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PREVIEW ISSUE

IUCN PROTECTED AREA DEFINITION, MANAGEMENT CATEGORIES AND GOVERNANCE TYPES

IUCN defines a protected area as:
A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.

The definition is expanded by six management categories (one with a sub-division), summarized below.

Ia Strict nature reserve: Strictly protected for biodiversity and also possibly geological/ geomorphological features, where human visitation, use and impacts are controlled and limited to ensure protection of the conservation values.

Ib Wilderness area: Usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, protected and managed to preserve their natural condition.

II National park: Large natural or near-natural areas protecting large-scale ecological processes with characteristic species and ecosystems, which also have environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.

III Natural monument or feature: Areas set aside to protect a specific natural monument, which can be a landform, sea mount, marine cavern, geological feature such as a cave, or a living feature such as an ancient grove.

IV Habitat/species management area: Areas to protect particular species or habitats, where management reflects this priority. Many will need regular, active interventions to meet the needs of particular species or habitats, but this is not a requirement of the category.

V Protected landscape or seascape: Where the interaction of people and nature over time has produced a distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.

VI Protected areas with sustainable use of natural resources: Areas which conserve ecosystems, together with associated cultural values and traditional natural resource management systems. Generally large, mainly in a natural condition, with a proportion under sustainable natural resource management and where low-level non- industrial natural resource use compatible with nature conservation is seen as one of the main aims.

The category should be based around the primary management objective(s), which should apply to at least three-quarters of the protected area – the 75 per cent rule.

The management categories are applied with a typology of governance types – a description of who holds authority and responsibility for the protected area.

IUCN defines four governance types.

Governance by government: Federal or national ministry/agency in charge; sub-national ministry/agency in charge; government-delegated management (e.g. to NGO)

Shared governance: Collaborative management (various degrees of influence); joint management (pluralist management board); transboundary management (various levels across international borders)

Private governance: By individual owner; by non-profit organisations (NGOs, universities, cooperatives); by for- profit organsations (individuals or corporate)

Governance by indigenous peoples and local communities: Indigenous peoples' conserved areas and territories; community conserved areas – declared and run by local communities.

For more information on the IUCN definition, categories and governance type see the 2008 *Guidelines for applying protected area management categories* **which can be downloaded at: www.iucn.org/pa_categories**

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PARKS is published to strengthen international collaboration in protected and conserved areas development and management by:

- exchanging information on practical management issues, especially learning from case studies of applied ideas;
- serving as a global forum for discussing new and emerging issues that relate to protected and conserved areas;
- promoting understanding of the values and benefits derived from protected and conserved areas to communities, visitors, business and others;
- ensuring that protected areas fulfil their primary role in nature conservation while addressing critical issues such as ecologically sustainable development, social justice and climate change adaptation and mitigation;
- changing and improving protected and conserved areas support and behaviour through use of information provided in the journal; and
- promoting IUCN's work on protected and conserved areas.

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PARKS: THE INTERNATIONAL JOURNAL OF PROTECTED AREAS AND CONSERVATION

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GUEST EDITORIAL: RECOGNISING THE BENEFITS OF PROTECTED AND CONSERVED AREAS FOR NATURE AND PEOPLE

John G. Robinson

Senior Conservationist Emeritus, Wildlife Conservation Society

Bio: John G. Robinson directed the Wildlife Conservation Society's conservation programs from 1990 to 2020. He has over 200 publications, including co-editing "Protected Areas. Are they safeguarding biodiversity?" (2016). He served as Vice President of the IUCN Council, and Councilor for North America and the Caribbean from 2012 to 2021.

Area-based conservation, through the establishment and management of protected areas, has been the cornerstone of modern conservation, but its importance is insufficiently recognised by politicians and policymakers.

Area-based conservation was highlighted at IUCN's First World Congress on National Parks in 1962, and promoted as a core conservation strategy at the 3rd World Parks Congress in 1982. While a diversity of management goals and authorities characterised protected areas (Dudley et al., 2010), generally these areas were legally established by governmental authorities for the "protection and maintenance of biological diversity" (IUCN, 1994), or the "conservation of nature" (Dudley & Stolton, 2008).

The ambition of area-based conservation expanded dramatically with the adoption of the Global Biodiversity Framework (CBD, 2020). Area-based conservation would now include both protected areas (generally understood to include the IUCN categories) but also other conserved areas, specifically "other effective area-based conservation measures" or OECMs. While all areas should demonstrably deliver on biodiversity outcomes, OECMs in particular also deliver on social goals, and include consideration of equity, rights and the distribution of costs and benefits.

The social implications of the expanded framework are explored in this issue of *PARKS* by Fajardo et al. and identify the critical role played by Indigenous peoples and local communiites in managing and restoring conserved areas. Ongoing work by IUCN's World Commission on Protected Areas (WCPA) seeks to define and categorise OECMs (IUCN, 2019). Not all areas that have the potential to be recognised as OECMs will be formally recognised as such. Inclusion of these conserved areas in, for example, national targets and global goals will often require that local customs are followed, and formal designations will need to be approved by relevant local actors, including Indigenous peoples. Nevertheless, area-based conservation efforts will include the traditional national parks but increasingly will extend to a huge range of categories of managed and conserved areas: nature reserves, sustainable development reserves, extractive reserves, community-based areas, Indigenous reserves, marine protected areas, *tabu* areas, and private reserves – to name just a few.

A common feature of all of these protected and conserved areas (increasingly referred to as PCAs) is that they have high ecological integrity. In common parlance, ecological integrity refers to how close a socio-ecological system is to its 'natural' state. However, most systems do not exhibit a single natural condition, and the dynamic nature of ecosystems arises in part from the interaction with human social systems, with all their different management and governance structures, cultural values and economic activities, as discussed by Rao et al in this issue. Ecological systems with high integrity are those whose structure, composition and functioning occur within the natural range of variation.

Where PCAs are aggregated together, effectively increasing the size and compactness, and decreasing the fragmentation of natural areas, and where they are physically or ecologically connected, this tends to create larger areas of high ecological integrity. The importance of area networks and ecological connectivity is explored by Laur et al. in this issue. Scaling up area-based conservation is increasingly a strategy to enhance the ecological integrity of natural areas (Robinson et al., 2024).

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Areas of high ecological integrity maintained by PCAs contribute to a wide range of ecological services (Watson et al., 2018). Such areas tend to both store and sequester more carbon than degraded areas, and thus contribute to climate change mitigation. By buffering people from extreme climate events, and by providing opportunities for people to develop alternatives, they allow people to adapt to changing conditions. Dudley, in this issue, examines how such areas contribute to climate mitigation and adaptation. Such areas also tend to have more faunal complexity, and the contribution of wildlife species to ecosystem services, particularly those related to climate change, has been well described (Timmins et al., 2024). In this issue, Timmins et al. examine wildlife's contribution to maintaining many ecological services. Areas with high ecological integrity disproportionately contribute to regulation and supply of freshwater and other hydrological services. Moberg et al., this issue focus on rivers, and their contribution to biodiversity conservation and the benefits they provide to people. Dobson focuses on the primacy of water, and argues that this benefit has a compelling, political value – more on that later. Areas of high ecological integrity are critical for biodiversity conservation, including avoiding species extinction, and maintaining community structure and composition (Betts et al., 2017). The contribution of PCAs to maintaining ecological integrity to reduce infectious disease risks and mitigate disease spillovers from wild species was repeatedly pointed out during the COVID-19 pandemic (Hockings et al., 2020). And natural areas with high ecological integrity are critical to the livelihoods and cultures of people who depend on the natural world, including Indigenous peoples (Adrachuk et al, this issue; Fa et al., 2020; Ng & Tan, this issue).

The rationale for establishing and maintaining PCAs as a mechanism to maintain ecological integrity, and the value of ecological integrity for a plethora of ecological services, are self-evident to most conservationists. And indeed, over the last 75 years there has been steady progress in establishing new internationally recognised protected and conserved areas. Nevertheless, the rate of growth in the number of such areas has been declining since the end of the last century, and political support for the establishment and maintenance of PCAs is waning in some quarters. Mascia and Pailler (2010) first described the phenomenon of "protected area downgrading, downsizing, and degazettement" (PADDD), and in recent years there have been concerns of a retreat from a number of promising conservation approaches (e.g. community-based natural resource management, payments for ecosystem services, eco-certification).

Government funding and support for PCAs increasingly are under threat. The United States historically has been an international leader in conservation, with bipartisan support for national parks and international initiatives. Under the present US administration however, support for the National Park Service, and for National Parks in general, has been significantly reduced (Schneid, 2025). The administration's abolition of USAID has had a dramatic impact on funding for conservation globally, including support for area-based conservation initiatives (Welz, 2025). This is having knock-on effects on the support for national and international conservation in the budgets of other national agencies. All of this is in the context of a steady erosion of natural areas in many parts of the world, a phenomenon termed 'ecocide' and described in this issue by Rallings and Caro.

The contradiction between the evident value of PCAs and the diminishment of their political and funding support, raises the question of what conservationists should do to address the issue. One answer is provided by Dobson in this issue of *PARKS*. He notes that ecological services like biodiversity conservation and mitigating climate change are abstract and not easily understood or quantified by political decision-makers. Politicians are focused on the short-term benefits which are relevant to their electorate. Dobson thus urges a focus on very tangible benefits provided by PCAs, such as the continuous supply of fresh, clean water, and argues that people, if they recognise the link to their own self-interest, are more likely to become advocates for such a benefit. One example is provided by Ng and Tan in this issue: community managers of protected areas in Malaysia cited their importance for maintaining cultural heritage. Similarly, a powerful argument for urban parks is that they allow people to directly appreciate the benefits of nature, as noted in this issue by Figueroa and Gray.

The broader point is that the arguments for area-based conservation are likely to be more successful when they are tangible and directly appeal to the general public. An instructive example might be provided by the US National Park Service (NPS). The initial budget reductions and layoffs occasioned by the Department of Government Efficiency at the beginning of the Trump administration, resulted in the Service losing 24 per cent of its full-time staff. Yet push back from the public, advocacy groups and resistance within Congress seem to be holding the budget level for 2026 – despite requests from the administration for very

significant additional cuts. Time will tell, but the initial outlook is more promising than it initially appeared.

PCAs are arguably the most effective mechanism to maintain large-scale ecological integrity. Ecological integrity in turn is essential for the maintenance of a wide range of ecosystem services, many of which provide direct social and economic benefits to people. To the extent that conservationists can mobilise those people to recognise their self-interest and influence public opinion and political decision-making, the more we can build the case for the support of area-based conservation.

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WILDLIFE'S CONTRIBUTIONS TO PEOPLE: CONSIDERATIONS FOR PROTECTED AND CONSERVED AREA MANAGERS AND SYSTEMS MANAGERS

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ABSTRACT

Nature's Contributions to People (NCP) are increasingly incorporated into conservation policy and highlighted in protected area systems and site-management frameworks. Climate instability is a major driver for use of these ecosystem services. Frequently omitted from this discourse is wildlife's contributions to people (WCP) which has recently been examined and identified as a driving force in pollination services, seed dispersal, carbon and nutrient cycling, water regulation, soil formation, habitat maintenance, and for their role in supporting cultural identities. The growing global emphasis on equity and the inclusion of Indigenous peoples and local communities in protected area decision-making underscores the role of these benefits in maintaining livelihoods and the necessity of collaboratively mapping and maintaining NCPs.

However, as protected area managers endeavour to integrate NCP into their practices, knowledge about the practical implications for wildlife management is far less known. This article examines how managers might identify and map WCP in their protected area, qualify and quantify the conditions necessary to protect and optimise these contributions and how to structure these optimal conditions through a management system.

Keywords: Wildlife; Protected area management; Ecosystem Services; Extinction; Abundance

INTRODUCTION

Protected and conserved areas (PCAs) are the cornerstone of global conservation efforts, safeguarding critical habitats, biodiversity and the ecological processes that underpin life on Earth (Maxwell et al., 2020). Yet, anyone managing a PCA today faces a convergence of financial, political and ecological pressures that threaten their long-term effectiveness and survival. Rising costs from climate change impacts (Beever et al., 2024; Parry et al., 2010), invasive species (Courchamp, 2024) and habitat degradation, combined with chronic underfunding and resource allocation challenges (Coad et al., 2019; Dudley et al., 2025; Waldron et al., 2020), require new approaches that go beyond traditional conservation narratives. One such approach is integrating Wildlife Contributions to People (WCP) into management planning, aligning conservation outcomes with sustainable development, public well-being, and global environmental goals.

Nature's Contributions to People (NCP) – a framework developed by IPBES (2019) – offers a structured and evidence-based way to link biodiversity to human needs. Building off NCP, WCP highlights the specific roles that wildlife play in delivering ecosystem functions and services: from pollination, seed dispersal and carbon storage to water purification, disease regulation, disaster mitigation and cultural inspiration. However, while many ecosystem assessments highlight these services, they rarely identify wildlife explicitly as service providers. This omission can undermine wildlife-focused conservation or restoration within management plans and understate the full value of biodiversity (Timmins et al., 2024). As services like water provision or climate regulation are evaluated in isolation from the species that sustain them, critical conservation opportunities may be lost.

Recognising WCP helps to fill this gap. It gives PCA, and PCA systems managers[1] (hereby "managers") the tools to link species conservation directly to ecosystem resilience

1 Note that the word 'manager' is used as a shorthand for the management authority, which might be a single person in a state-run or private PCA, or a more collective process in one under the governance of Indigenous peoples, local communities or trusts.

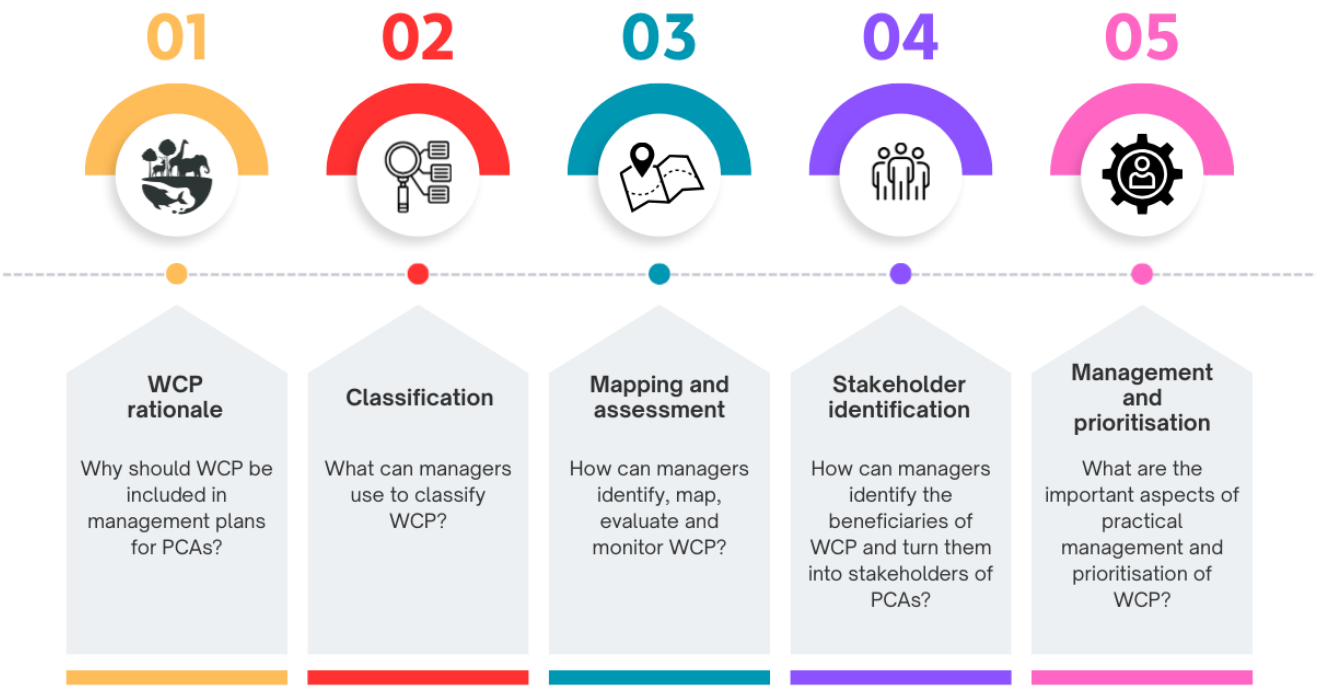

Figure 1. Five step process for WCP management

and societal benefit, thereby broadening support across sectors and making a stronger case for funding, protection and restoration. Tools like the Protected Area Benefits Assessment Tool (PA-BAT+; Ivanić et al., 2020) and the Toolkit for Ecosystem Service Site-based Assessment (TESSA; Peh et al., 2013) provide accessible methodologies for mapping and assessing these contributions and their beneficiaries, making WCP a practical and policy-relevant approach for PCA governance.

While it is essential to communicate the utilitarian value of wildlife to stakeholders, it is equally important to recognise the intrinsic value of species. Too often, conservation is forced to justify itself in economic terms, answering the common questions "Why should we care?" or "What does this species do for us?" This reduces biodiversity to ecosystem service accounting. While this is effective for some audiences, it risks entrenching the idea that species must "pay to stay", as infamously framed by Robert Mugabe at a 1997 CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) meeting. Monetising nature alone, as Kenter (2018) and others argue, distorts our moral relationship with the natural world. It cannot replace the ethical, cultural and spiritual imperatives that compel people to protect the wild. Leopold's "land ethic" reminds us that our bonds with nature are as much about reverence as utility (Leopold, 1968), and some conservation thinkers now argue that biodiversity itself should be granted rights, as biodiversity has inherent value as part of the fabric of life on Earth (Dudley, 2023).

Recognising the intrinsic value and inherent rights of species and ecosystems provides a necessary ethical foundation for conservation – complementing, rather than competing with, utilitarian arguments. Ultimately, connecting people with nature requires both approaches. Cultivating affection and respect must go hand in hand with communicating clear evidence of relevance. By explicitly identifying and managing WCP in PCAs, managers can better engage stakeholders, justify investment, and build lasting support for the species and ecosystems at the foundation of our collective future.

ANALYSIS

Veenstra (2018) recommends five questions to ask to integrate ecosystem service management into PCA management planning. We have refocused and redesigned these five questions to centre on WCP in a management process (Figure 1).

WCP rationale

PCAs face escalating funding shortfalls due to limited public budgets (Coad et al., 2019; Waldron et al., 2020), political pressures and reallocation of public funding (Dudley et al., 2025) and increasing costly pressures from the compounding threats of climate (Beever et al., 2024; Parry et al., 2010), invasive species (Courchamp, 2024) and unsustainable harvesting (Schulze et al., 2017). Appealing to public and political support, making the case for the extrinsic values of PCAs and securing innovative financing mechanisms, including payments for ecosystem services, are increasingly essential to

ensure sustainable management and long-term ecological and social outcomes (Besançon et al., 2021).

