsequently, 414 publications (Supplementary materials, Appendix 1) were included in the review, and the

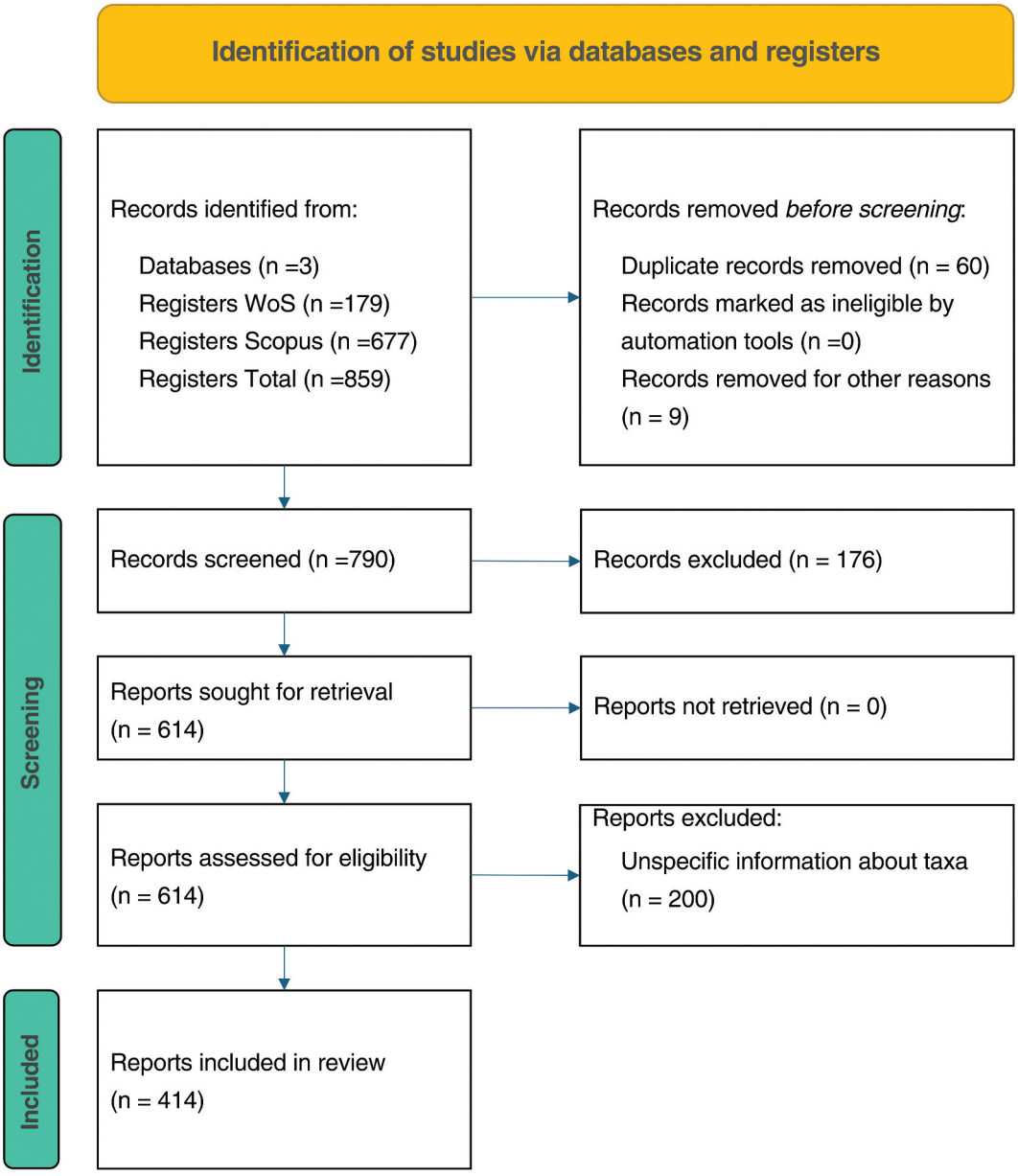

Figure 1. The PRISMA flow diagram shows the procedure followed in this study.

rest were excluded because they were duplicated, belonged to another discipline, or presented a lack of specific information. Each publication was screened by an author, with the results subsequently pooled.