To make the case for WCP, and the PCAs that support them, managers should consider different advocacy strategies for the various stakeholders (from local people to national government, as well as national and global constituencies) that benefit from WCP. Wildlife contributes to matters important to various stakeholders in different ways. For governments, the ecosystem services from wild animals contribute to a range of global obligations under treaties and conventions.

Wildlife plays a pivotal role in mitigating climate change, contributing to the Sustainable Development Goal (SDG) 13; the Paris Agreement and Kunming-Montreal Global Biodiversity Framework (GBF) Target 8, by enhancing carbon sequestration (Berzaghi et al., 2025) through browsing and grazing, seed dispersal, and carbon cycling (Mahli et al., 2022; Schmitz et al., 2020). Megafauna and predators also reduce wildfire risks and maintain ecosystem albedo effects (Mahli et al., 2022). In marine systems, whales and sea otters boost carbon storage via nutrient recycling and plankton and kelp regeneration respectively (Lavery et al., 2014; Pearson et al., 2023; Smith et al., 2013; Wilmers et al., 2012). Contrary to previous thinking, Burrell et al. (2024) suggest that herbivore browsing pressure in rewilded landscapes encourages vegetation to invest more in root growth, likely enhancing landscape carbon storage.

Healthy wildlife populations can significantly improve water purification and hydrological regulation (Lynch et al., 2023), contributing to SDG 6 and the Water Convention. Beaver dams and canals enhance water retention, sediment capture and nutrient cycling, reducing erosion and improving downstream water quality (Brazier et al., 2021; Ronnquist & Westbrook, 2021). Soil engineers like small mammals and termites increase water filtration in the soil, decreasing risks of drought (Cheik et al., 2022; Fleming et al., 2014). Filter feeders such as bivalves (Holovkov et al., 2023) and net-spinning caddis fly larvae (Hood et al., 2018) capture chemicals and sediments, purifying polluted waters. Salmon nest-building influences sediment sorting and likely reduces erosion (Montgomery et al., 1996). Animals that disrupt stagnant pools, like crocodiles and antelopes, reduce the risk of oxygen depletion (Gereta & Wolanski, 1998). The evidence goes on.

Wildlife protect against floods, storms, wildfires, erosion and landslides. Coral reefs reduce storm damage by billions annually (Beck et al., 2018), supported by reef-maintaining fish species (Woodhead et al., 2019). Bivalve molluscs aid mangrove growth, enhancing coastal

Parrot fish simultaneously graze choking algae from corals and excrete important algae back onto corals © Hannah L. Timmins

defence (Gagnon et al., 2020). Herbivores maintain grassland diversity, reducing erosion (Berendse et al., 2015), while seed dispersers like birds and bats assist in slope stabilisation (Mayta et al., 2024; Shiels & Walker, 2003).

Wildlife directly contribute to human food security (SDG 2, GBF 5) by providing protein through fish and game harvests (ChaplinKramer et al., 2025) but also through enhanced pollination boosting agricultural yields (IPBES, 2016; Peixoto et al., 2022) and nutrient cycling (Otero et al., 2018; Timmins et al., 2024), essential functions often overlooked in food systems. Such food system support also reduces poverty (SDG 1) and can underpin sustainable livelihoods (SDG 11), along with the tourism benefits (World Travel & Tourism Council, 2021).

The One Health approach links wildlife, ecosystems and human health, promoting integrated management in PCAs to prevent zoonotic disease emergence (Destoumieux-Garzón et al., 2018). Disturbances and biodiversity loss increase human contact with wildlife pathogens (Jones et al., 2008). Predators and scavengers, like vultures and birds of prey, support SDGs by providing disease control, decreasing spillover risks of zoonotic diseases such as rabies, and Lyme disease (Myers et al., 2013). Wildlife also provides significant benefits to human health through recreation, tourism, enhancing mental health, cognitive function and emotional well-being (Cox & Gaston, 2018).

Wildlife experiences inspire awe, support cultural identity and enrich spiritual life (Leopold, 1968; Taylor, 2009). Many Indigenous cultures, spiritual beliefs, traditional knowledge, livelihoods and identities have been shaped by wildlife (Hill et al., 2020). Species like

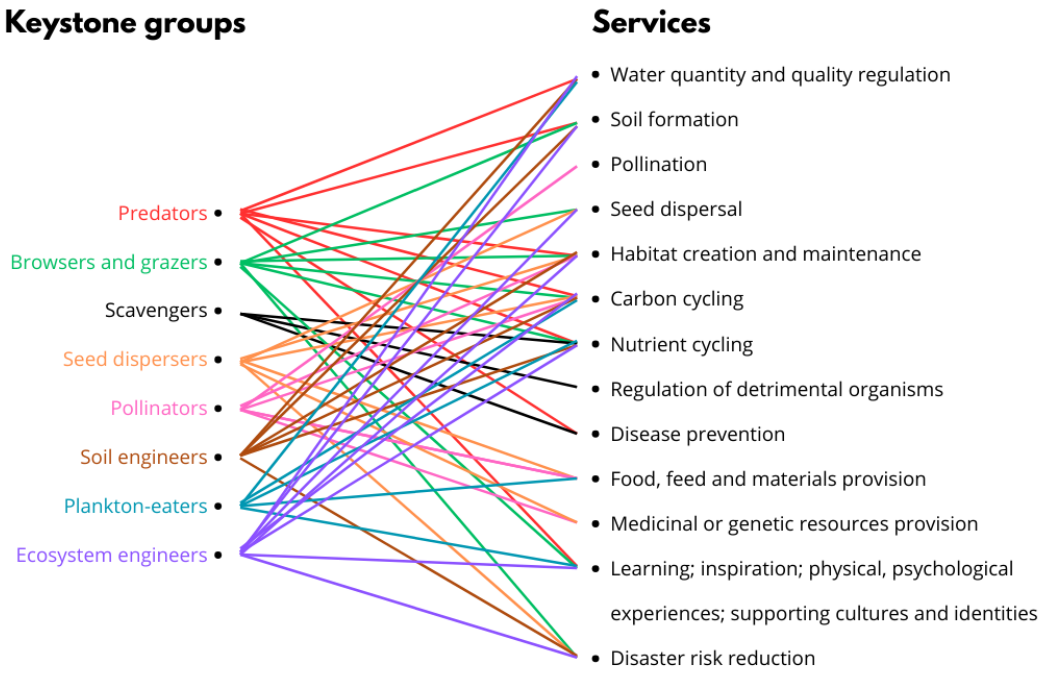

Figure 2. WCP identification lists and connections between guilds and services

the caribou for Inuit or the jaguar for Amazonian peoples embody cultural continuity, ecological understanding and sacred relationships. Thus, many species of wildlife also play a role in underpinning **Indigenous peoples' rights** to culture and identity.

In addition to the above contributions, WCP also play essential roles in achieving SDGs 14 and 15 on Life below water and Life on land, the GBF more broadly, the Convention on Wetlands, the Convention on Migratory Species, the Nature Positive by 2030 target, the Green New Deal for Nature and People, and in advancing objectives under the UN Convention to Combat Desertification's Land Degradation Neutrality target, the UN Framework Convention on Climate Change and the UN Decade on Ecosystem Restoration. In order to make the case for protection, effective management and adequate funding, it is essential that managers are aware of the WCPs that their PCA protects and delivers and both their local and global implications.

Classification

First, managers need to familiarise themselves with the materials available, building an understanding of the theories of, and evidence for, WCP. Next, they can begin to identify what WCPs their PCA delivers. Several typologies exist to support the mapping of WCP at various levels, each with a slightly different approach to classification. Timmins et al. (2024) define the guilds of wildlife and outline the various contributions that these guilds deliver. Another approach would be to begin with the services themselves. Chaplin-Kramer et al. (2025) map the IPBES's original NCP typology (2019) onto wildlife to outline a broad framework of wildlife functions. Combining the related Timmins et al. (2024) and Chaplin-Kramer et al. (2025) systems, we propose the following umbrella typology (Figure 2) aiming to support managers to identify all mechanisms at play whether starting from the species present or the services delivered:

The above two lists are designed to be comprehensive, rather than simplified, to support managers in identifying as many functional groups as possible and mapping out the services and contributions they provide that may otherwise go overlooked.

Mapping and assessment

Mapping WCP should involve two parallel processes:

- Identifying wildlife species present (both permanent and migratory) and deducing their functions and services;
- Identifying the ecosystem services of the PCA and deducing their dependence on wildlife present.

Many PCAs will have species inventories (to varying degrees of completeness); those that do not should aim to collect basic species data. Species inventories would best be developed by amalgamating data from various sources including management-led surveys (such as Spatial Monitoring and Reporting Tool patrol lists), citizen science surveys (for example, iNaturalist) and Traditional Ecological Knowledge (TEK). These can be cross-checked against existing national and regional checklists, standardised taxonomies and global databases such as

Figure 3. Examples of different goals, evidence for communication and audiences in WCP benefits awareness-raising

The IUCN Red List of Threatened Species™. Developing a comprehensive species inventory can be a near-limitless exercise; it is recommended that managers be pragmatic and focus on species, relatives or guild members that have already been documented in providing WCP in the broader literature.

The species inventory can then be used to deduce WCP based on literature available for the particular species present, for other members of their guilds or close relatives (see the first two columns in the example matrix in Table 1).

In parallel, the manager can work backwards to identify the ecosystem services delivered by a PCA and then deduce which wildlife species are providing the underlying WCP that maintain the ecosystem services. In reality, ecological systems have evolved much redundancy (Keyes et al., 2021). Meaning that whilst one or a group of species may be disproportionately responsible for delivering a service, fundamentally ecosystems rely on countless invisible connections between species.

Numerous integrated tools exist to help managers identify ecosystem services from PCAs including the Toolkit for Ecosystem Service Site-based Assessment (TESSA, 2013) or the PA-BAT+ (Ivanić et al., 2020). Managers can use the PA-BAT+ to map key benefits for various stakeholder groups (including local communities, government, civil society, the economic sector and academia), a key exercise for the manager to answer question four (below). Once the services and benefits of the area have been identified, the manager can then assess which wildlife species may be contributing to these services, further developing the matrix in Table 1. Managers should integrate species inventorying and ecosystem service mapping into adaptive management cycles to monitor changes in species populations, threats and contributions.

Stakeholder identification

The PA-BAT+ describes how to run a participatory, consensus-led evaluation, to generate an analysis of PCA benefits for stakeholders both local and distant. Managers can use the PA-BAT+ to map key benefits for local communities, government, civil society, the economic sector, academia, the national and international public, etc. Managers can use this data to fill in the fourth column in Table 1, indicating which stakeholders are benefitting from the WCP. The fifth column in Table 1 can be used to describe communications tools for outreach to key stakeholders.

Of course, WCP can be positive or negative for local stakeholders (Chaplin-Kramer et al., 2025). Negative contributions, namely human–wildlife conflict, include crop damage, competition with and predation on livestock, and may threaten human life and property. Impacts like these can hamper species conservation and undermine WCP benefit awareness-raising. Integrating coexistence measures into management plans can help managers mitigate these negative effects, for example, supporting local people with improved livestock protection (Gross et al., 2025). Managers also may want to target awareness-raising communications on the evidence of benefits of WCP to specific audiences to achieve specific goals (see Figure 3).

Recovering populations of wildebeest have shifted the Serengetti ecosystem from a carbon source into a carbon sink. © Hannah L. Timmins

Management and prioritisation

Managers should consider the conditions necessary for species to deliver and optimise WCP. For maximum ecosystem functionality delivering optimal services, intact faunal assemblages need to operate with abundant populations over large, connected landscapes and seascapes (Timmins et al., 2024). Abundant and widespread wildlife enhances resilience to natural and human-induced disturbances by increasing the chances of survival, adaptation and recovery (Loreau & Mazancourt, 2013). Larger populations are more likely to have the genetic, behavioural and cultural plasticity to adapt to changing conditions and ensure the continued provision of ecosystem services. Larger populations are also more likely to deliver ecosystem services at a meaningful scale (Gaston et al., 2018). Greater species richness, particularly including larger-bodied animals and ecosystem engineers, and a larger geographic extent are critical for resilience and WCP delivery (Harrison et al., 2014).

In order to optimise the above factors, managers should consider a number of wildlife vital signs at the ecosystem and species levels (focusing on the species of particular importance for WCP identified in the above exercise and the data that they have available and prioritising species with substantial evidence):

- Ecosystem richness: how many species are present? Is this decreasing/increasing?
- Assemblage intactness:
  - ◇ are there any species missing or reduced in number?
  - ◇ are there any ecosystem engineers / keystone species missing or reduced in number?
  - ◇ are there any large-bodied species missing or reduced in number?
  - ◇ are there any invasive species disrupting the functioning of the ecosystem?
- Population and species abundance: Has the density or population size changed? Is there any historical data for comparison?
- WCP-species diversity: How healthy is the genetic diversity of the population (dependent on the data available)?
- WCP-species extent: How large is the range of the population? Does it connect to neighbouring populations? If it is a species of importance for nutrient cycling, does it have access to the relevant ecotypes to move nutrients?
- WCP-species habitat quality and complexity: Does the species have access to important habitats (e.g. spawning areas, winter feeding grounds, etc.) to sustain a healthy population?

Next, the manager should consider the threats and pressure that might be influencing these qualities, and the actions they can take to reverse losses, reduce threats and bolster ecosystems, populations and WCP. For example, if there are keystone species or large-bodied species missing, consider reintroductions following IUCN good practices available (IUCN/SSC, 2013). If genetic diversity is low in a WCP-species, reinforcement releases might be key. If insect richness is decreasing due to insecticides in the surrounding landscape, a targeted campaign to highlight these losses and their impacts on pollination services may help. Similarly, working with landscape stakeholders to increase connectivity to other ecosystems can help reconnect populations and re-establish lost nutrient cycles.

Managers will notice that many of the above actions will require landscape-level collaboration, political will and local support. Whilst PCAs are critical to the survival of wildlife and the preservation of WCP (Maxwell et al., 2020), the services that wildlife provide, along with the issues threatening them, often transcend PCA boundaries. Moreover, in many cases locally-extinct keystone and large-bodied species, needed to restore WCP, will require local support and government permits to re-establish. For these reasons, it is essential that managers are familiar with WCP and can readily communicate to stakeholders not only about the services wildlife deliver but also about the ecological mechanisms at play and the human actions that bolster and protect or threaten them.

CONCLUSIONS

Integrating WCP into PCA management planning is critical to address the growing challenges of biodiversity loss, funding shortfalls and any reduced support for conservation, and to ensure optimal delivery of WCP (Coad et al., 2019; Dudley et al., 2025; Waldron et al.,

Table 1. An example matrix inventorying species present; confirmed and potential WCP; management actions to protect and restore WCP; key beneficiaries; and communications tools to reach them, for a fictional Southern African PCA

Species present	WCP (deduced through literature on this species, close relatives or guild members)	WCP management	Key beneficiary	Communications tool/s
Spotted Hyena (*Crocuta crocuta*)	***Confirmed:*** Nutrient cycling (Abraham et al., 2021); Disease prevention (Sonawane et al., 2021). ***Potential:*** Similar to other species in their guild (large predators that hunt in groups), hyena may play a role in carbon storage, sequestration and water regulation (Timmins et al., 2024).	Human–hyena coexistence; prey population management.	Local communities; politicians and national policymakers; multilateral organisations involved in healthcare.	Local outreach. Policy briefs, high profile media stories.
Hottentot Golden Mole (*Amblysomus hottentotus*)	***Potential:*** Similar to related species, likely plays a role in soil aeration and formation; carbon storage; vegetation health and carbon sequestration; water filtration; disaster risk reduction (droughts and flooding).	Livestock overgrazing mitigation; sustainable fuelwood collection.	Local communities; politicians and national policymakers; insurance companies; carbon markets.	Local outreach, discussion with disaster insurance companies and national carbon companies.
Blue Wildebeest (*Connochaetes taurinus)*	***Confirmed:*** Numerous studies exist detailing the role of migratory wildebeest in carbon storage and sequestration (Holdo et al., 2009) and nutrient cycling (Timmins et al., 2024).	Livestock overgrazing mitigation; livestock disease management; landscape connectivity.	Carbon markets; local arable farmers.	Advocacy and discussion with carbon companies. Landscape-level planning and stakeholder engagement.
Cape Vulture (*Gyps coprotheres*)	***Confirmed:*** Numerous studies exist detailing the role of vultures in disease prevention, particularly for pathogens like botulism and anthrax, and nutrient cycling (Jalihal et al., 2022; Skotnes-Brown, 2021).	Coexistence; reduce poisonings and death from powerlines.	Local communities; livestock farmers; multilateral organisations involved in healthcare.	Educational outreach.
Various bee species	***Confirmed:*** Numerous studies exist quantifying the value of bee pollinators (Requier et al., 2019).	Reducing pesticide use regionally; maximising landscape nectar sources.	Local arable farmers.	Educational outreach.

2020). By identifying, protecting, restoring, managing and communicating the services that wildlife provide, managers can strengthen the ecological effectiveness, financial sustainability and public relevance of PCAs.

Wildlife plays vital roles in supporting climate regulation, water purification and hydrological regulation and disaster mitigation. These contributions link directly to global frameworks including the SDGs, the GBF, the Paris Agreement, the Convention on Wetlands, and the UN Decade on Ecosystem Restoration. Wildlife also bolsters food security, reduces poverty and supports sustainable livelihoods and tourism. WCP strengthen public health through regulating disease vectors, purifying air and water, and supporting mental well-being. Wildlife contributes to cultural identity, education, and spiritual values.

To integrate WCP into management planning, managers must classify, identify and evaluate these contributions using typologies such as those proposed by Timmins et al. (2024) and Chaplin-Kramer et al. (2025). These tools help determine what species deliver which services, how they relate to specific ecosystem functions, to what

quality they are delivering WCP, what threats they are facing and what management actions can protect and reinforce them and their services. Mapping WCP requires combining species inventories with data on ecosystem service provision, using tools such as TESSA (Peh et al., 2013) and PA-BAT+ (Ivanić et al., 2020).

Understanding who benefits from WCP allows managers to turn beneficiaries into stakeholders. Tools like PA-BAT+ can guide participatory processes to identify local, regional and international beneficiaries and inform tailored communications strategies to secure their support. Effective outreach can also help mitigate threats to WCP-providing species by raising awareness or influencing policy and behaviour.