2.2. Data analyses

Each publication was exhaustively reviewed to extract the spatio-temporal biodiversity information and the discourse dimension to which it referred. The spatial analysis was made including the countries where the study was carried out. Papers were categorised using the framework of Merçon et al. (2019), who identified four major biocultural discourses for conservation purposes, emphasizing epistemic and ethico-political dimensions. The epistemic dimensions included social-ecological and anthropological discourses, while the ethico-political dimension emphasised social rights (bottom-up) and (2) intergovernmental (top-down) discourse. Taxa were identified as follows: (1) terrestrial invertebrates; (2) marine and freshwater species, including marine and inland water fish, and marine and inland water algae; (3) amphibians; (4) marine and terrestrial reptiles; (5) marine and terrestrial birds; and (6) marine and terrestrial mammals, with 'terrestrial' comprehending freshwater ecosystems. Ecosystems were classified as (1) wetlands – following the Ramsar definition (Ramsar 1971); (2) forests; (3) anthropogenic landscapes (rural and urban ecosystems); (4) mountains; (5) coastal areas; (6) grassland and savannas; and (7) arid or semi-arid ecosystems. We used alluvial plots to illustrate the relationships among taxonomical groups and ecosystems visually. The alluvial plots were developed utilising the 'ggplot2' and 'ggalluvial' packages within the R software, version 4.2.0 (R Core Team 2024).

3. Results

3.1. Spatio-temporal and discourse analyses

Our systematic literature review resulted in a list of 414 publications containing biocultural research information. Of these references, 177 (42.9%) referred explicitly to biocultural conservation, restoration, or management plans. This review includes publications from 96 countries, where Mexico ($n = 61$), the United States ($n = 36$), and India ($n = 21$) were where most biocultural research was developed (Figure 2, Supplementary materials, Appendix 2).

The temporal distribution shows the number of publications annually. Publication rates vary through time; between 2000 and 2010, the yearly average of publications was 0.9, while between 2011 and 2022, the average was 29.5 publications per year (Figure 3). As of the conclusion of this review, the year 2023 has accounted for 64 publications. The rate of publication increased markedly from 2016. Early works in our review approached the inclusion of biocultural perspectives for conservation within national and international organisations and conventions, such as the Convention on Wetlands (RAMSAR 1971) and the Convention on Biological Diversity (CBD). Other authors emphasised the need for the conservation of agrobiodiversity and the restoration of food traditions (Nabhan et al. 2010, Shen et al. 2010).

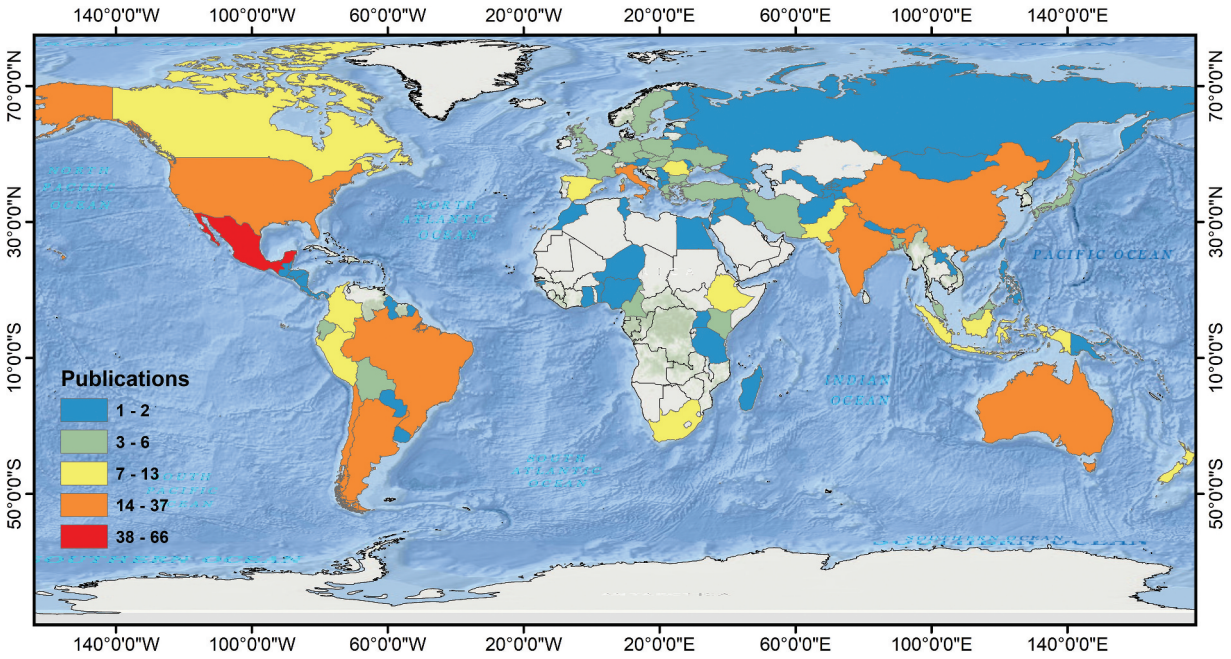

Figure 2. Spatial distribution by country of 414 worldwide publications between 2000–2023 included in this study.

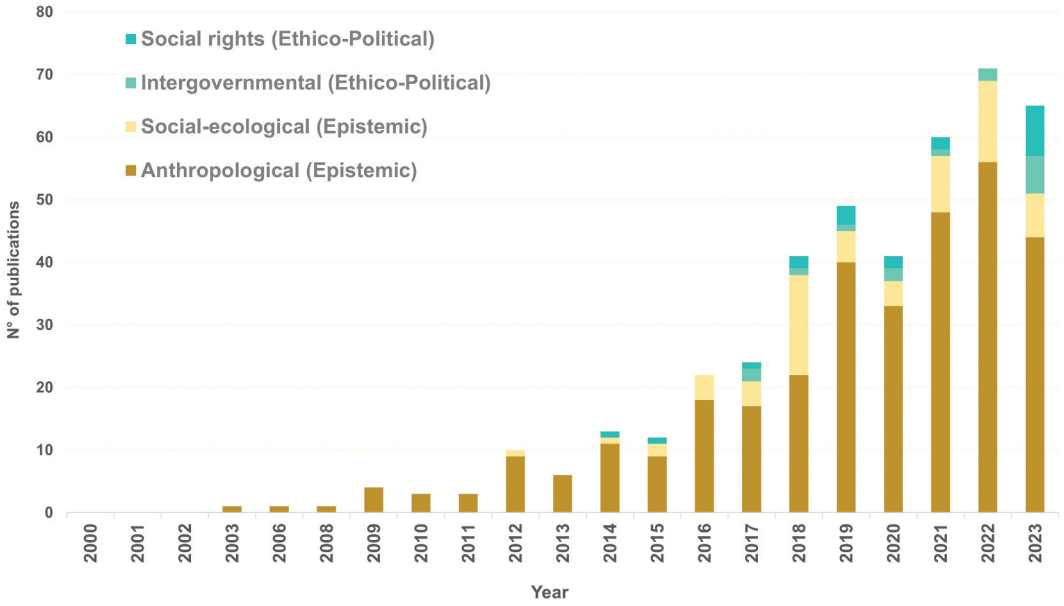

Figure 3. Temporal distribution of publications reviewed between 2000 and 2023, showing temporal trends in biocultural research globally by discourse dimension.

Using the framework of Mercon (2019) this review confirmed the two dimensions (epistemic and ethico-political) each with its two discourses (namely social-ecological; anthropological; social rights; and intergovernmental). The anthropological discourse (76.9%) was encountered much more frequently than the social-ecological discourse (15.1%) (Supplementary materials, Appendix 3). The ethico-political dimension had considerably fewer publications, most addressing social rights discourse (5.0%) and intergovernmental discourse (3.3%). In a temporal analysis, the anthropological discourse dominated from the early years of this review period (2003), where researchers in, e.g. Bangladesh, Indonesia, Guyana, and China published on ethnobotany, agrobiodiversity and biocultural conceptualisations in early 2000 (Amin 2003; Platten and Henfrey 2009; Shen et al. 2010). Meanwhile, the social-ecological discourse was emphasised in publications from 2012, when resilience and sustainability became the focus (Calvet-Mir et al. 2016; Chan et al. 2016). In 2014, the ethico-political dimension appeared in publications emphasising the social rights discourse. These publications highlighted the rights of IP&LCs to access natural resources and self-governance, especially in South American countries and Japan (Cámara-Leret et al. 2014; Fukamachi 2017). In 2017, intergovernmental publications on biocultural conservation began to appear, focusing on the effects of intergovernmental policies (e.g. CBD, IPBES, and UNESCO) and biocultural diversity loss in Peru, Palestine and Chile (Angé et al. 2018; Hill et al. 2019; Méndez-Herranz et al. 2023; Qumsiyeh et al. 2023).