Communicating the intrinsic value, inherent rights of biodiversity and the utilitarian arguments for WCP are crucial tools for managers. By explicitly identifying, managing and restoring WCP, they can better engage stakeholders, justify investment, and build lasting support for the biodiversity that underpins human well-being. To do this effectively, managers can take inspiration from Indigenous knowledge systems and embrace the principle of *two-eyed seeing* (or *two-way thinking;* **Cebrián-Piqueras et al., 2020**). This approach values both Western science and TEK, including the power of story and inspiration, acknowledges that different worldviews offer complementary insights into managing biodiversity and ecological relationships, and fosters more inclusive, resilient and ethically grounded conservation practices. By bridging these knowledge systems, managers can better reflect the full spectrum of values – spiritual, cultural and economic – that biodiversity holds for humanity.

Crucially, WCP depend on ecological conditions such as species abundance, intact assemblages and landscape connectivity (Harrison et al., 2014; Loreau & Mazancourt, 2013). Managers should assess trends in these indicators and act accordingly: through reintroductions, connectivity restoration, threat mitigation, and reinforcement of vulnerable populations.

Ultimately, PCAs alone cannot maintain WCP. Landscape-level cooperation, political will and broad-based public engagement are needed to support wildlife populations across their full ecological range. Managers are key to building this support, and by clearly articulating the value of WCP and the ecological processes behind them, they can embed wildlife conservation into the heart of sustainable development strategies.

ABOUT THE AUTHORS

Hannah L. Timmins is a conservation consultant and ecologist based in Istanbul with 12 years' experience working in numerous countries, at various levels from protected areas to landscapes and conservation policy. As part of Equilibrium Research, Hannah has coauthored influential IUCN guidance, reports and policy papers. Hannah is interested in the expansion, effectiveness and connectivity of protected and conserved areas globally, the role of wildlife in ecosystem services, community conservation, rewilding and species restorations.

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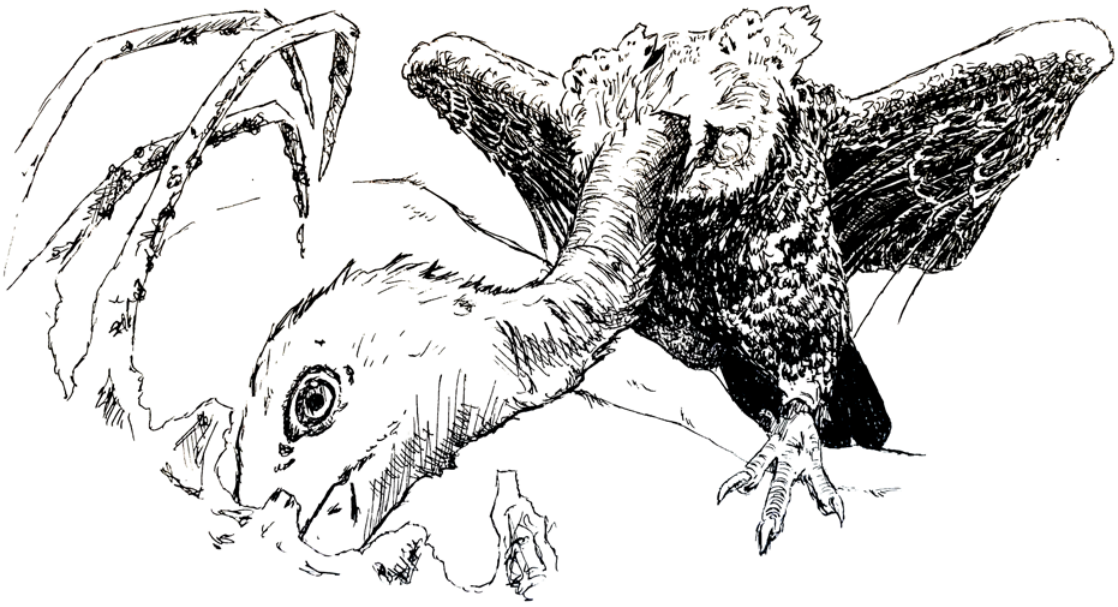

Through their carrion clean-up, vultures are capable of protecting us from rabies, anthrax, botulism and more. © Hannah L. Timmins

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RÉSUMÉ

Les contributions de la nature à l'homme (CNH) sont de plus en plus intégrées dans les politiques de conservation et mises en avant dans les systèmes de zones protégées et les cadres de gestion des sites. L'instabilité climatique est un facteur majeur de l'utilisation de ces services écosystémiques. Les contributions de la faune sauvage à l'homme (CFS), qui ont récemment fait l'objet d'études et ont été identifiées comme un moteur des services de pollinisation, de dispersion des graines, du cycle du carbone et des nutriments, de la régulation de l'eau, de la formation des sols, du maintien des habitats et de leur rôle dans le soutien des identités culturelles, sont souvent omises de ce discours. L'importance croissante accordée à l'équité et à l'inclusion des peuples autochtones et des communautés locales dans la prise de décision relative aux aires protégées souligne le rôle de ces avantages dans le maintien des moyens de subsistance et la nécessité de cartographier et de préserver les NCP de manière collaborative.

Cependant, alors que les gestionnaires d'aires protégées s'efforcent d'intégrer les PCN dans leurs pratiques, les connaissances sur les implications pratiques pour la gestion de la faune sauvage sont beaucoup moins connues. Cet article examine comment les gestionnaires peuvent identifier et cartographier les PCW dans leur aire protégée, qualifier et quantifier les conditions nécessaires pour protéger et optimiser ces contributions, et comment structurer ces conditions optimales à travers un système de gestion.

RESUMEN

Las Contribuciones de la Naturaleza a las Personas (PCN) se incorporan cada vez más en las políticas de conservación y se destacan en los sistemas de áreas protegidas y los marcos de gestión de sitios. La inestabilidad climática es un factor clave para el uso de estos servicios ecosistémicos. Con frecuencia se omiten en este discurso las Contribuciones de la Vida Silvestre a las Personas (PAV), que recientemente se han examinado e identificado como un factor impulsor de los servicios de polinización, la dispersión de semillas, el ciclo del carbono y los nutrientes, la regulación hídrica, la formación del suelo, el mantenimiento del hábitat y su papel en el apoyo a las identidades culturales. El creciente énfasis mundial en la equidad y la inclusión de los pueblos indígenas y las comunidades locales en la toma de decisiones sobre áreas protegidas subraya el papel de estos beneficios en el mantenimiento de los medios de vida y la necesidad de mapear y mantener de forma colaborativa las PCN.

Sin embargo, a medida que los administradores de áreas protegidas se esfuerzan por integrar las PCN en sus prácticas, el conocimiento sobre las implicaciones prácticas para la gestión de la vida silvestre es mucho menor. Este artículo examina cómo los administradores pueden identificar y mapear el WCP en su área protegida, calificar y cuantificar las condiciones necesarias para proteger y optimizar estas contribuciones y cómo estructurar estas condiciones óptimas a través de un sistema de gestión.

IUCN'S LEADERSHIP IN ECOLOGICAL CONNECTIVITY CONSERVATION THROUGH INTEGRATED SCIENCE, POLICY AND PRACTICE

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ABSTRACT

As the countermeasure to fragmentation, ecological connectivity conservation is a comprehensive strategy to save biodiversity, increase resilience to climate change and benefit people across lands and waters. Building on strong science, policy and practice, the World Commission on Protected Areas' Connectivity Conservation Specialist Group (CCSG) released *IUCN Guidelines for conserving connectivity through ecological networks and corridors*. Available in six languages, the Guidelines provide consistent information to conserve ecological connectivity, especially to support achieving the "well-connected" element of Target 3 of the Kunming-Montreal Global Biodiversity Framework. To better meet area- and species-based goals at larger scales, the Guidelines provide leading definitions, recommend formal recognition of "ecological corridors" as critical building blocks of "ecological networks" and provide principles and requirements for ecological corridors. They serve as the key resource for standardising multilaterally agreed definitions and frameworks for ecological corridors to be recognised and reported as spatially explicit conservation measures. This paper examines developments in connectivity conservation policy and implementation, discusses challenges in measuring connectivity and highlights country-level efforts to recognise ecological corridors. It summarises the Guidelines and presents a replicable, adaptable approach developed by CCSG and partners for applying them through engagement with rightsholders and interested parties, supporting consistent design, governance, management and monitoring of ecological corridors and networks.

Key words: ecological corridor, ecological network, protected area network, wildlife corridor, road ecology, connectivity indicators

INTRODUCTION

Fragmentation – the division of habitat into smaller and more isolated patches – caused by human activities poses a grave threat to biodiversity and ecological processes (Haddad et al., 2015; Ma et al., 2023; Romanillos et al., 2024). Each year, unprecedented levels of deforestation, land conversion and loss of nature surpass the previous year (Durán et al., 2020; Goldman et al., 2024; WWF, 2024). Combatting this fragmentation to conserve nature at larger scales requires comprehensive approaches, including maintaining, enhancing and restoring ecological connectivity.

Ecological connectivity is defined as "the unimpeded movement of species, connection of habitats without hindrance and the flow of natural processes that sustain life on Earth" (CMS, 2024a). It facilitates ecological and evolutionary processes, from population dynamics to gene flow and adaptation to climate change (Crooks & Sanjayan, 2006; Hilty et al., 2020). It is also critical for most landscapes, seascapes and ecosystems because few protected areas and unprotected areas of intact natural habitat are large enough to support all life stages of many, especially wide-ranging, wildlife, or to sustain ecological processes and allow species to shift ranges in response to climate change (Heller & Zaveleta, 2009; Newmark et al., 2023). By conserving ecological connectivity, the habitats and genetic diversity of wild animal and plant species can be better safeguarded, along with ecosystem functions and characteristics such as

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Aerial view of land fragmented by palm oil plantations in Malaysia. © CLLC / Gary Tabor.

migration, hydrology, nutrient cycling, pollination, seed dispersal, food security, climate resilience and disease resistance, across all biomes and spatial scales.

As humans exert pressure, reducing habitats and pushing wild species into ever-smaller pieces of nature, the global community is increasingly prioritising connectivity conservation as the countermeasure to fragmentation. Connectivity conservation, grounded in scientific research (Liczner et al., 2024) and legal concepts (Lausche et al., 2013), is being addressed through policy, law and management, as demonstrated in 2019 in an analysis of 263 terrestrial connectivity conservation plans written over the preceding 30 years (Keeley et al., 2019). It is defined by the IUCN World Commission on Protected Areas' (WCPA) Connectivity Conservation Specialist Group (CCSG) as "the action of individuals, communities, institutions and businesses to maintain, enhance and restore ecological flows, species movement and dynamic processes across intact and fragmented environments" (CCSG, n.d.a). This evolution into a mainstream conservation practice is driven by decades of work across IUCN, which has solidified the concept and policies through more than 30 official IUCN resolutions adopted by its members increasingly acknowledging that isolated PCAs alone are not sufficient; their vitality is often dependent on their ecological connectivity to surrounding lands and waters. This leadership is instrumental in driving a paradigm shift from solely focusing on formal protected areas (Dudley, 2008) and other effective area-based conservation measures (OECMs) (Jonas et al., 2024) – hereafter protected and conserved areas (PCAs) – to recognising the need to create well-managed PCAs interconnected within ecological networks for conservation. This shift embraces new and expanded PCAs as fundamental for achieving conservation goals while reinforcing efforts that can fulfil the "well-connected" element of Target 3 under the Convention on Biological Diversity's (CBD) Kunming-Montreal Global Biodiversity Framework (KMGBF). This is especially critical considering that the *Protected Planet Report 2024* finds that "Protected and conserved areas must almost double in area on land and more than triple in the ocean for the 30% target to be reached by 2030" (UNEP-WCMC & IUCN, 2024a) while also concluding that although 17.6 per cent of global terrestrial land was protected by PCAs, the network of PCAs "[...] is not well-connected yet" (UNEP-WCMC & IUCN, 2024b).

After decades in the making, broad consensus on concepts and pathways forward was catalysed in 2016 with adoption of IUCN Policy Resolution 087, *Awareness of Connectivity Conservation Definition and Guidelines* (IUCN, 2021a). Between 2017 and 2020, more than 100 CCSG Members in 30 countries discussed, wrote, reviewed and eventually published the first-ever *IUCN Guidelines for conserving connectivity through ecological networks and corridors* (Hilty et al., 2020). The Guidelines detail the many ways ecological corridors can connect PCAs to form ecological networks and can provide communities with ecological, social and economic value. They also provide advice to governments and conservation

Deer attracted to salt used to melt ice on the wintry roads in Montana, USA © CLLC / Kylie Paul.

Zebra near the Standard Gauge Railway passing through Nairobi National Park and Tsavo National Park, Kenya © CLLC / Melissa Butynksi.

practitioners on how to design, plan and implement ecological corridors including delineation, governance, tenure, management, long-term monitoring, evaluation and reporting. Twenty-five case studies complement the Guidelines illustrating projects from around the world.

This article first details ongoing developments in science, policy and practice for advancing connectivity conservation. It then discusses challenges of measuring connectivity, briefly examines country-level efforts and shares innovations of the Guidelines, highlighting applications to scale up and implement ecological connectivity conservation through projects and initiatives that fulfil international environmental commitments and secure connectivity among PCAs. Finally, it provides insights into a replicable, adaptable planning framework for ecological corridors following the Guidelines that prioritises engagement with partners, rightsholders and interested partners and supports development of delineated corridors with defined objectives, governance models and comprehensive management and monitoring plans.

POLICY INTEGRATION FOR ECOLOGICAL CONNECTIVITY

Through a growing body of international, national and subnational policy, planning and implementation, there is a tangible shift in focus from conserving specific areas and species to planning at larger spatial scales across the matrix of human uses in landscapes, seascapes and ecosystems that surround and connect PCAs to achieve functional ecological networks. The CBD's KMGBF is important for elevating countries' commitments for ecological connectivity conservation, its measurement and implementation (Box 1), especially reinforcing the "well-connected" element of PCAs that was first included in Target 11 of the Aichi Strategic Plan for Biodiversity (2011–2020). Adopted by the CBD's 15th Conference of the Parties (CBD/CoP-15) in 2022 as Decision 15.4 (CBD, 2022a), the KMGBF emphasises the fundamental contribution that connectivity makes to functioning ecosystems and thriving species, and its benefits to people. Following rigorous review of the final version of the KMGBF, goals and targets that explicitly address connectivity include:

- Goal A: *The integrity, connectivity and resilience of all ecosystems are maintained, enhanced, or restored, substantially increasing the area of natural ecosystems by 2050; […];*
- Target 2: *Ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration, to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity;*
- Target 3: *Ensure and enable that by 2030 at least 30 per cent of terrestrial, inland water, and of coastal and marine areas […] are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures […];* and
- Target 12: *Significantly increase the area and quality and connectivity of, access to, and benefits from green*

and blue spaces in urban and densely populated areas sustainably, by mainstreaming the conservation and sustainable use of biodiversity, and ensure biodiversity-inclusive urban planning, enhancing native biodiversity, ecological connectivity and integrity, […].

Additionally, the KMGBF implicitly addresses the key role of connectivity in two additional targets:

- Target 1: *Ensure that all areas are under participatory integrated biodiversity inclusive spatial planning and/or effective management processes addressing land and sea use change, […];* and
- Target 14: *Ensure the full integration of biodiversity and its multiple values into policies, regulations, planning and development processes, poverty eradication strategies, strategic environmental assessments, environmental impact assessments and, as appropriate, national accounting, within and across all levels of government and across all sectors, […].*

Focusing on Target 3 – also known as the "30x30 Target", a central strategy for biodiversity conservation is expanding and improving the coverage, representativeness, connectivity and equitable governance of PCAs. Coverage is a key component of area-based conservation; connectivity and representation have received less attention in science and practice because they can be more challenging to measure and communicate. Nonetheless, to ensure that the global PCA network fully achieves the KMGBF's purpose to halt and reverse biodiversity loss, countries need to focus on the "well-connected" element of PCAs (Maxwell et al., 2020) to meet the third essential principle for area-based biodiversity conservation that "habitat patches must be functionally connected" (Riva et al., 2024).

Additional policy decisions of multilateral instruments and international institutions emphasising connectivity to achieve their objectives continue to be summarised (Hilty & Laur, 2021) and documented online (CCSG, n.d.b). Additional recent key developments include the following.

- In 2021, the 7th IUCN World Conservation Congress (WCC) adopted Policy Resolution 073, *Ecological connectivity conservation in the post-2020 global biodiversity framework: from local to international levels* (IUCN, 2021b) emphasising the importance of ecological networks and corridors to sustain biodiversity and nature's contributions to people; recommending that all IUCN Members work to conserve connectivity by documenting it across ecosystems, informing policies, laws and plans, identifying key drivers and building synergies across institutions and borders to implement solutions; and recommending that Parties to the Convention on Biological Diversity (CBD) include appropriate goals, targets and indicators, including an indicator for migratory species. Additionally, Policy Resolution 071, *Wildlife-friendly linear infrastructure* (IUCN, 2021c) recognises the particular importance of avoiding and mitigating fragmentation caused by linear infrastructure (i.e. roads, railways, canals) to conserve connectivity.
- In 2023, the 10th Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) adopted a decision on its work programme up to 2030, including approving a "methodological assessment of integrated biodiversity-inclusive spatial planning and ecological connectivity". As a fast-track assessment, it is intended to be completed by 2027 to address methods, guidance, tools, scenarios, models, data, knowledge and capacity-building for integrating biodiversity into, and promoting connectivity, in spatial planning across sectors and scales (IPBES, 2023).
- In 2023, the UN Convention on the Law of the Sea (UNCLOS) adopted the *Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ Agreement)* that includes connectivity among the indicative criteria for identifying marine protected areas in the high seas (BBNJ, 2023; IUCN-HSSG, 2025).
- In 2024, the Convention on Migratory Species adopted:
  - *The Samarkand Strategic Plan for Migratory Species 2024–2032* with the vision "by 2032, migratory species are thriving and live in fully restored and connected habitats" (CMS, 2024b); and
  - The resolution on *Impact Assessment and Migratory Species* asking Parties to take connectivity into account to avoid impediments when planning linear infrastructure and constructing other barriers such as fences and walls (CMS, 2024c).