3.2. Taxonomic and ecosystemic distribution of biocultural studies

This analysis showed that 66.7% of taxa used in biocultural studies are terrestrial plants (and their products, e.g. seeds and fruits - Figure 4). Terrestrial invertebrates, vertebrates, and fungi represent 27.4% of the reviewed studies. Vertebrate taxa with the highest representation are mammals and birds, with 8.7% and 6.7%, respectively. Less represented taxa are reptiles and amphibians, with 2.8% and 1.3%, respectively. The 5.0% of the publications deal with marine and freshwater species. Marine and freshwater species were represented by marine vertebrate species with 2.6%, while marine plants and freshwater plants represented 0.7% of taxa.

Birds in biocultural conservation research are reflected mainly through use in the food traditions of the Americas (Nabhan et al. 2010), socio and ethno-ornithology (intergenerational dialogues with Indigenous communities about forest birds in Wallmapu, Chile, Ibarra et al. 2022) or the local perceptions of the Andean condor in central Argentina (Manzano-García et al. 2017). Birds have also been documented in biocultural restoration in New Zealand and Australia. These projects aim to repair damage caused by non-Indigenous people to ecosystems by incorporating the return of harvesting practices or traditional life patterns for Indigenous communities (Wehi and Lord 2017).

On the other hand, the reviewed research showed that rural and urban anthropogenic landscapes dominate the publications with 48.6% (Figure 4). Forests are the second most discussed ecosystem in the assessed publications, with 27.5%, while wetlands make up 8.5%. The remainder, composed of mountains, coastal, and low vegetation cover