At time of writing, IUCN Members had just adopted Motion 127, *Recognising and Reporting Ecological Corridors* as part of deliberations of the 8th WCC in Abu Dhabi (United Arab Emirates) from 9–15 October 2025. Building on previous mandates, and progress made since the 7th WCC, this Policy Resolution calls on IUCN to foremost:

- *[…] recognise the value of, and advocate for, a multilaterally agreed definition and frameworks for ecological corridors as a spatially explicitly conservation measure that reflects biocultural diversity and supports multifunctional landscapes*

> *and seascapes, assisting in the full implementation of the CBD Kunming-Montreal Global Biodiversity Framework (KMGBF), especially for Target 3, and to encourage further actions to advance this work, in line with the IUCN Connectivity Guidelines and the KBA (Key Biodiversity Area) Standard* (IUCN, 2025)

This is a critical step in mobilising strong, coordinated efforts by IUCN, diverse institutions, experts and practitioners to advocate for and support connectivity conservation.

MEASURING ECOLOGICAL CONNECTIVITY

Building on the developments in science, policy, and practice, the accompanying monitoring framework adopted to assess implementation of the KMGBF (CBD, 2025) includes numerous indicators relevant to ecological connectivity (Theobald et al., 2024). These indicators are intended to assist CBD Parties in monitoring and reporting progress towards the goals and targets by 2030. They can also be useful for national target setting, scenario planning and adaptive management. For Target 3, the coverage (area, proportion) of PCAs is identified in the monitoring framework as a major ('headline') indicator, while four minor ('component/complementary') indicators are included for monitoring progress of the "well-connected" element of Target 3: ProtConn (Saura et al., 2017), ProNet (Theobald et al., 2022), Protected Area Representativeness and Connectedness (PARC-connectedness; Harwood et al., 2022) and the Protected Area Isolation (PAI) indicator (Brennan et al., 2022).

Countries typically calculate indicators using their authoritative data. However, there is value in third parties (e.g. the UNEP World Conservation Monitoring Centre (UNEP-WCMC)) computing indicators in a consistent, comparable manner leveraging global datasets, such as the degree of human modification (Theobald et al., 2025). Such globally standardised indicators enable direct comparison across countries, can be reported to the CBD Secretariat and support countries with limited resources, time or technical capacity.

The *Protected Planet 2024* report shares the results for the four connectivity indicators related to Target 3 concluding that although 17.6 per cent of global terrestrial land was protected by PCAs, the network of PCAs "[…] is not well-connected yet" (UNEP-WCMC & IUCN, 2024b). However, thresholds above which a country's PCA system is considered well-connected are arbitrarily set. Also, the four indicators measure connectivity in different ways precluding a direct comparison of connectivity values (Table 1).

Although there has been no further guidance from CBD on how to establish what "well-connected" means or how to quantify it, research is increasing and a recent effort has been made to offer a framework for harnessing scientific knowledge to monitor, map, conserve and restore areas that promote connectivity and maintain well-connected ecosystems. This work is driven by the recognition that "[o]nly by being able to characterize connectivity in measurable terms will we be able to assess whether we have successfully met the 30x30 objective for well-connected protected areas" and therefore provides the following definition:

> *A landscape, seascape, or protected-area network is well connected if organismal movement is sufficient to maintain the long-term persistence of focal taxa, maintain ecological functions, and/or sustain the provisioning of ecosystem services relative to counterfactuals with the same amount of intact habitat and no barriers to movement.* (Brodie et al., 2025)

THE IUCN CONNECTIVITY GUIDELINES

Commitments to conserving ecological connectivity, its measurement and implementation are now more elevated in importance and focus, especially with adoption of the KMGBF. This section highlights objectives, details and applications of the *IUCN Guidelines for conserving connectivity through ecological networks and corridors* (Hilty et al., 2020) that have supported increased focus in policy fora and the implementation that is now being driven with IUCN's leadership. The publication of the Guidelines in 2020 met a clear demand for a more consistent understanding of, and effective approaches to, connectivity conservation across sectors, supporting conservation commitments from international to local levels, including the KMGBF. The Guidelines also provide the world with a leading resource for advancing and scaling application of best practices to safeguard the interconnectedness of PCAs and to restore degraded or fragmented ecosystems that are critical to the health of biodiversity.

The Guidelines are based on best available science and practice for maintaining, enhancing and restoring connectivity among and between PCAs and other intact ecosystems, with the main purposes being to:

Table 1. Indicators included in the Kunming-Montreal Global Biodiversity Monitoring Framework for monitoring progress of the well-connected element of Target 3

	ProtConn	ProNet	PARC-connectedness	PAI
Description	Measures the percentage of a country or region covered by protected lands reachable by moving between protected areas	Measures how well protected areas are grouped together in the landscape, with higher values meaning PCAs are closer and form larger connected clusters, and lower values meaning they are more isolated from one another	Measures how well each protected cell is connected not only to other protected areas, but also to nearby unprotected areas with intact natural vegetation	Measures how isolated each protected area is from other protected areas, based on the resistance in the intervening landscape
Data or parameters needed	• PCA shapefiles • Total landscape area • Least-cost or Euclidean distances between patches • Distance threshold • The maximum product probability of all possible paths between 2 patches (where a path is a set of steps in which no patch is visited >1 time)	• PCA shapefiles • Least-cost or Euclidean distances between patches • Distance threshold	• PCA shapefiles • Raster layer of natural and semi-natural vegetation • Resistance layer • Maximum dispersal distances or decay functions that weight connectivity by distance	• PCA shapefiles • Resistance layer
***Protected Planet Report 2024* parameters**	• 10 km distance threshold • Euclidean distance between PCAs	• 10 km distance threshold • Euclidean distance between PCAs	Remotely-sensed data on land cover change to track the loss of connectivity that occurs when unprotected intact vegetation is lost	Resistance layer: based on the relationship between the human footprint and movement distance of 48 mammal species
***Protected Planet Report 2024* results**	8.52% of the world's terrestrial surface is protected and connected	28.9% of PCAs are connected	On average, each grid cell (1 km^2) on land within a PA or OECM is 71% connected to grid cells containing intact vegetation and/or other PCA grid cells	Does not provide a global-level indicator of connectivity, but provides scores at the national or subregional level that are then used to compare relative levels of connectivity

- consolidate a wealth of knowledge and best available practices;
- set global definitions that function across terrestrial, freshwater and marine environments much in the same way that IUCN's protected area definition is agnostic of ecosystem type;
- outline the fundamentals of what needs to be in place to recognise an ecological corridor as being effectively conserved; and
- highlight an approach that could be used to begin tracking conserved ecological corridors at a global level.

For the first time, the Guidelines introduce a common definition of ecological corridors as "[...] a clearly defined geographical space that is governed and managed over the long term to maintain or restore effective ecological connectivity". The Guidelines recognise ecological corridors as distinct and separate from PCAs. They also advance their formal recognition as critical building blocks of ecological networks alongside PCAs. The definition addresses that while ecological corridors may conserve biodiversity, their only strict requirement is to conserve connectivity. Specifically, corridors may not always be habitat for focal species but may function to permit movement of those species between habitats. However, corridors may also provide continuous habitat for a variety of species. Overall, the Guidelines account for different types of ecological corridors suitable for meeting a range of connectivity goals.

Ecological networks for conservation are defined by the Guidelines as "[a] system of core habitats (protected

areas, OECMs and other intact natural areas), connected by ecological corridors, which is established, restored as needed and maintained to conserve biological diversity in systems that have been fragmented". Assuming that the elements are well-designed and managed, the ecological network will function to conserve biological diversity over time and through space better than any individual element on its own (Bennett & Mulongoy, 2006; Hilty et al., 2020).

Fundamental principles of ecological corridors are as follows:

- Ecological corridors are not a substitute for PCAs.
- Ecological corridors should be identified and established in areas where connectivity is required aiming to build ecological networks for conservation.
- Each ecological corridor should have specific ecological objectives and be governed and managed to achieve connectivity outcomes.
- Ecological corridors may consist partly or entirely of natural areas managed primarily for connectivity.
- Ecological corridors should be differentiated from non-designated areas by the specific uses that are allowed or prohibited within them.
- To achieve their objectives, ecological corridors require their own management plans (terrestrial, freshwater or marine as the case may be).
- Input from rightsholders and interested parties, together with corridor modelling and mapping are effective approaches for identifying where conserving connectivity may be important and feasible (Hilty et al., 2020). Once a specific area is identified, conserving ecological corridors requires steps ranging from documenting basic information, selecting objectives, choosing a governance model, delineating boundaries, agreeing on and implementing management actions and designing monitoring plans. The basic elements to be incorporated in an ecological corridor plan include:
  - **Objectives:** The biodiversity elements and associated ecosystem service values to be connected;
  - **Contribution to ecological network:** The role of the ecological corridor in the larger ecological network in which it is located;
  - **Social and economic values**: The wide range of social and economic benefits considered to maximise design, acceptance, management of allowable human activities and effectiveness of connectivity;
  - **Delineation:** The agreed boundaries, ensuring the size allows for effective management to achieve the objectives, demarcated by the entity or entities governing and managing it;
  - **Governance:** The arrangement of how the corridor is governed, by whom and who is held accountable;
  - **Tenure:** The conditions and rights under which the areas are held, occupied or used, including a mix of tenure whether legal or customary;
  - **Legal or other effective mechanisms:** The specific instruments pertaining to management, describing the governing authority, and establishing the area's tenure to support implementation;
  - **Longevity:** The considerations made to support durability over significant periods of time, so long as connectivity values remain, and including succession of governance arrangements and periodic reviews;
  - **Management:** The actions required to meet objectives of structural needs, functional needs and management of allowable human activities; and
  - **Monitoring, evaluation, reporting:** Both aspirational and readily feasible components of the plan that can be tracked, evaluated and adapted to achieve the objectives.
- Lastly, ecological corridors should be documented and tracked at both national and international levels.

The Guidelines recommend that documentation for reporting includes at least the following:

- Name of the area;
- Geographic description;
- Map of location using a polygon shapefile;
- Year of establishment; and
- Contact information of reporting organisation(s).

With the Guidelines at hand, and approaches tailored to national and subnational contexts, ecological corridors are being increasingly designated at national and subnational levels. To support efforts to meet or exceed the best practices in the Guidelines and achieve enduring connectivity, UNEP-WCMC is working with CCSG and other partners to build a World Database on Ecological Corridors (WDEC) as a global, spatial, open database. When officially launched, the WDEC is intended to be part of *Protected Planet* – the most up to date and complete source of data on protected areas and other effective area-based conservation measures (OECMs) – and contribute towards improved understanding of how well-connected PCAs are globally, while tracking progress towards connectivity conservation goals. As ecological corridors become a more standardised tool and are entered into the WDEC, decisions about whether PCAs are connected can be based on the presence of an ecological corridor.

FOLLOWING THE IUCN CONNECTIVITY GUIDELINES TO ESTABLISH ECOLOGICAL CORRIDORS

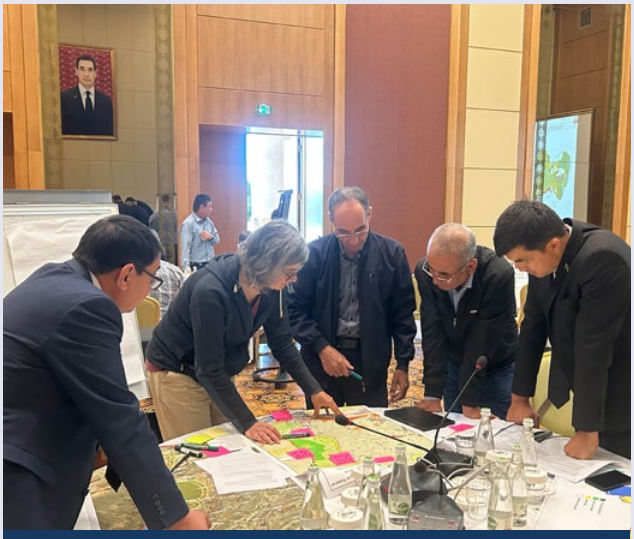
Beyond policy negotiations, scientific research and producing guidance, IUCN's leadership is advancing a diversity of efforts around the world that are working to apply the Guidelines and scale up and implement ecological connectivity conservation through projects and initiatives that fulfil international environmental commitments. Driven by partnerships among local and regional decision-makers, landowners, scientists and community members, new projects are emerging that integrate connectivity conservation into land-use and marine spatial plans, infrastructure development, and conservation frameworks. Much of this is informed by NGOs, governments and communities increasingly working together to ensure delivery of consistent connectivity practices effectively tailored to specific contexts (CMP, 2025).

Connectivity planning can occur at two scales: at the country or regional scale and at the scale of an individual corridor (Beier et al., 2008, 2011). In many cases, planning at the country or regional scale precedes planning at the corridor scale. At both scales it is important that rightsholders and interested parties take the following steps:

- Already have, or during the workshops create, a shared vision of a connected land- or seascape;
- Build a shared understanding of ecological corridors based on the Guidelines;
- Identify the project team;
- Define the scope;
- Decide on the connectivity conservation values (species, places, processes);
- Identify critical threats; and
- Assess the situation with respect to connectivity.

Box 1: Practical applications of the IUCN Connectivity Guidelines

A diversity of efforts have been led by CCSG, the Center for Large Landscape Conservation (CLLC) and partners to focus on applying the principles and requirements in the Guidelines, as well as related best practices in the IUCN Technical Report *Addressing ecological connectivity in the development of roads, railways and canals* (Ament et al., 2023) and *Marine connectivity conservation 'rules of thumb' for MPA and MPA network design* (Lausche et al., 2021). Initially conducted in Romania in 2019 (BearConnect Project, CLLC, & CCSG, 2020), related workshops have been held in Turkmenistan (CLLC, 2023), the Pantanal-Chaco in South America (Creech et al., 2023), Southern Kenya-Northern Tanzania (CLLC, n.d.), Uzbekistan (CLLC, 2024) and Quebec (Canada) (CEM, 2024). Each workshop has contributed towards ongoing development of a replicable and tailorable framework to advance practical application of the principles by engaging partners, rightsholders and interested parties in connectivity conservation planning. Efforts continue via CCSG seeking more places and partners to plan and execute effective delivery of workshops and recommendations in countries and regions to demonstrate application, replication and efficacy.



Participants at Connectivity Conservation Workshop – Ecological Networks for Koytendag State Nature Reserve (SNR) in Ashgabat (Turkmenistan) in April 2023 © CLLC / Aaron Laur.

Participants at Workshop: Transboundary Multi-Species Functional Connectivity in Southern Kenya-Northern Tanzania in Arusha (Tanzania) in August 2024 © CLLC / Annika Keeley.

Once these steps are completed, corridors can be modelled, mapped and, if relevant, prioritised for implementation based on values, risks and opportunities (MNRT, 2022). Informed by detailed spatial data and local knowledge, the project team can delineate the corridor(s), decide on a governance structure and develop a management plan. Once this is accomplished, creating a monitoring plan is important to track the effectiveness of the ecological corridors and report progress (Keeley et al., in press). While implementing this planning framework in workshops over the past six years (Box 1), the following insights have been gained.

- Invest time to identify key partners, rightsholders and interested parties to be engaged in the workshops, ensuring no one feels excluded. Be aware of different contributions participants can offer in the planning process.
- In many land- and seascapes, connectivity studies and projects have already been undertaken and may be ongoing. A key step preparing for the first workshop is to review existing connectivity-related information from the region, including legislation and policies, and design it to participants' current context. Avoid re-inventing the wheel and build on previous work.
- Carefully plan workshops to maximise outcomes, ensuring clear goals are set jointly among planning partners.
- During the workshops, provide participants with opportunities to share past and ongoing connectivity planning and implementation and agree on additional information and steps needed.
- Printing large format maps with relevant data (e.g. PCAs, existing corridors, roads, watercourses, settlements) about the area grounds the discussion allowing participants to make spatially explicit comments and recommendations.
- The Conservation Standards (CMP, 2025) are a useful planning framework for designing conservation projects and provide guidance on assessing the situation and developing management plans.
- Working in small groups is an effective way for all participants to share knowledge and perspectives. Worksheets and world-café-style discussions are effective ways to engage participants in small groups and contribute efficiently to overall workshop outcomes.
- It is important to prepare a comprehensive workshop report summarising presentations, discussions and contributions and clearly stating recommendations and next steps. Such a report can guide subsequent strategic planning and implementation of recommendations.

Examples of country-level efforts towards connectivity conservation are given in the Supplementary Online Material.

CONCLUSION

The path forward for ecological connectivity conservation is both urgent and full of opportunities. Combatting fragmentation is essential to bend the curve for positive biodiversity gains. Defining clear and concise connectivity metrics will be essential for tracking progress and ensuring accountability. Countries will need tailored support to determine the best application of well-connected PCA networks, complemented by strategic conservation efforts that safeguard ecological flows across human-dominated land- and seascapes. Cross-realm coordination, linking terrestrial, freshwater and marine systems, will be critical to sustaining the integrity of ecological networks at scale.

Equally important is enabling policy that facilitates on-the-ground implementation. As many countries and subnational governments have already established ecological corridors on public, community and private lands and seas, increasing application of the IUCN Connectivity Guidelines and the formal recognition of ecological corridors is crucial as a distinct category of spatially explicit conservation measures, in addition to PCAs and Indigenous People and Local Communities-managed areas. This recognition will strengthen ecological network design, accelerate conservation action and provide clearer reporting for global biodiversity-related targets.

Efforts focusing solely on PCA designation miss the dynamic aspects of nature conservation challenged by climate change. Rapid advances in methods and technology, coupled with an unprecedented explosion of species movement data, are transforming our understanding of connectivity needs for both species and ecological processes. Demand for effective connectivity conservation will only grow. In this pivotal moment, IUCN must continue to lead in advancing ecological connectivity as a foundational conservation practice.

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SUPPLEMENTARY ONLINE MATERIAL

Country-level efforts towards connectivity conservation

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RÉSUMÉ

En tant que contre-mesure à la fragmentation, la conservation de la connectivité écologique est une stratégie globale visant à préserver la biodiversité, à accroître la résilience au changement climatique et à bénéficier aux populations terrestres et aquatiques. S'appuyant sur des données scientifiques, des politiques et des pratiques solides, le Groupe de spécialistes de la conservation de la connectivité (CCSG) de la Commission mondiale des aires protégées a publié les Lignes directrices de l'UICN pour la conservation de la connectivité grâce aux réseaux et corridors écologiques. Disponibles en six langues, ces lignes directrices fournissent des informations cohérentes pour préserver la connectivité écologique, en particulier pour soutenir la réalisation de l'élément « bien connecté » de l'objectif 3 du Cadre mondial de Kunming-Montréal pour la biodiversité. Afin de mieux répondre aux objectifs basés sur les zones et les espèces à plus grande échelle, les lignes directrices fournissent des définitions de référence, recommandent la reconnaissance officielle des « corridors écologiques » comme éléments essentiels des « réseaux écologiques » et énoncent les principes et les exigences applicables aux corridors écologiques. Elles constituent une ressource essentielle pour normaliser les définitions et les cadres multilatéraux convenus pour que les corridors écologiques soient reconnus et signalés comme des mesures de conservation spatialement explicites. Le présent document examine l'évolution des politiques et de la mise en œuvre en matière de conservation de la connectivité, aborde les défis liés à la mesure de la connectivité et met en évidence les efforts déployés au niveau national pour reconnaître les corridors écologiques. Il résume les lignes directrices et présente une approche reproductible et adaptable développée par le CCSG et ses partenaires pour les appliquer en collaboration avec les détenteurs de droits et les parties intéressées, en soutenant la conception, la gouvernance, la gestion et la surveillance cohérentes des corridors et réseaux écologiques.

RESUMEN

Como contramedida a la fragmentación, la conservación de la conectividad ecológica es una estrategia integral para salvar la biodiversidad, aumentar la resiliencia al cambio climático y beneficiar a las personas en todas las tierras y aguas. Basándose en sólidos fundamentos científicos, políticos y prácticos, el Grupo de Especialistas en Conservación de la Conectividad (CCSG) de la Comisión Mundial de Áreas Protegidas publicó las Directrices de la UICN para la conservación de la conectividad a través de redes y corredores ecológicos. Disponibles en seis idiomas, las Directrices proporcionan información coherente para conservar la conectividad ecológica, especialmente para apoyar el logro del elemento «bien conectado» de la Meta 3 del Marco Mundial de Biodiversidad de Kunming-Montreal. Para cumplir mejor los objetivos basados en áreas y especies a mayor escala, las Directrices proporcionan definiciones principales, recomiendan el reconocimiento formal de los «corredores ecológicos» como elementos fundamentales de las «redes ecológicas» y establecen principios y requisitos para los corredores ecológicos. Sirven como recurso clave para estandarizar las definiciones y los marcos acordados multilateralmente para que los corredores ecológicos sean reconocidos y notificados como medidas de conservación espacialmente explícitas. En este documento se examinan los avances en la política y la aplicación de la conservación de la conectividad, se analizan los retos que plantea la medición de la conectividad y se destacan los esfuerzos realizados a nivel nacional para reconocer los corredores ecológicos. Resume las Directrices y presenta un enfoque replicable y adaptable desarrollado por el CCSG y sus socios para aplicarlas mediante la colaboración con los titulares de derechos y las partes interesadas, apoyando el diseño, la gobernanza, la gestión y el seguimiento coherentes de los corredores y redes ecológicos.

THE CENTRAL IMPORTANCE OF WATER IN SETTING A TRANSACTIONAL GLOBAL CONSERVATION AGENDA

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ABSTRACT

Global politics has entered a more transactional era. Although ecosystem services provide valid economic arguments for conserving biodiversity, these arguments do not resonate with politicians focused on tangible, short-term benefits for their electorate. We need more cogent arguments for conserving large areas of land that provide transactional benefits to voters. Climate change falls short; it is a secondary threat to biodiversity and has limited political support, except when inclement weather directly impacts humans through floods, hurricanes or droughts.

All these disasters are fundamentally linked to water Paradoxically, the global water supply is becoming increasingly tenuous and variable, yet it remains intimately connected to the presence of forests and large montane areas. Developing an International Convention on Water would indirectly create an agenda that leads to the protection of a significant proportion of the Earth's terrestrial areas. The majority of protected areas lie above 1,000 metres. They need to be managed in ways that conserve biodiversity while ensuring they supply a continuous supply of clean freshwater for the planet's human populations and domestic livestock. Water could then flow from these areas into those with more intensive agriculture, industry, and the low-lying cities where most of the Earth's human population lives.

Keywords: freshwater, ecosystem services, agriculture, river, pollution

INTRODUCTION

Establishing a viable global network of national parks has been one of the major success stories of conservation biology and environmental policy over the last 50 years. But biodiversity is still declining. Some of what we have done as conservation biologists has slowed this decline, but not enough. We need to complement current biodiversity conservation efforts with innovative initiatives that resonate with the business and agricultural communities that support transactional politicians and with the electorate. We are now entering a period when transactional politics will dominate decisions that threaten the viability and integrity of national parks, wilderness areas, and their non-voting denizens. The viability of the parks that conserve Earth's vital stores of biological diversity has never been more threatened.

The situation is further complicated by considerable confusion within the global environmental movement regarding the distinction between climate change and biodiversity loss. Climate change is not the principal driver of biodiversity decline. There are two fundamental scientific facts we cannot ignore: (1) Habitat loss and overexploitation are the current primary drivers of biodiversity loss (Caro et al., 2022; Dobson et al., 2021) and (2) The best way to protect biodiversity is to reverse land use change through restoration and reinforce the protection of protected areas, while monetising their value. Concomitantly, this may slow and potentially reverse climate change. The global conservation community needs to present a more unified agenda that reflects these scientific facts.

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An uncomfortable asymmetry

Climate change can be slowed by reducing carbon inputs into the atmosphere, but it can only be reversed if we find ways to remove carbon dioxide and other greenhouse gases from the atmosphere. We can take significant steps in this direction and potentially reduce global warming by at least 25 per cent if we conserve and expand forests and savannas (Anderegg et al., 2020; Dobson et al., 2022). Forests and savannas have provided this service for at least the last two hundred million years, long before humans evolved to disrupt the system. There are no human-made technologies available that will scale up to remove carbon and other greenhouse gases from the atmosphere within the next 25 years (Santos, Ferreira, & Pedersen, 2022). And then, it will likely be too late.

Carbon storage and water provisioning as ecosystem services

Plant photosynthetic processes, as well as their roots and soil microorganisms, help clean water and facilitate nutrient uptake. The chemistry of photosynthesis and the physiology of plants determine the efficacy with which they scrub CO_2 from the atmosphere, while cleansing large amounts of freshwater and returning it to the surrounding atmosphere (Reid & Lovejoy, 2022). Plants must transpire to supply their leaves with the water necessary for photosynthesis (Thomas, 2014). Chlorophyll converts carbon dioxide and water into oxygen, which is released into the local atmosphere, and amino acids, which are the building blocks that allow the plant to store carbon as structural tissue or as resources in its roots for next year's growth. Only a small amount of water absorbed by the roots and transpired by the leaves is used in photosynthesis; all of it is cleansed by passing through the plant. The large amounts of water absorbed by plant roots and released by their leaves maintain turgor pressure and flow. The water released can rise to form clouds, or precipitate out on surrounding surfaces, finding ways to flow back into the soil or streams and rivers. A strong hint of the efficacy of this process comes from the Keeling curve that quantifies levels of CO_2 in the atmosphere (Keeling et al., 1976); while the general trend is continuously upward, due to excessive CO_2 emissions, the annual cycle within the rising curve reflects leaf out in the northern forests and algal growth in oceans (Keeling, Chin, & Whorf, 1996). Both processes pull CO_2 out of the atmosphere. These annual cycles serve as a yearly reminder of the power of higher plants and oceanic algae to mitigate climate change. It's the only time we see a decline in atmospheric CO_2; it happens every year, and plants drive it.

Forests and savannas are major carbon sinks

The amount of carbon stored and volume of water cleansed vary between different plant groups: deciduous trees are denser than coniferous ones and mainly grow in warmer climates at lower altitudes and latitudes (Phillips et al., 2019; Thomas, 2014) In contrast, conifers have lower wood density but cover vast areas of the sub-Arctic and other arid regions (Mo et al., 2024). Their long afterlife partly compensates for their low wood density; they take nearly twice as long to break down when they die and can thus store carbon for a prolonged afterlife (Pielou, 1988). When rainfall falls below 800–1,000 mm/year, woodlands are replaced by grasslands (Sankaran et al., 2005; Staver, Archibald, & Levin, 2011), which predominantly store carbon in their extensive root systems. Grasslands do an excellent job of absorbing water from the soil whenever annual rains appear. Marine algae also remove vast amounts of carbon from the atmosphere and are rarely limited by water (Chung et al., 2011; Krause-Jensen & Duarte, 2016); the only constraint on their growth is light when they grow sufficiently densely. Marine algae have significant potential to supply future food for humans and livestock and to act as nurseries for increasingly embattled, polluted and overexploited fisheries.

The world's savannas and their extensive biodiversity are under the largest threat from agricultural expansion (Beale et al., 2013; Ogutu et al., 2014). The world's most important crops are grasses (corn, wheat, rice, sorghum, etc.), and these grow best in the same savanna habitats as their wild ancestors (Harris, 2014). Grass is also the preferred forage for the planet's vast herds of cattle, sheep and goats. Grazing could be much better managed as a way of promoting carbon storage and water recycling (Ritchie, 2020). Longer cycles of grazing within the annual rain cycle could allow grass more time to regrow at the maximum rates created by occasional grazing, particularly if it is fertilised gratis with one of the two most noxious by-products of cattle farming – poop! Creative management of grazing allows grass roots to build up as a carbon stock in the soil and minimises the rate at which ruminating cattle emit methane (the other noxious by-product that is an important greenhouse gas). Structured grazing reduces the need for burning at the end of the year, a practice that adds carbon and other pollutants into the atmosphere.

Economically, the above discussion places carbon storage and water supply on a different plane from other ecosystem services, which have largely fallen short as a mechanism for protecting biodiversity. Most ecosystem

service arguments do not resonate with politicians and the majority of voters. Ecologically, ecosystem service arguments are often flawed, especially when they overlook the fact that all biological communities are characterised by a log-normal distribution of abundance, with many rare species and a few ubiquitous ones (Winfree et al., 2015). This means that more than 90 per cent of ecosystem services are supplied by 10 per cent of common species. These underlying patterns of species abundance mean that rare species contribute little to ecosystem services.

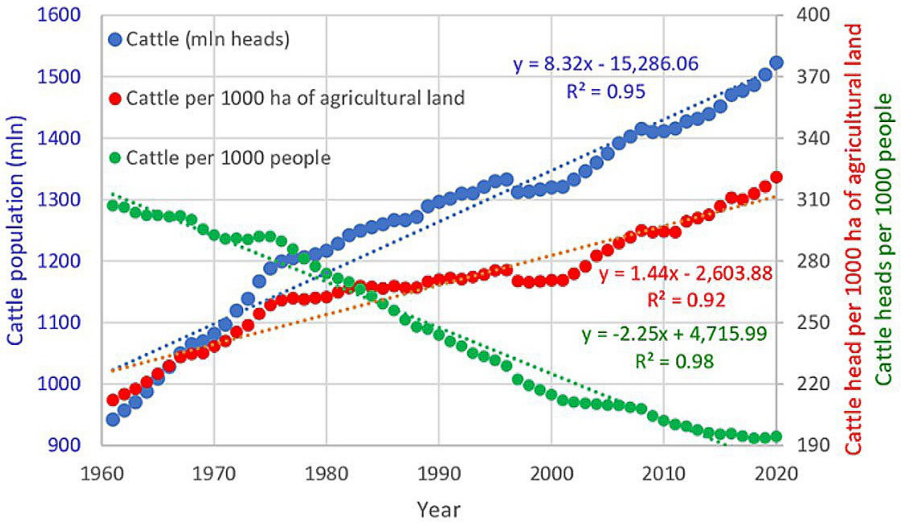


Figure 1. Global cattle population, density per 1,000 ha, and number per 1,000 people (Kozicka, Žukovskis, & Wójcik-Gront, 2023).

While considerable progress has been made in recent decades on evaluating ecosystem services, these arguments have only limited leverage in a political climate focused on short-term profits, fossil fuels, pseudo-currencies and military might. To conserve protected areas and their biodiversity, we must focus on the simplest, most tangible commodity they produce. In an ideal economic world, we need an ecosystem product whose value increases as rapidly as human population growth, one that is inelastic and cannot be replaced by an alternative product, and one that is fundamental to the lives of even the most marginalised members of humanity.

WATER!

Water is the one commodity that fulfils all three of these criteria. There is a finite amount of water on the planet: a cube whose base is around 50 per cent larger than Spain; 98 per cent of this cube is seawater (Pielou, 1998). A lot, but increasingly less, of the two-metre-deep pool of freshwater is stored in glaciers and the polar ice caps. The remaining freshwater is shared and recycled between the planet's 9 to 10 billion people, their business activities, and their agricultural needs. Livestock, humans and their business activities are all increasing. The available volume of freshwater is not. All humans require approximately 3 l of water per day (2.7 l for women and 3.7 l for men[1]). Industry, as well as computer data storage and increasingly AI, require vast amounts of cooling freshwater. Seawater is too corrosive for industrial cooling needs. Each of the 1.6 billion members of the global cattle herd requires 75 to 120 l of water per day, and nearly 50 per cent more at tropical temperatures (Figure 1). There are also 2.3 billion sheep and goats, and 0.75 billion pigs, which require 4 to 7.8 l/day and 8 to 12 l/day, respectively. Basic economics tells us the value of freshwater is rising faster than the number of people who need to use it. There is indeed water, water, everywhere, but increasing demand leaves fewer drops to drink.

All of this makes freshwater an increasingly valuable commodity. Most of the water we drink, or use to irrigate our crops, has been recycled. If we are lucky, this has occurred naturally through the evaporation of water falling as rainfall, which then passes through the roots and leaves of plants. If we are less fortunate, it has been industrially recycled, accumulating trace elements of chemicals that are detrimental to our physical and mental health. Many of the world's poorest people have minimal access to either source of recycled water. They bathe in weakly diluted sewage water and boil it to drink using firewood and charcoal, which concomitantly depletes forests and adds carbon to the atmosphere.

How could a focus on water help us achieve vital environmental goals, such as the protection of 30 per cent of the world's land and ocean areas by 2030? Let us initially acknowledge, whispering it quietly, that the Convention on Biological Diversity (CBD) is not well-suited for this purpose in the current and emerging political climate[2]. The CBD acknowledges many vital aspects of biodiversity and has drawn global attention to

1 Dietary reference intakes for electrolytes and water. US National Academies of Sciences, Engineering, and Medicine. https://www.nationalacademies.org/our-work/dietary-reference-intakes-for-electrolytes-and-water. Accessed Oct. 2, 2020.

2 The Convention on Biological Diversity is too complex, multifaceted and confusing for politicians and decision-makers. International treaties work best when focused on a single issue. For example, the Montreal Protocol works well and was quickly adopted as it focused on a unitary issue, the impact of refrigerants on the integrity of the ozone layer. Even the Paris Accord, which deals with climate, has too many variables for an overtaxed political mind. An international treaty on water has underlying simplicity, and while meeting fundamental human requirements, also has the potential for nefarious profits, all of which creates appeal across a broad political spectrum.

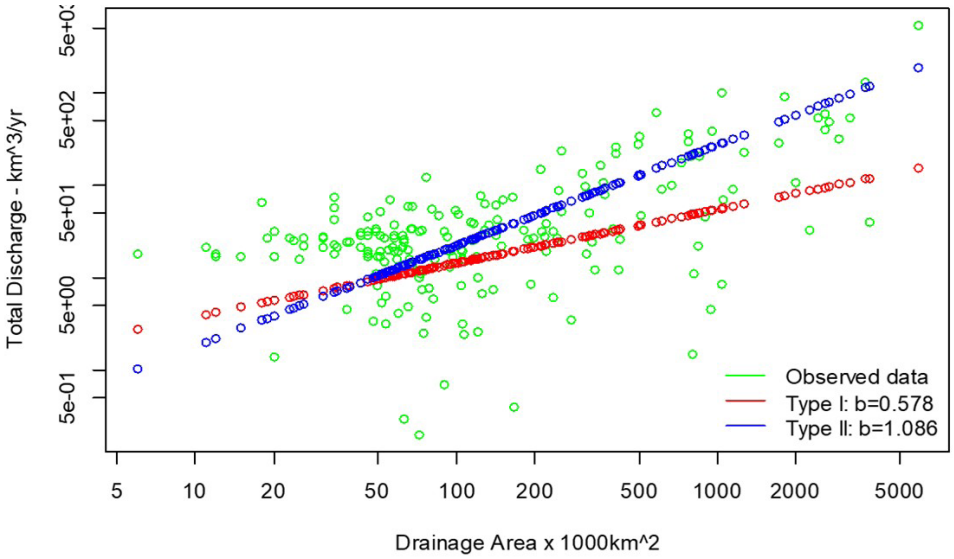
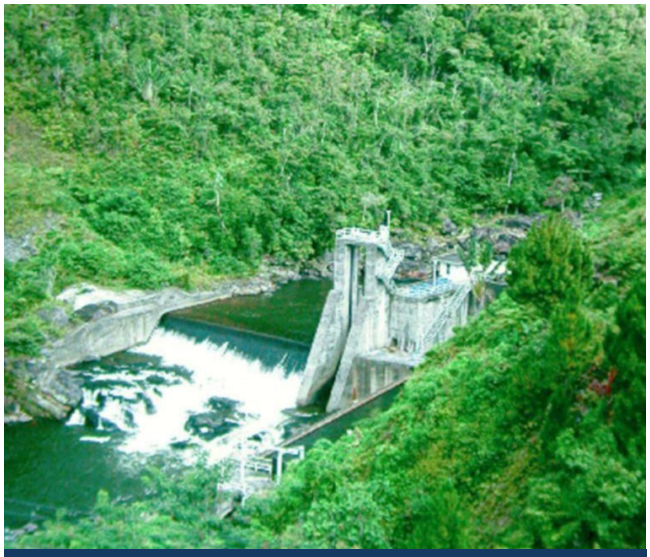


Figure 2. Total discharge from the world's 200 largest rivers by drainage area. Two regression lines are fitted to the log-transformed data. The red line illustrates the traditional least squares regression which assumes drainage area can be measured accurately. This curve begins to saturate. The blue line illustrates the major axis regression which assumes error in both drainage area and discharge (which is always highly variable). The second correct regression gives a slope of unity.



Hydroelectric dam in Ranomafana NP, Madagascar. The dam supplies all the electricity to power Madagascar's second largest city, Fianarantsoa. The park contains 13 lemur species; it was originally set up to protect the forest that supplies water to the river powering the hydroelectric scheme. © Andy Dobson

the problems associated with the loss of biological diversity. This has leveraged some popular support for conservation efforts that many nations have agreed to support. However, it fell short when confronted with woefully ignorant politicians in increasingly autocratic countries. Their focus is on short-term, popular projects that facilitate their re-election while maintaining the wealth of the oligarchies and industries that support their election campaigns.