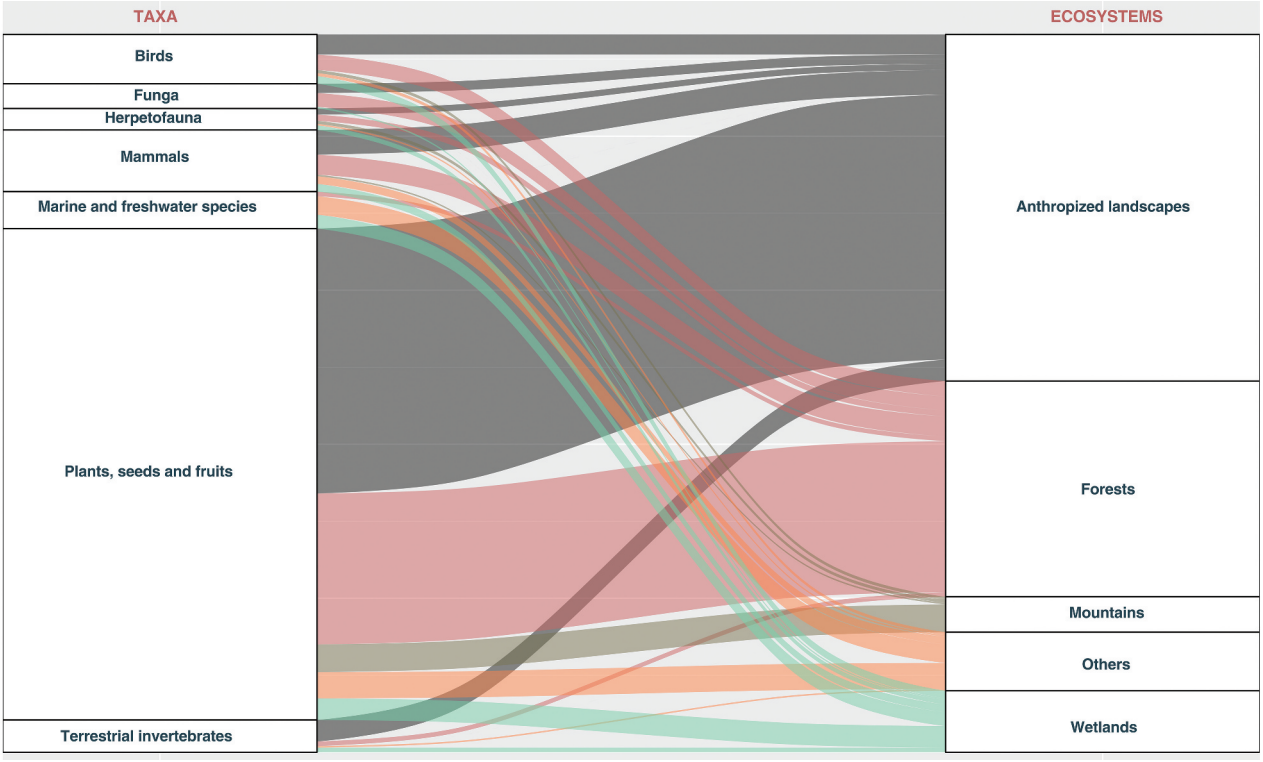

Figure 4. Distribution and connections of taxa and ecosystems of reviewed publications. The left column represents the categories of taxa found in the review, while the right column represents the main ecosystems. The ecosystem 'others' includes grassland and savannas, coastal, and arid or Semi-arid ecosystems.

ecosystems, represent 14.6% of publications. This bibliographic analysis on biocultural approaches to conservation showed low rates of bird studies in wetland ecosystems (1.1%). Most bird research was conducted in anthropogenic landscapes (2.8%) and forests (2.2%).

Research publications on biocultural approaches in wetland conservation included diverse subjects. These include the cultural values of wetlands in Nepal (Rai 2006) or the existence of 'wetland spirits' associated with particular conservation of wetland ecosystems in Peru (Fabiano et al. 2021). Indigenous rights to access wetland species have been addressed in Australia (Ligtermoet et al. 2023). Furthermore, wetland research includes examples of local management and bioindicators in Brazil (Azevêdo et al. 2018). It also explores biocultural management for agriculture in Mexico (Peraza-Villarreal et al. 2019) and restoration efforts in Hawai'i (Möhlenkamp et al. 2019). Additionally, studies on river governance highlight the consideration of water as an active partner in human and non-human species relations (Strang 2023).

3.3. Approaches to biocultural conservation of wetland birds

Despite the wealth of publications on biocultural approaches described above, there were rather few publications ($n = 5$), examining biocultural conservation research focusing on birds in wetlands. We found a predominance of management practices based on I&LK in wetlands threatened by social-ecological changes and habitat loss (Valasiuk et al. 2018; Herse et al. 2021, 2022). At the same time, reviewed actions and practices developed by IP&LCs contribute to positive feedback between people and other components of nature. For example, Ahmed et al. (2022) reported that wetland birds are part of cultural identity, conferring nature contributions to people through recreation, family time, spirituality, and connection to the environment.

Our review highlights local efforts to maintain wetland ecosystems as providers of wild traditional foods, and local efforts to protect endangered bird species. One example is people's efforts to actively conserve wetlands that are the habitat of the Aquatic Warbler (*Acrocephalus paludicola L.*), in Belarus (Valasiuk et al. 2018), being willing to pay for appropriate conservation programs. In New Zealand, Herse et al. (2022) worked with a Māori community to develop a demographic model for sustainable harvesting of Black Swan (*Cygnus atratus*) eggs, a situation also documented for the Moulting Lagoon Ramsar Site in Tasmania (DCCEEW 2007). A study in the United States has shown that wetlands provide habitat for some birds that are basic components of the traditional and Indigenous food systems of local communities (Ahmed et al. 2022).

4. Discussion

This study shows that biocultural conservation efforts focusing on long-term human-bird relationships in vulnerable ecosystems, such as wetlands, are notably underrepresented in the literature. Wetland birds are considered culturally significant (Tidemann and Gosler 2010), strong indicators of environmental change (Fraixedas et al. 2020), and highly threatened by climate and land-use changes (Northrup et al. 2019; WWF 2024). Despite this, their potential importance in biocultural conservation has rarely been explored. On the other hand, an ethico-political discourse dimension emerged the last decades due to intergovernmental agreements and IP&LC advocacy. Biocultural discourses played a crucial role in advancing the causes of Indigenous and local community rights and shaping the priorities of environmental civil society organisations (Sault 2018).