Setting aside large areas of the planet's land mass to conserve biodiversity requires preserved land to produce tangible benefits that politicians recognise as vital to those who elect them, or to the economy of the military-industrial complex that allows them to retain power (Vidal, 2002). Thanks to water, most protected areas already make significant and fundamental contributions to key aspects of all nations' budgets. The health of their human populations, productivity of crops and domestic livestock, and industrial productivity are all dependent on the silent contribution of water.

Water, water everywhere

Most water arrives in all nature reserves, farms and other domesticated habitats as rainfall, some flows in from upstream rivers. Significant amounts of this evaporate from leaves and other surfaces, but this condenses at night or returns as rain (Pielou, 1998). Rain is generated by and collected by watersheds – often in montane areas. Rivers and streams carry water downstream where changes in altitude allow water to power hydro systems and then supply water to agriculture, industry and direct human use (Picture 1. Ranomafana). Water enters oceans in estuarine areas surrounded by salt marshes and mangrove forests that protect against storm damage and often act as primary nurseries for many fisheries.

River discharge scales with drainage area (Figure 2). (Earlier studies assumed a saturating relationship, but this stemmed from a fundamental flaw in their statistical analysis.) This linear relationship means that the larger the area of watersheds we protect, the more water will be available for downstream consumption. The water available to humans is essentially entirely dependent on

Forest of Parque Nacional Soberania, near Gamboa, Panama. Water from the park is essential for maintaining water levels in the Panama Canal. © Andy Dobson

the montane and lower altitude forested watersheds that feed streams and rivers. Most rivers originate in montane regions and flow through forests, then pass through savannas and agricultural land before forming estuaries and entering oceans; all are areas of high biodiversity. River water leaves forests and nature reserves in predictably located streams, rivers and underground aqueducts. Protected areas must find a way to leverage the outflow of this vital and most tangible ecosystem service. As many subsistence farmers cannot afford to pay for water, local and national governments, as well as private landowners, need to find ways to efficiently and ethically price and tax water in their national, regional and personal budgets (Salzman, 2017). This may require adding a 'water benefits' subsidy to admission fees for protected areas. The science is simple, but politicians and lawmakers need to develop policies that reflect this and more accurately value freshwater and the land that captures and cleans it (Garrick et al., 2017; Gleick, 2003; Postel, Daily, & Ehrlich, 1996).

Let us consider a tangible example provided by a protected area: Parque Nacional Soberania surrounds the Panama Canal, which provides the water that enables shipping to move between the Pacific and the Caribbean. The canal provides access to European markets for marine traffic from Southeast Asia and the West Coast of the United States, as well as to European and West African markets, and vice versa. The canal is primarily formed by Lake Gatun, whose river outlet was blocked by a dam after locks were constructed to raise shipping to the lake's level (McCullough, 2001). The recent construction of new locks that permit the passage of the world's largest container ships now allows around 20 per cent of world trade to pass through the canal (Wang, 2017). The water in Lake Gatun is entirely dependent upon water supplied by the forests of Parque Nacional Soberania (Condit et al., 2001) (Picture 2: Parque Nacional Soberania). The edge of this forest is continually eroded by small-scale agriculture, which leads to a reduction in water level in the canal, particularly during El Nino droughts (Condit et al., 2001).

One of the biggest business deals of 2025 was the purchase of the ports at either end of the canal, providing the American multinational investment company, BlackRock, with control over access to the Panama Canal. Curiously, there was no recognition in the purchase agreement of the canal's significant dependence on water supplied by Parque Nacional Soberania. This is arguably one of the world's single largest ecosystem services. The whole investment is dependent upon the integrity of the forest of Parque Soberania. It would seem wise for the Panama Canal Authority and BlackRock to levy an additional charge on every vessel passing through the canal, and use this revenue to preserve and expand the forests that feed the canal and keep water levels stable.

Land for water will conserve biodiversity

Several independent groups have suggested that between 25 per cent and 50 per cent of global land should be set aside for nature, biodiversity and all non-human species (Noss et al., 2012; Wilson, 2016). The goal of protecting a significant proportion of global terrestrial biodiversity might gain broader appeal among politicians and their electorate by the designation of 50 per cent of global land area above 500 m as wilderness to protect the water supply for humans and agriculture. The focus on rivers and lakes would also protect significant amounts of freshwater biodiversity (Leal et al., 2020; Piczak et al., 2023). Moreover, land used to supply freshwater would also function as a significant carbon sink, helping to mitigate global climate heating.

I make the case that the best way to set aside 50 per cent of land for biodiversity is to roughly split the global terrestrial environment into four quarters, each of which supports different but overlapping sets of biological diversity and each of which supports other components of the human economy. The key psychological and economic step here is to acknowledge that some areas are better suited for agriculture, some are better suited for biodiversity, and others are more suitable for human habitation. In an ideal world, we would divide these into non-overlapping areas. Logistically and politically, this is impossible. However, altitude already divides land areas along these lines, with most biodiversity conserved on

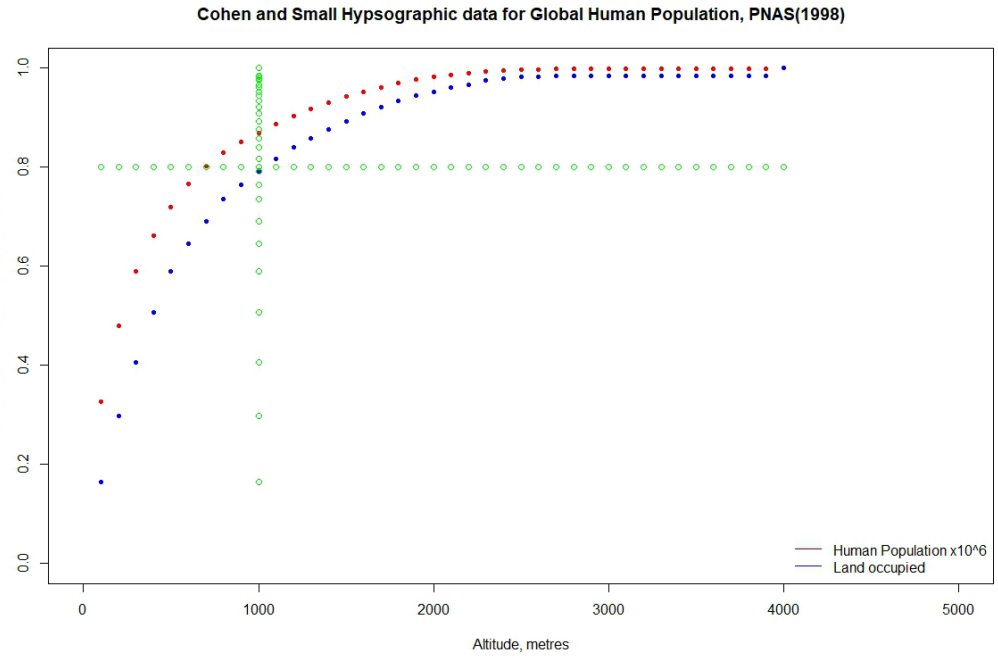


Figure 3. Hypsographic demography: the relationship between altitude and human population (red) and land occupied (blue). The red curve illustrates cumulative human population ranked by altitude in which people live. The blue curve illustrates total area of land occupied ranked by altitude. The green lines indicates that 80% of occupied land is at less than 1,000 m and that 80% of people live at less than 500 m (after Cohen & Small, 1998).

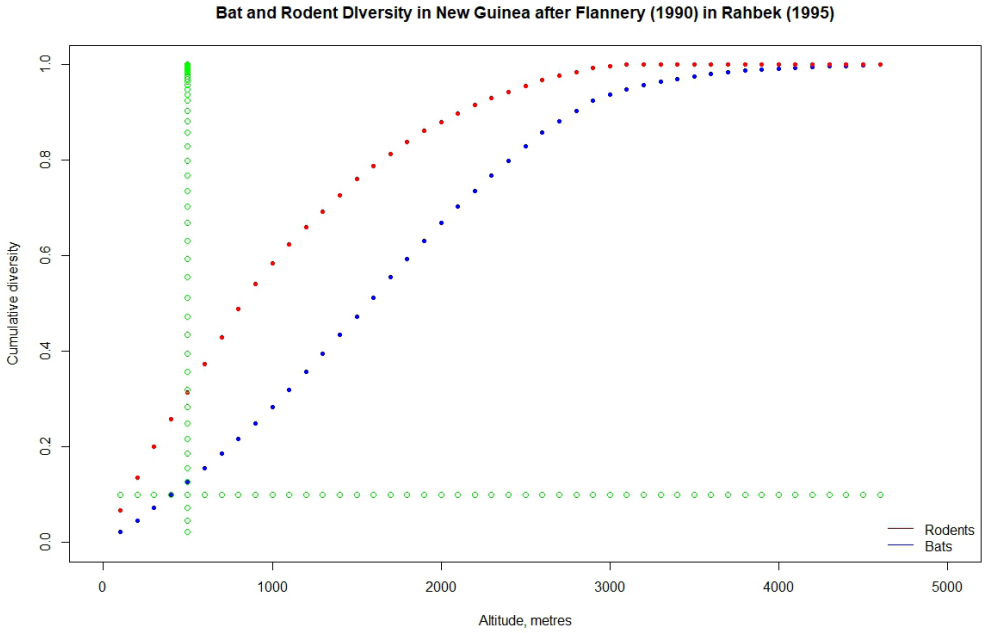


Figure 4. Species richness at different elevations from Rahbek review in *Ecography* (1995). Figure A plots data for rodent and bat diversity in New Guinea. In all cases, species diversity peaks at just over 1,000 m and more than 80% of diversity is present at greater than 500 m.

land at intermediate to higher altitudes (Fjeldså & Rahbek, 1997; Rahbek, 1995), while most agriculture and areas of high human population density tend to occur near sea level (Cohen & Small, 1998).

Three sets of information suggest that what I propose has already been partially implemented, more by luck than by design. Classical hypsographic studies of human demography and altitude have shown that the majority of the human population lives at altitudes lower than 500 m (Figure 3), and is typically located in coastal areas (Cohen & Small, 1998; Small, Gornitz, & Cohen, 2000).

Unfortunately, these people will be significantly impacted by the sea-level rise that will occur as the polar ice caps recede and the ocean level rises due to climate heating. Their upslope movement will encroach on land at mid-altitudes and will likely lead to further agricultural expansion. As rising oceans are a consequence of climate change, it is doubly important to focus on conserving and restoring forests and savannas in ways that can help slow climate change and concomitant sea-level rise.

The second piece of evidence comes from ecologists' long-term fascination with altitudinal patterns of

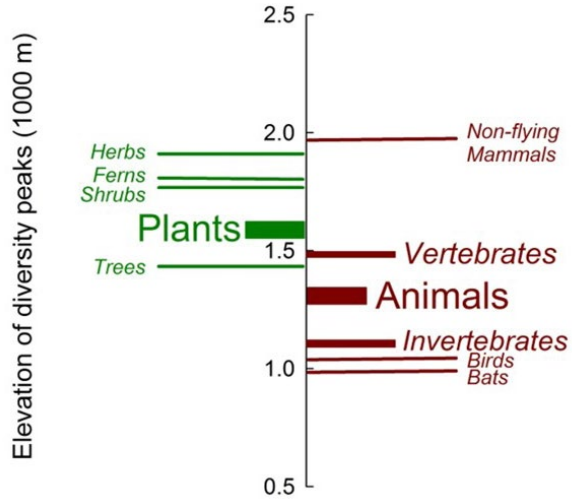


Figure 4B. Global variation in elevational diversity patterns (after Guo et al., 2013). The altitude at which elevational diversity peaks is illustrated for plants (on the left) and animals (on the right).

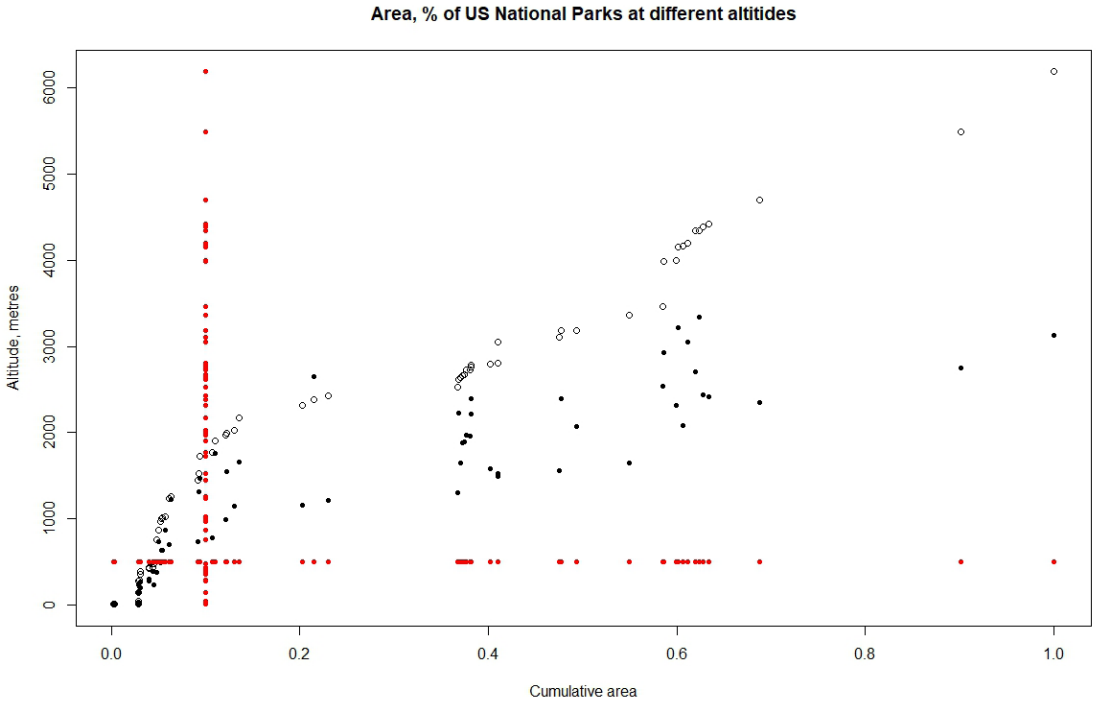


Figure 5. Relationship between altitude and area of land in national parks. The mean altitude for each of the 63 US National Parks is given by the solid circles, the highest elevation by the open circles. Ninety per cent of area (vertical red line) in National Parks lies in land above 500 m in altitude (horizontal red line). Data available from https://en.wikipedia.org/wiki/List_of_national_parks_of_the_United_States and https://en.wikipedia.org/wiki/List_of_national_parks_of_the_United_States_by_elevation.

diversity, which date at least to Humboldt's time in the 18th century (Wulf, 2015). The work of Rahbek illustrates that levels of biodiversity tend to peak at mid-altitudes (Fjeldså & Rahbek, 1997; Rahbek, 1995) (Figure 4). Crucially, more recent studies of a variety of animal and plant groups have confirmed that biodiversity tends to peak at altitudes higher than those where most humans and livestock reside (Guo et al., 2013) (Figure 4B). This means that most of the biodiversity tends to occur at altitudes higher than where most humans are living and growing crops.

The final piece of evidence concerns the altitudinal distribution of current national parks and wilderness areas. Although many parks in the US were initially set up to conserve their geological features, they also do an excellent job of protecting biological diversity. Data on altitudinal distribution of national parks in the United States show that only 3 per cent of their total area occurs in low-lying areas (<50 m), mainly in the Florida Everglades and Keys (Figure 5). Around 10 per cent lies below 100 m; the rest of the land occupied by US national parks lies at higher altitudes; more than 90 per cent lies above 500 m. I suspect that these altitudinal patterns of relative abundance are true for most continents.

Yellowstone National Park in winter accumulates water as snow which melts to supply water the following summer © Andy Dobson

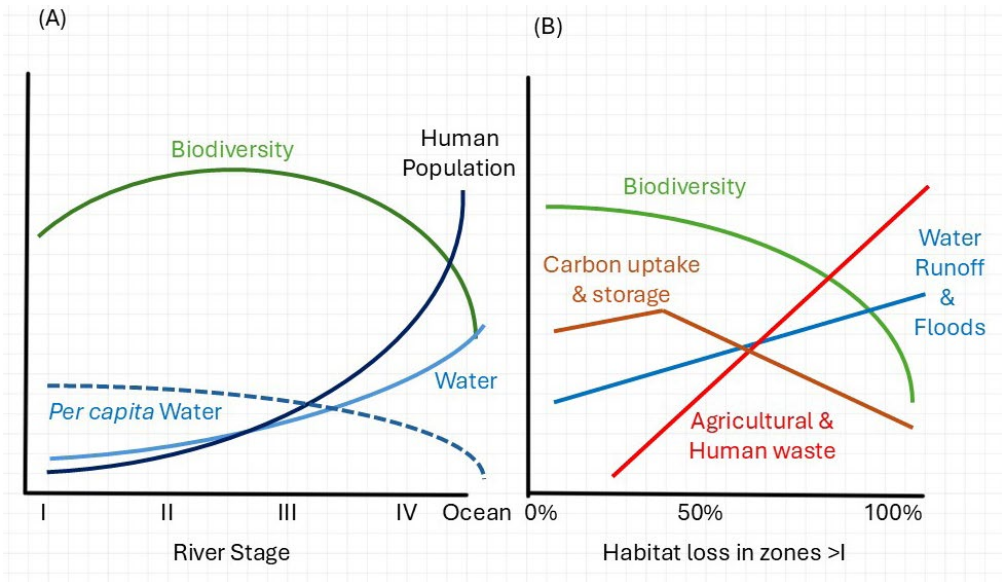


Figure 6. (A) Hypothetical relationships between rivers stage, biodiversity, human population density, water volume and per capita water available at different river stages from montane (IV) to the ocean. (B) Relationships between proportional habitat loss in upstream zones (II–III) of a river system and the amount of human and agricultural waste in the river, the rate of water run-off and resultant downstream floods, the amount of carbon stored or taken up by remaining vegetation, and its associated biodiversity. All of the rates in these figures can be parameterised and converted into a more detailed analytical

There is thus limited overlap in the United States between areas where the majority of humans live and areas high in biodiversity, where most protected areas are situated (Picture 3 Yellowstone in winter). Crucially, these areas supply significant amounts of freshwater to the agricultural lands and people living at lower altitudes, many of whom may never visit the parks that make their lives possible. As cities, industry and agriculture are totally dependent upon large supplies of freshwater, there is a huge incentive for conserving the lands that supply this water. This will indirectly protect biodiversity as a side benefit. If ways can be found to amortise the supply of water, this will provide funds and an incentive to protect both biodiversity and water supplies.