4.1. Spatio-temporal analyses

The spatio-temporal analyses showed a remarkable increment in biocultural conservation research between 2000 and 2023, with an increasing number of publications from the Americas, Asia, and Oceania. The inception of the biocultural approach emerged within the realms of biological and ecological anthropology during the dynamic period spanning the 1960s to the 1980s. This period was notably marked by pivotal events such as the Declaration of Belém in 1988 (Zuckerman and Martin 2016). However, it's in the contemporary discourse that its significance in conservation has garnered substantial attention. This resurgence is largely attributable to the flourishing discourse surrounding biocultural approaches, especially prominent within the North American anthropological tradition (e.g. Maffi 2005). Moreover, its evolution finds resonance in the discourse of international conventions, further solidifying its stance and relevance in the global conservation narrative (Bridgewater and Rotherham 2019).

Our review demonstrates that globally, Mexico had the highest number of publications concerning biocultural approaches to conservation. Mexico has contributed significantly to the development of biocultural conservation by exploring the correlation between high diversity in both species and languages (Linares-Rosas et al. 2021). This correlation has been discussed in several studies, emphasising the interconnectedness of biological and cultural aspects (Grant 2012). González-Rivadeneira (2023), indicates that there are two main reasons why Mexico developed research on biocultural approaches, becoming a 'laboratory of ideas'. On the one hand, it was due to the social movement demanding social justice for IP&LCs dating from 1990, and on the other hand, to the rise and development of the social-environmental movement, which resulted from cooperation on initiatives between civil society, academia, and the political establishment (Léonard and Foyer 2011).

The significance of biocultural approaches is acknowledged not only in Latin America but also in Oceania and Asia. In these regions, historical and geographical trajectories inextricably intertwine cultural and biological diversity. Moreover, questions regarding the complementarity of I&LK mirror those raised in Latin America, where the contribution to the development of biocultural understanding is not exclusively thanks to academia, but local and regional organisation (Vidal and Brusca 2020; González-Rivadeneira 2023). In Australia, the work of many researchers engaged with Indigenous communities increased the rates of publications from the 1990s until the present, with a clear focus on identifiable Indigenous authorship (Ens et al. 2015). China also registered with a high rate of biocultural research in our study. Hathaway (2012) referred to the role of Chinese scholars and members of international NGOs in highlighting the importance of IP&LCs in the management and defence of biocultural diversity. Italy was the European country with most biocultural contributions in our review. Factors such as human migration, isolation, and natural selection generated by the interaction of geography, environment, and culture have promoted a complex human-nature relationship (Anagnostou et al. 2022, Nazari et al. 2023). Italian policies, like the National Strategic Plan for Rural Development 2007–2013, promoted by the Ministry of Agriculture, supported conservation and planning efforts for rural landscapes and their complexities (Agnoletti 2013).

4.2. Biocultural conservation discourses

Over time, biocultural conservation discourses have primarily focused on epistemic dimensions, such as anthropological and socioecological aspects. In contrast, ethico-political dimensions, including social rights and international policy, have remained a minority focus, although emerging more significantly in the last two decades. Epistemic dimensions primarily originate within academia and target academic audiences, with limited influence on policymakers and IP&LC. In contrast, research addressing ethico-political dimensions have a more diverse origin, weaving contributions from IP&LC movements and scholarly work. This type of research is more targeted toward non-governmental organisations and policymakers, aiming to influence the

improvement of rights and policies across scales (Wolverton et al. 2014; Merçon et al. 2019).

In the Global South, particularly in Latin America, biocultural discourses play a crucial role in advancing the causes of IP&LCs rights and shaping the priorities of environmental civil society organisations (Sault 2018). The rise of an ethico-political dimension highlights how IP&LCs worldwide have developed local institutions, offering lessons on balancing people and nature through their maintenance and adaptation (Montgomery and Vaughan 2018). Zanotti (2018) highlights the growing need and application of frameworks to address power, rights, and Indigenous perspectives in local to global environmental problems. Dominant discourses can influence government decisions and scholarly interests, focusing on some taxa and ecosystems and excluding the less representative, influencing the perception and conceptualisation of biocultural systems (Parks 2018). This is due to discourses not being inactive narratives, but a functioning and dynamic whole with the capability to influence material practices and power relations (Feindt and Oels 2005). Discourse diversification with a focus on biocultural approaches will promote the filling of pending research and management gaps improving the conservation success.

4.3. Taxonomic and ecosystem representation

Lack of robust biocultural approaches in designing conservation plans, especially for wetlands, has reduced their conservation success. It has created barriers to the implementation of conservation in territories where management over millennia has been developed by IP&LCs (Deroy et al. 2019). Wetlands as social-ecological systems are considered fundamental in supporting human well-being and development (Pyke et al. 2018). They are also ecosystems highly vulnerable to the effects of climate change, paradoxically also helping in adaptation to climate and other negative global changes (Moreno-Mateos et al. 2012; Mendez et al. 2012; Clarkson et al. 2013) but are not sufficiently represented in the academic literature underpinning biocultural conservation.

This study found that biocultural approaches to conservation focused largely on researching edible plants and vegetable products used by people in anthropogenic landscapes, such as rural and urban environments. On the other hand, fauna and fungi species from threatened ecosystems remain understudied in biocultural approaches to conservation. These results are coherent with the findings of Reyes-García et al. (2023), who found that a list of culturally important species is dominated by terrestrial plants contrasting with a low representation of vertebrates and invertebrates. The bias in taxonomic representation in research has been addressed by Rozzi (2019), who defines it as 'taxonomic chauvinism' or the overrepresentation of particular taxa excluding the diversity of others. Although Rozzi (2019) refers to the dominance of vertebrates in philosophical research, we show that the mental images of edible plants and vegetable products prevail in biocultural approaches to research.

The focus on biocultural conservation of plants, fruits, and seeds in anthropic landscapes aligns with the dominance of anthropological perspectives in discourses. These findings demonstrate the role of traditional agriculture in biocultural heritage conservation by reflecting the intimate relation between people and local ecosystems (Kaulen-Luks et al. 2022). Traditional agricultural systems are integral to conserving and transmitting knowledge about sustainable farming practices and biodiversity (Cortés et al. 2023). These systems contribute to the unique biocultural heritage of communities worldwide, emphasising the interdependence of culture and nature (Agnoletti and Santoro 2022). The extended effort in biocultural conservation of edible plants and their products in anthropic landscapes must be replicated for other taxa and highly vulnerable ecosystems. This is crucial to avoid the loss of biocultural knowledge, which can change human perception of these organisms, leading to increasing disconnection from nature (Cicero et al. 2019).

Underrepresented taxonomic groups in our review, such as reptiles, amphibians and terrestrial arthropods, are threatened by global change (Roll et al. 2017; Halsch et al. 2021; Button and Borzée 2021). However, they are poorly addressed in biological (Valencia-Aguilar et al. 2013; Perennes et al. 2023) and cultural (Alves and da Silva Policarpo 2018; Reyes-García et al. 2023) research for conservation. More research and practice must be implemented to maintain I&LK and its subsequent relationship with biocultural heritage locally and globally, or both biodiversity and cultural diversity risk being lost.

4.4. Policy and management implications

Our results are consistent with the findings of Lukawiecki et al. (2022), who demonstrated the application of biocultural theory to conservation in the academic literature. Their findings suggest an increased use of biocultural approaches in recent decades. We found insufficient application of biocultural efforts for bird conservation in wetland ecosystems, making it difficult to operationalise bird conservation through effective policies, management, and research. Lack of documentation and maintenance of I&LK concerning wetlands birds limits the ability of decision-makers to establish effective biocultural conservation policies. It also hinders the official recognition of IP&LCs in conserving key socio-ecosystems. The inclusion of biocultural approaches

in official national conservation plans, as well as within international organisations and conventions, has been a recurring theme throughout the period covered in our review. However, despite the progress made in this regard (Thornton et al. 2020), biocultural approaches to conservation of wetlands birds remain a challenge for local (Herse et al. 2022; Ma et al. 2022; Strang 2023) and international initiatives (Bridgewater and Kim 2021).

Effective conservation and management practices are essential for maintaining the biocultural value of wetland birds, which need to focus on place-based and participative management actions. The identified gap in the biocultural conservation of wetland birds leads to weak connections between knowledge and policy, overlooking the biocultural significance of human-bird relationships for sustainability. Recognising the cultural value of wetland birds can enhance the support engagement of IP&LCs for conservation initiatives implemented in their territories, thereby fostering active participation (Hill et al. 2019; Lyver et al. 2019). This can be promoted by including IP&LCs in decision-making to ensure that conservation initiatives align with their needs. These cultural connections can inspire IP&LCs to actively engage in conservation efforts. For example, collaborative work on the migratory shorebird Far Eastern Curlew (*Numenius madagascariensis*) not only strengthened conservation value of the species but also enhanced the self-determination of an Indigenous Ranger group (Lilleyman et al. 2022).