It is a relatively straightforward exercise to make simple 'toy models' of this form of land use and water supply. One can then build economic decision-making into these models (Figure 6, Dobson et al., in review). The model assumes that complex landscapes can be divided into altitudinal zones that reflect the different classical stages of river flow (river continuum concept; Doretto, Piano, & Larson, 2020; Vannote et al., 1980). At the lowest altitude (<200 m), rivers are turning into estuaries and flowing into the ocean. The majority of land in this zone

IV will have been converted into cities, manufacturing facilities, intensive agriculture, shopping malls and golf courses. Around 50 per cent of the human population lives here (Cohen & Small, 1998; Small & Cohen, 2004). Agriculture is more productive and tends to be focused in these lower-lying areas. However, both water and pollutants flow into this region from the areas between 200 and 500 m that surround it (zone III). At these slightly higher altitude lands, human population is lower, and both extensive and intensive agriculture are present. It is possible that significant biodiversity can be maintained in the areas between intensive agriculture, but this will decline as agriculture expands (Phalan et al., 2011).

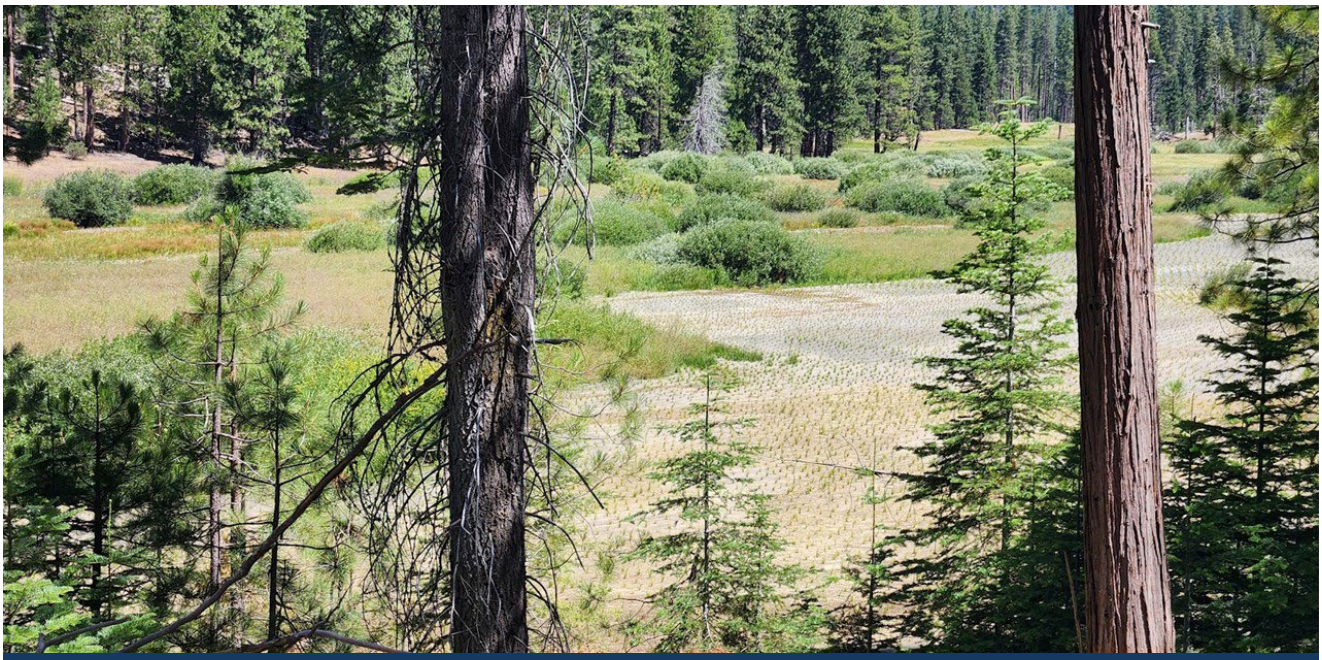
Many, but not all, nature reserves and protected areas are situated at higher altitudes on land that is largely unsuitable for agriculture. Zone II lies between 500 and 1,000 m, where agriculture is less intensive and a considerable area can be set aside for biodiversity. The classic example would be the Trento region of Italy, which produces high-end fruit, wine and dairy products, while also containing significant forests and montane areas that support Europe's largest wolf and brown bear populations. The Sierra Nevada of California has similar potential, but falls short for complex political reasons, not least the demand for water for agriculture in California's Central Valley (Thornton & Weiland, 2016). Water flows into zone III from the more mountainous regions that rise to the highest slopes. The highest areas in zone I are too steep for agriculture, often forested, and covered in winter snow, which serves as a major store of water into early summer. This highest area supports the lowest density human population, frequently supplemented by significant seasonal tourism in summer and winter, attracted by recreational activities which may occasionally include biodiversity. Water is stored here in snow fields and glaciers. It may also be stored in zones II and III as reservoirs used to drive hydroelectric schemes or to supply clean piped water to lower-lying coastal cities. The flow of water connects all four regions, and it is much cheaper to let water run downhill for free than to spend lots of energy moving it uphill. A significant amount of biodiversity can be conserved in the two highest regions, a relatively benign, pragmatic and economic way for nature to receive half.

A key hidden assumption underlying these models is that pollutants always accumulate in rivers and streams as they run downstream. The rate at which pollutants from agriculture (faecal pollution and chemical fertilisers) can be cleaned up is highly dependent on areas of habitat that are left with natural vegetation to absorb and utilise these 'accidental' plant nutrients. This creates a direct economic trade-off between biodiversity and water quality, and between the volume and type of food produced by agriculture. The best way to supply cheap, clean freshwater and healthy food to people living in low-lying cities is to optimise the amount of forest and savanna conserved around upstream watersheds. Several studies of children's health in different river systems confirm the importance of this effect (Herrera et al., 2017).

CONCLUSION

Freshwater is one of the most valuable resources on the planet (Brown, 1997; Chichilnisky & Heal, 1998; Postel et al., 1996; Pretty, 2003) and its value is increasing as per capita supplies of freshwater decline. Forests and savannas consistently produce large flows of clean freshwater. Humans, agriculture and industry have a fundamental dependence on access to the planet's finite supply of freshwater (Gleick, 2003; Salzman, 2017). All of which suggests that focusing new national and international conservation agendas around the theme of providing safe sources of clean freshwater for human populations is a win-win situation. Initiatives such as the Freshwater Challenge can play a major role here (https://www.freshwaterchallenge.org/). A conservation agenda that explicitly acknowledges the role that protected areas play in maintaining the supply of freshwater should find ways to charge for it (Garrick et al., 2017). This could provide funds to conserve and restore the land from which water flows (Figure 4. Restoration at Ackerson Meadows, Yosemite). All of which provides a powerful transactional economic mechanism for conserving large amounts of land and the species that provide the ultimate ecosystem service of cleansing and regulating freshwater flows.

There is, of course, no easy way to reorganise the global conservation agenda along the lines I have suggested. I would like to strongly emphasise that what I propose is complementary to current conservation efforts, not a replacement for them. However, complementing pleas to conserve biodiversity with transactional arguments to conserve freshwater and its biodiversity is an approach that will resonate across a broader political spectrum. Although there are considerable local, regional and international conflicts over freshwater and its distribution, the Dublin Statement on Water and Sustainable Development provides further impetus to develop local, national and international policy over water use (Giordano & Wolf, 2003; ICWE Secretariat, 1992). I do not doubt that the strongest motivation to drive this agenda will be the rapidly approaching shortage of viable, stable and long-term water supplies that are central to human health and agricultural production.



Restoration of flood meadows at Ackerson Meadows on the edge of Yosemite NP, California. American Rivers have restored the meadows by restructuring the soil and planting with native seeds. In the last two years, it has raised the water table by 15 feet and provided habitat for restored native vegetation and three endangered species: Western Pond Turtle, American Fisher, and the Willow Flycatcher © Andy Dobson

Focusing on land to provide water will inadvertently provide land that protects biodiversity.

Freshwater is central to human health and well-being. The global supply of freshwater is the ultimate constraint on economic growth. Concomitantly, freshwater is often the most pressing need for those living in poverty. The areas of land set aside as reserves to protect the water supply for humans and agriculture could potentially protect a major proportion of global terrestrial and freshwater biodiversity. A UN Convention on Water could be more effective than the UN Convention on Biodiversity in protecting biodiversity. Politically, conserving land for water is a much easier sell in a world where droughts and wildfires will increasingly plague humans and their equally thirsty domestic livestock populations and industries.

ABOUT THE AUTHOR

Andy Dobson has worked on the ecology of wildlife disease and conservation biology for most of his career. His research has focused on Serengeti NP, Yellowstone NP, coastal California, and on backyard birds across the United States. He is currently writing a series of books that describe how natural history interacts with quantitative biology to help us understand the natural dynamics of the ecological communities in national parks.

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RESUMEN

La política mundial ha entrado en una era más transaccional. Aunque los servicios ecosistémicos proporcionan argumentos económicos válidos para conservar la biodiversidad, estos argumentos no resuenan entre los políticos centrados en beneficios tangibles y a corto plazo para su electorado. Necesitamos argumentos más convincentes para conservar grandes extensiones de tierra que proporcionen beneficios transaccionales a los votantes. El cambio climático no es suficiente; es una amenaza secundaria para la biodiversidad y cuenta con un apoyo político limitado, excepto cuando las inclemencias del tiempo afectan directamente a los seres humanos a través de inundaciones, huracanes o sequías.

Todos estos desastres están fundamentalmente relacionados con el agua. Paradójicamente, el suministro mundial de agua es cada vez más escaso y variable, pero sigue estando íntimamente relacionado con la presencia de bosques y grandes zonas montañosas. La elaboración de una convención internacional sobre el agua crearía indirectamente una agenda que conduciría a la protección de una parte significativa de las zonas terrestres del planeta. La mayoría de las áreas protegidas se encuentran por encima de los 1000 metros. Deben gestionarse de manera que se conserve la biodiversidad y se garantice un suministro continuo de agua dulce limpia para las poblaciones humanas y el ganado doméstico del planeta. El agua podría entonces fluir desde estas áreas hacia aquellas con una agricultura y una industria más intensivas, y hacia las ciudades de baja altitud donde vive la mayor parte de la población humana de la Tierra.

RÉSUMÉ

La politique mondiale est entrée dans une ère plus transactionnelle. Bien que les services écosystémiques fournissent des arguments économiques valables en faveur de la conservation de la biodiversité, ces arguments ne trouvent pas d'écho auprès des politiciens qui se concentrent sur les avantages tangibles et à court terme pour leur électorat. Nous avons besoin d'arguments plus convaincants pour conserver de vastes zones terrestres qui offrent des avantages transactionnels aux électeurs. Le changement climatique n'est pas suffisant ; il s'agit d'une menace secondaire pour la biodiversité et il bénéficie d'un soutien politique limité, sauf lorsque les conditions météorologiques défavorables ont un impact direct sur les humains sous forme d'inondations, d'ouragans ou de sécheresses.

Toutes ces catastrophes sont fondamentalement liées à l'eau. Paradoxalement, l'approvisionnement mondial en eau devient de plus en plus précaire et variable, mais il reste intimement lié à la présence de forêts et de vastes zones montagneuses. L'élaboration d'une convention internationale sur l'eau permettrait de créer indirectement un programme menant à la protection d'une partie importante des zones terrestres de la planète. La majorité des zones protégées se trouvent à plus de 1 000 mètres d'altitude. Elles doivent être gérées de manière à préserver la biodiversité tout en garantissant un approvisionnement continu en eau douce propre pour les populations humaines et le bétail domestique de la planète. L'eau pourrait alors s'écouler de ces zones vers celles où l'agriculture et l'industrie sont plus intensives, ainsi que vers les villes de basse altitude où vit la majeure partie de la population humaine de la Terre.

DESIGNING PROTECTED AND CONSERVED AREAS TO SUPPORT FREE-FLOWING RIVERS: ENVIRONMENTAL FLOWS, CONNECTIVITY AND COMMUNITIES

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ABSTRACT

Rivers are not isolated features, they are lifelines, and less than one third of the world's large rivers remain free-flowing. Protecting free-flowing rivers requires honouring the people who sustain them, and embracing conservation as a shared, relational practice rooted in connection, reciprocity and care. Free-flowing rivers support dynamic flow regimes, sediment transport, species diversity, migration, and the resilience of landscapes. They provide essential services such as clean water, food security, flood regulation, and cultural values for millions of people globally. Despite their importance, rivers remain highly threatened and under-protected. This paper builds on the recent IUCN World Commission on Protected Areas guidance on inland waters, detailing community-based river protections that secure environmental flows and connectivity. Innovative cases from the Ecuadorian Amazon, Gayini in Australia, the Puelo and Futaleufú Rivers in Chile, the Bita River in Colombia, and the San Pedro Mezquital and Usumacinta Rivers in Mexico, highlight how local communities have worked with partners and governments to establish protected and conserved areas that keep their waterways connected and flowing. The paper concludes with recommended approaches to elevate rivers and their stewards in implementation of the 30x30 protection target and beyond.

Keywords: freshwater ecosystems, protected areas, 30x30, community conservation, freshwater biodiversity

INTRODUCTION

Riverine ecosystems cover less than one per cent of the Earth yet support a disproportionately large fraction of its biodiversity and life sustaining services (Allen et al., 2018; Finlayson et al., 2017). They are distinguished by their water flows, dynamism and connectivity in multiple dimensions. Free-flowing rivers are increasingly rare, with more than two-thirds of the world's largest rivers existing in an altered state (Grill et al., 2019). A free-flowing river is defined as one that is functionally connected upstream to downstream (longitudinally), between its riverbed and the floodplain (laterally), between groundwater and surface water (vertically), has sustained seasonal and interannual patterns of flows over time (Poff &Ward, 1989; Ward & Stanford, 1995) and is not obstructed in the entirety of its length.

Rivers are lifelines for both people and nature, shaping cultures, sustaining livelihoods and anchoring biodiversity. They supply water to communities and support one-third of the global food resource, including major inland fisheries in the Mekong, Ganges, Amazon and Congo (Convention on Wetlands, 2025; WWF, 2021). Beyond provisioning, rivers serve as transportation corridors, sacred spaces, mental and physical health supports, tourism hubs and cultural anchors (Kumar et al., 2017; Verschuuren et al., 2021). In total, freshwater ecosystems contribute an estimated US$50 trillion annually through nutrient cycling, water purification, carbon sequestration, and floodplain storage and productivity (WWF, 2021).

Ecologically, rivers and their floodplains host the highest biodiversity density of any biome (Finlayson et al., 2017) and act as connectivity corridors for species, nutrients and sediments (Hilty et al., 2021). The loss of riverine habitats from dams and diversions has contributed to the staggering decline of monitored populations of

Fisher communities in the Mekong River, Vientiane, Laos PDR © Emanuela Colombo / WWF-Laos

freshwater species by 85 per cent since 1975 (WWF, 2024). This decline is mirrored across species reliant on riverine ecosystems, with migratory fish populations down by 81 per cent, aquatic megafauna such as river dolphins and hippos reduced by 88 per cent, and mega-fishes experiencing a staggering 94 per cent loss (WWF, 2024). Free-flowing rivers are also vital for both terrestrial and marine ecosystems, supplying critical food and water resources, migratory corridors, shaping and maintaining deltas, and regulating temperature and water quality.

This paper builds on the recent IUCN World Commission on Protected Areas guidance on designing and managing protected and conserved areas for inland waters (Moberg et al., 2024) and highlights approaches to design and designate river conservation areas using detailed community-based river protection cases where connected and flowing rivers have been secured.

STARTING WITH COMMUNITIES

Unlike static landscapes, rivers are dynamic systems flowing across territories, cultures and governance regimes (Zhang et al., 2023). Their ecological health is inseparable from the well-being of those who live alongside and depend on them (Fromherz & Lyman, 2022). An approach rooted in communities, human rights, equity and inclusion is necessary from the beginning stages of planning (FAO, 2016; Franks et al., 2024; UNGA, 2010, 2019).

For many communities, rivers are sacred and central to identity, sustenance and cultural continuity (Cultural Survival & First Peoples Worldwide, 2023; FAO, 2016). Conservation efforts that overlook these relationships risk reinforcing historical injustices and undermining resilience (TNC, 2020; USAID, 2021). Rather than imposing exclusionary models that restrict access or prioritise ecological metrics alone, river conservation must elevate community-led stewardship and recognise diverse governance systems (Franks et al., 2024; Meinzen-Dick & Pradhan, 2002; WWF & IUCN WCPA, 2023).

This calls for inclusive, place-based frameworks that respect customary rights, Indigenous and traditional knowledge and local perspectives (Fromherz & Lyman, 2022), while confronting power imbalances to ensure voices of marginalised communities actively shape decision-making (Friedman et al., 2018; McDermott et al., 2013). This also includes considering how participatory processes can support sustainable use, intergenerational knowledge exchange, and adaptive capacity amid climate and hydrological change (Moberg et al., 2024; Zhang et al., 2023).

A leading example can be found in Ecuador's Sistema Fluvial Nushiño-Curaray-Villano. In response to threats in the watershed, Indigenous nations and The Nature Conservancy (TNC) worked together to scope opportunities to conserve the area, including the concept of a fluvial reserve. The proposal considered was establishment of a 'Community Conservation and Management Use Area', a category of conservation that is included in Ecuador's legal framework. This category promotes the protection of Indigenous peoples' rights to self-determination and guarantees the freedom to make decisions without pressure.

Representatives of the Indigenous nations asked TNC to facilitate a Free, Prior and Informed Consent (FPIC)

Workshop with representatives of the Kichwa Indigenous communities to define strategies to be included in the management plan for the Nushiño-Curaray-Villano Fluvial System, Puyo, March 2024. © Gabriela Celi/The Nature Conservancy

process with all 80 Waorani and Kichwa communities living in the area. An FPIC guide and report were created to define and document the consultation process including detailed information about the Indigenous nations, and the processes for discussion, decision-making and final consent. Each of the 80 communities voted on the potential proposal with the options of affirmative, affirmative with conditions, negative but open to future discussions, or negative. As of 2024, all 80 communities have voted to recognise the fluvial system as a community-led conservation area. They are leading development and implementation of the governance structure, management and monitoring plans with support from TNC (Moberg et al., 2024).

By starting with communities, conservation models are more just, resilient and ecologically effective (Convention on Wetlands, 2000; Perry et al., 2024). Additional resources and principles are included in detail in Chapter 3 of the IUCN WCPA inland waters report (Moberg et al., 2024).