Incorporating ethico-political discourses into research can enhance its impact on conservation and management efforts while prioritising social justice and the rights of IP&LC in decision-making. This requires identifying the social, cultural, and political dimensions relevant to the conservation issue and understanding how policies and actions affect different stakeholders, particularly marginalised groups (Lam et al. 2020). Facilitating the co-production of knowledge ensures that ethico-political dimensions are authentically represented (Hill, Walsh, et al. 2020). This is in accordance with current thinking on the need for transformative change to create a more sustainable world. Thus, a biocultural approach to wetland bird conservation that incorporates ethico-political discourses benefits both the species and their habitats while legitimising I&LK and land use practices (Dawson et al. 2024). Using biocultural discourses is particularly helpful in emphasizing these perspectives in governance and practice (Zanotti 2018), contributing to a social construction that can influence international negotiating settings (Hughes and Vadrot 2019). They also foster paradigms that weave IP&CLs' strategies into broader approaches for sustainable living such as 'buen vivir' (*Sumak Kawsay or Suma Qamaña*) (Villalba 2013).

Academic and IP&LCs collaboration emphasises the importance of weaving I&LK and Western science to achieve optimal outcomes for management and conservation (Tengö et al. 2021). The challenge lies in recognizing that I&LK and scientific knowledge are distinct yet equally legitimate knowledge systems (Tengö et al. 2014). This approach necessitates restructuring learning strategies to facilitate sustainability transformations (Ojeda et al. 2022). Educational initiatives play a vital role in ensuring that conservation efforts are not only ecologically sound but also culturally appropriate and sustainable in the long term (Tarakini et al. 2018; Hopper et al. 2019). The next steps in developing biocultural approaches to conservation should focus on strengthening initiatives that: (1) foster collaborative work with IP&LCs in the design and implementation of conservation policies from different discourses, (2) ensure equitable representation of species and socio-ecosystems and (3) establish effective strategies that promote human (especially Indigenous peoples) rights.

5. Conclusion

Although expanding globally, biocultural conservation literature remains focused on anthropology, ecology, and a narrow range of taxonomic groups and ecosystems. Integrating ethico-political discourses into research could significantly enhance its impact on conservation and management efforts while prioritising social justice and the rights of IP&LCs in decision-making processes. Despite being culturally significant and threatened by environmental and anthropogenic disturbances, wetland birds and their ecosystems are frequently overlooked yet could be a 'flagship' for prioritizing biocultural approaches. This study highlights a bias in the biocultural approach to conservation, focusing heavily on edible plants in anthropic landscapes, while fauna and fungi in crucial ecosystems remain understudied. This ethnobotanical focus has historically dominated biocultural research, reflecting the anthropological origins of the biocultural approach. Enabling a sustainable future for people and the ecosystems they depend on demands an expansion of these efforts to include diverse taxa and vulnerable socio-ecosystems.

Within I&LK, birds are intricately linked to the cultural practices and identity of people, while wetlands provide nature's contributions to people entwined with productive and spiritual interests. As critical socio-ecosystems, wetlands have ecological and cultural significance, emphasising the importance of incorporating biocultural approaches in conservation strategies for long-term sustainability. Birds are excellent species for biocultural conservation efforts

due to their tangible and intangible meaning to IP&LCs. Those meanings of birds and wetlands underscore the importance of incorporating biocultural approaches into conservation strategies, encompassing diverse discourses, species, and ecosystems. This integration is crucial for ensuring long-term sustainability by respecting and leveraging the deep connections between people and nature. Integrating ethico-political discourses and ensuring equitable representation of species and ecosystems in biocultural conservation will enable scholars, civil society, and policymakers to adapt to diverse regional contexts. This approach fosters the development of pluralistic strategies that support community welfare, promote environmental justice, and uphold the rights of IP&LCs.Endnote: In this work, we use IP&LC and I&LK (instead of IPLC and ILK) to explicitly distinguish between local people and Indigenous communities following the recommendations from Cultural Survival and First Peoples Worldwide (2022).

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ORCID

Paola Araneda http://orcid.org/0000-0001-5054-7627
Peter Bridgewater http://orcid.org/0000-0001-7972-5386
José Cristóbal Pizarro http://orcid.org/0000-0002-5240-2816
José Tomás Ibarra http://orcid.org/0000-0002-7705-3974

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