STRENGTHENING PCA NETWORK DESIGN AND DESIGNATION FOR RIVERS

As part of the Kunming-Montreal Global Biodiversity Framework (GBF) many countries have pledged to conserve at least 30 per cent of the world's land, inland waters and ocean through an ecologically representative, well-connected and equitably governed network of protected and conserved areas by 2030 (hereafter, 30x30).

Globally, 17.6 per cent of rivers are included in, or border protected and conserved areas (PCAs), with free-flowing rivers receiving comparable coverage (Moberg et al., 2024; Opperman et al., 2021; UNEP WCMC, 2024). However, most

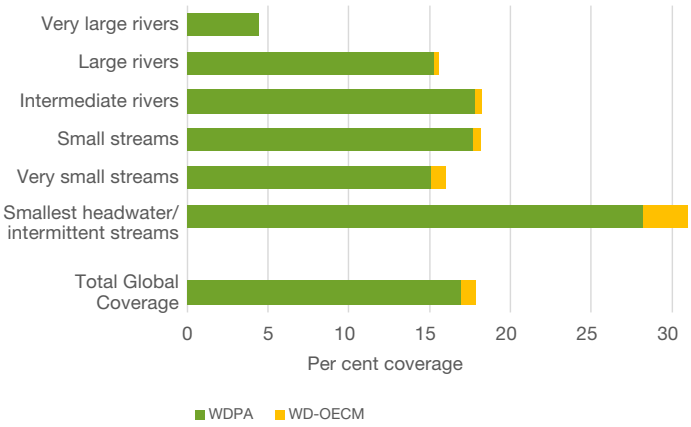


Figure 1. Extent of river length, by size class, covered by existing protected areas (WDPA) and other effective area-based conservation measures (WD-OECM) (UNEP-WCMC & IUCN 2024a; UNEP-WCMC & IUCN 2024b). Size classes are based on average annual discharge of cubic metres per second (cms); headwaters (<0.001), very small streams (0.001–0.1), small streams (0.1–10), intermediate rivers (10–1,000), large rivers (1,000–100,000), very large rivers (>100,000).

coverage focuses on headwaters and intermittent streams, with limited representation of large rivers (Figure 1). Moreover, inclusion in PCAs does not guarantee effective conservation as siting, design and management must align with freshwater ecosystem objectives (Abell et al., 2017; Higgins et al. 2021; Moberg et al., 2024).

Traditional area-based conservation models have long favoured terrestrial ecosystems, frequently overlooking freshwater systems despite their critical ecological roles and vulnerability. To safeguard rivers and their associated habitats, conservation strategies must evolve.

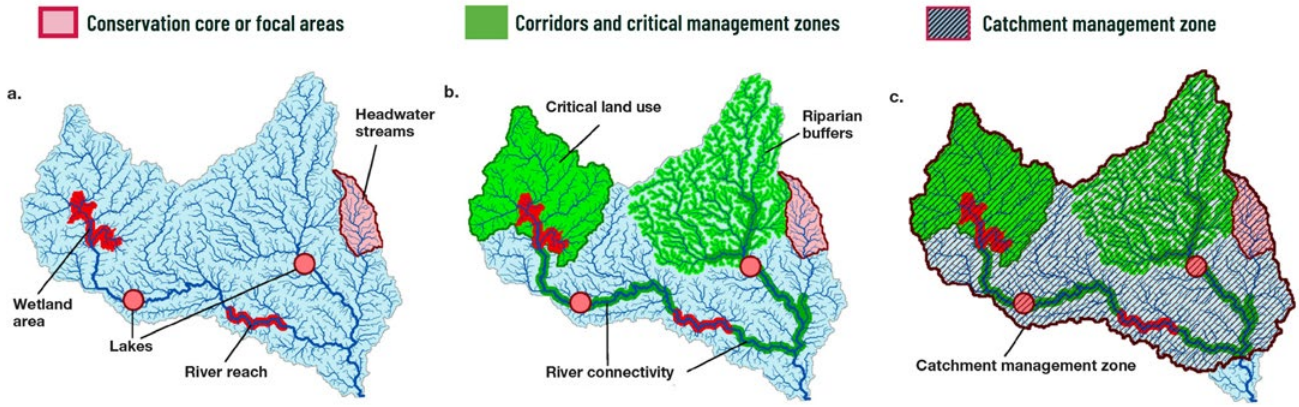


Figure 2. A basin/catchment protection approach tailored to river ecosystems including (a) cores or focal areas (b) corridors or critical management areas and, (c) catchment (basin) management zones (Adapted from Abell et al., 2007).

This includes adapting spatial planning, site design, and legal frameworks to reflect basin-scale dynamics, landscape connectivity, and integrated, function-driven approaches that are grounded in governance realities (Abell et al., 2017; Hilty et al., 2021; Moberg et al., 2024; Figure 2).

Spatial planning. Effective spatial planning requires treating freshwater, terrestrial, coastal and marine ecosystems as interconnected systems. Prioritisation should incorporate freshwater-specific data and tools to identify ecological gaps and guide protected area design that reflects hydrological processes. River protection must consider scale and context, recognising the nested nature of rivers within broader basins and the influence of upstream and downstream dynamics (Thieme et al., 2023). Connectivity, including longitudinal, lateral and vertical, is essential. Preserving functional integrity means safeguarding processes like natural flow regimes and sediment transport, which are vulnerable to both direct river impacts and basin-wide activities. Evidence shows that integrated planning across ecosystems can achieve conservation goals more efficiently than siloed approaches; in fact, integrating the needs of freshwater species into overall reserve planning increased freshwater benefits by 600 per cent while only decreasing terrestrial outcomes by 1 per cent (Leal et al., 2020).

Site design. Designing protected areas for rivers requires function-based site design. Using rivers as boundaries can fragment ecosystems and undermine conservation goals. Instead, geographic boundaries should encompass key habitats and processes tailored to specific riverine values and management objectives (Higgins et al., 2021). Protection does not need to be uniform across catchments, for example, spawning habitats such as deep pools may warrant strict protection, while migratory corridors could be shielded from disruptive barriers yet remain accessible for low-impact use. Basin-wide management practices can help reduce sedimentation and maintain water quality (Abell et al., 2007).

Site design must be anchored in clear objectives and measurable targets. For example, maintaining migratory routes for fish may involve targets like barrier-free reaches and continued species use. Environmental standards such as thresholds for flow, water quality, connectivity, and habitat (e.g. Peake et al., 2011), integrity, should be embedded in designation and management frameworks and be enforceable yet adaptable (Moberg et al., 2024). For example, a protected river might be required to maintain a Connectivity Status Index score of ≥95 per cent to ensure ecological function over time (Grill et al., 2019).

Legal mechanisms. Aligning area-based protection designations with the needs of free-flowing rivers remains challenging. Traditional designations like national parks, biosphere reserves and heritage sites are often not designed for freshwater conservation. Legal frameworks tend to focus on land use and vegetation, overlooking aquatic processes, water use, and habitat conditions. Consequently, activities like dam construction or industrial water withdrawals may be permitted within existing protected area laws. Globally, over 500 new hydropower dams are proposed in existing protected areas (Thieme et al., 2020), underscoring the persistent threats facing freshwater ecosystems even within zones intended for conservation.

To strengthen river conservation, a comprehensive assessment of legal and policy tools is essential. This includes evaluating protected area legislation, water management plans, energy, fisheries, and cultural preservation policies for their ability to support healthy freshwater ecosystems (Moberg et al., 2024). Enhancements may explicitly include rivers and riparian zones in legal designations, embedding enforceable standards, integrating land and water use conditions, prohibiting incompatible

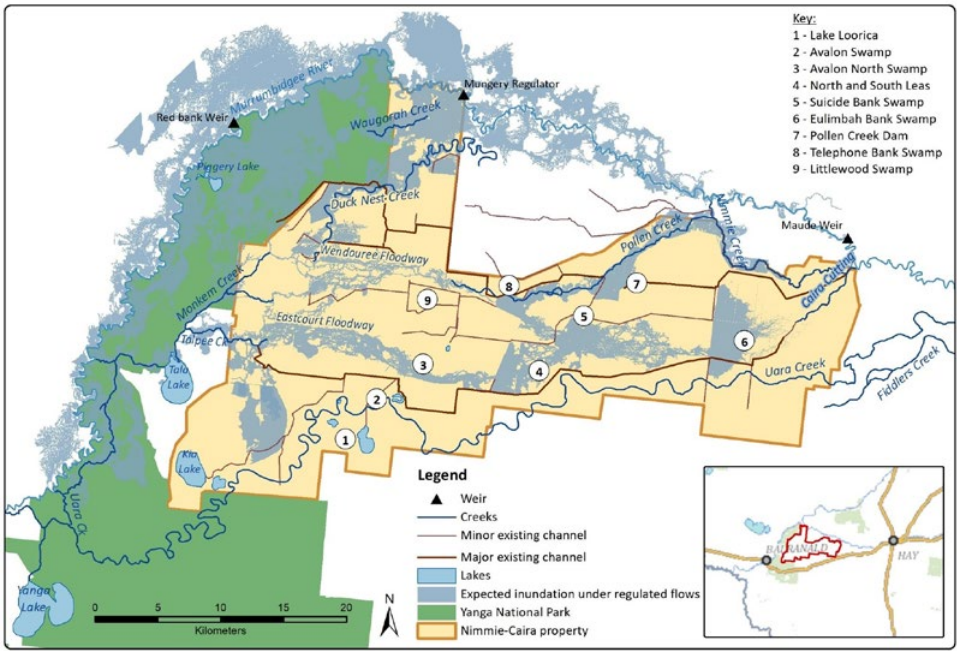


Figure 3. Map of Gayini (formerly Nimmie-Caira) boundaries, focal rivers and creeks, wetlands and floodways. Source: NSW Department of Industry (2018).

activities and subsidies incentivising these, and establishing governance structures with sustainable budgets.

Ultimately, a multi-layered approach is needed. Where gaps persist, advocacy for new laws and policies becomes imperative. Rethinking spatial planning through a freshwater lens can deliver lasting protection for rivers and the communities that depend on them.

COMMUNITY-LED PROTECTION OF FLOWS AND CONNECTIVITY

Gayini: Returning legal rights to Traditional Custodians

The Lowbidgee floodplain, with its fertile grounds and expansive network of rivers, creeks, oxbows and backchannels, has been home to First Nations people for over 50,000 years. Nested in the Murrumbidgee River Valley, it is one of the largest remaining wetland areas in Australia's Murray-Darling Basin.

The cultural health of the Nari Nari people, traditional custodians of this area, depends on flow patterns, flooding and connectivity (Woods et al., 2022). Annual and inter- annual floods spill over banks and move across the valley, filling a vast network of wetlands and floodways. These processes have sustained productive fishing and hunting grounds comparable to "supermarkets where food was plentiful and trade connections occurred" (Woods et al., 2022).

Beginning in the mid-1800s with European colonisation, Lowbidgee's lands and waters were sold or granted as private property. First Nations people, not considered citizens at the time, were excluded from ownership and lacked the resources to participate.

Over the next century, land and water rights were further subdivided. The area was used for grazing, then converted for irrigated crops. More than 2,000 km of levees, channels, diversions and reservoirs were built to manage flows for agriculture and domestic use, reducing connectivity and flow. This led to the loss of 76 per cent of floodplain habitat and its rich diversity of fish, aquatic invertebrates, amphibians and waterbirds (Kingsford, 2003; Kingsford & Thomas, 2004; NSW Department of Primary Industries, 2015).

In 2011–2012, the New South Wales (NSW) and Australian governments launched the AU$180 million Nimmie-Caira water-recovery project, acquiring 19 properties (84,417 ha) and associated water rights to restore environmental flows and protect cultural heritage (Woods et al., 2022). The area connects Yanga National Park to several creeks for most of their lengths, along with riparian zones and floodplain wetland complexes (Figure 3).

In 2019, land titles were formally returned to the Nari Nari Tribal Council (NNTC), marking the legal return of the Lowbidgee to its Traditional Custodians. Renamed 'Gayini', the Nari Nari word for water, the area reflects the restoration of cultural and ecological values (Woods et al., 2022). In 2023, the NNTC signed a historic Conservation Agreement with the NSW Biodiversity Conservation Trust (BCT), securing permanent protection and sustainable management of over 55,000 ha. Supported by a perpetual AU$1 million annual investment and a governance model embedding Indigenous leadership, it is the largest conservation covenant on Indigenous-owned land in NSW (Fitzsimons et al., 2025).

The Agreement used a three-tiered zoning approach: (1) ecologically important areas; (2) actively regenerating areas; and (3) areas with restoration potential. Innovations include restoring environmental flows and hydrology across the Lowbidgee floodplain via 23 regulators and over 650 irrigation and levee bank cuts (Woods et al., 2002). Land management includes conservation grazing to control non-native biomass and cultural burning to restore native vegetation. Additionally, over 1,200 cultural sites are protected and support traditional activities like canoe-making and medicinal plant collection. A Strategic Adaptive Management framework guides decisions, backed by 15 years of co-designed biodiversity and cultural monitoring.

Gayini exemplifies how Indigenous-led stewardship, restored rights, co-designed monitoring, and sustainable finance can protect ecological connectivity and cultural integrity. Understanding financial, policy and governance models that are successful is one of the highest priorities for research on privately protected areas (Fitzsimons & Mitchell 2024). As a model for 30x30 targets, it shows how conservation covenants can be adapted to Indigenous-owned lands, integrating cultural values with large-scale freshwater ecosystem management Fitzsimons et al., 2025).

Bita River: A basin-scale model for free-flowing river conservation

The Bita River, a 510 km tributary of the Orinoco River, originating in Colombia's Llanos high plains, exemplifies how basin-scale conservation can safeguard free-flowing rivers while integrating community priorities and national biodiversity goals. Draining an 825,000-ha basin, the Bita River supports rich biodiversity including Amazon River Dolphin (*Inia geoffrensis*), Jaguar (*Panthera onca*), migratory fish and birds, turtles, crocodiles, tapirs and otters and provides critical ecosystem services to local communities through tourism, fisheries and recreation (Romero et al., 2016).

In 2014, the Alliance for the Protection of the Bita River was formed by government entities and civil society to develop a collaborative conservation strategy. Using systems thinking and participatory decision-making frameworks, the Alliance engaged fishers, farmers, companies, scientists and citizens to identify conservation priorities and evaluate protection mechanisms. Analyses included biological surveys, gap analyses and scenario modelling, which led to a tiered conservation approach balancing conservation, restoration, and sustainable production zones (Figure 4; Suárez et al., 2021; WWF & UMCES, 2016).

In July 2018, the Bita River Basin Wetlands Complex became Colombia's largest Ramsar site and one of the world's first to safeguard an entire free-flowing river system under international protection. The designation aims to maintain the river's natural flow regime, biodiversity, and ecological connectivity, while addressing threats such as land conversion for cattle and forest plantations, agricultural runoff, overharvesting, infrastructure development, and climate change.

Following the designation, Colombia established a 228,457-ha ecological corridor along the river and floodplain to facilitate movement and migration of fish, Amazon River Dolphin, Jaguars and other wildlife, including conservation agreements with local landowners. The Bita River Ramsar site is also recognised as an Other Effective Area-based Conservation Measure (OECM) in Colombia under the category of a 'Complementary Conservation Strategy'

Royal Spoonbill (*Platalea regia*) nestlings at Gayini © Vince Bucello Midstate Video Productions

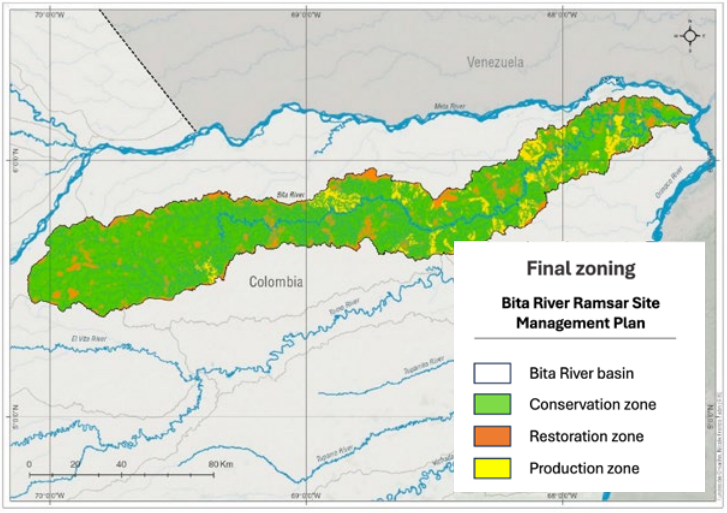


Figure 4. Basin-scale land and water use zoning for the Bita River Management Plan

The Bita River supports aquatic megafauna including the Giant River Otter (*Pteronura brasiliensis*) and Amazon River Dolphin. © R. Isotti, A. Cambone / Homo Ambiens / WWF

(CCS). CCSs contribute to the connectivity of the National System of Protected Areas (SINAP) and support diverse governance models, including Indigenous and local leadership. This designation allows for flexible, context-specific governance that respects and elevates Indigenous and local leadership, allowing communities to co-manage resources, uphold cultural values and contribute to long-term environmental stewardship. By linking environmental authorities, community organisations and scientific institutions, it allows decision-making to be transparent, equitable and grounded.

Mexico water reserves: Protection of the San Pedro Mezquital and Usumacinta Rivers

Mexico's Environmental Water Reserve system represents a pioneering national strategy to protect river connectivity. Formalised by a set of presidential decrees published between 2014 and 2018, the framework allocates flow volumes to nature across priority basins based on detailed environmental flow and cost-benefit assessments (Salinas-Rodríguez & Martínez Pacheco, 2024). The decree outlines three use segments, including domestic, hydropower and environmental, and mandates that any infrastructure must demonstrate non-interference with flow regimes, sediment transport, and Indigenous cultural sites (Barrios Ordóñez et al., 2015). At the national level, Mexico's water reserve framework is designed to maintain ecological processes by legally allocating from 10–30 per cent up to 80–95 per cent of mean annual runoff to environmental flows, depending on each river's targeted management objectives classes (Salinas-Rodríguez et al., 2021; Salinas-Rodríguez & Martínez Pacheco, 2024).

The San Pedro Mezquital River, the last free-flowing river in Mexico's western Sierra Madre Mountains, exemplifies how legal designation and community advocacy can safeguard riverine connectivity and environmental flows. Stretching 540 km to the Pacific Ocean, the river's seasonal hydrology sustains the Marismas Nacionales, a 200,000-ha mangrove wetland complex designated as both a Biosphere Reserve and Ramsar site. During the rainy season, high flows inundate the floodplain, depositing nutrient-rich sediment that supports agriculture, fisheries, and the livelihoods of 432 local communities (IUCN, 2022).

In response to the proposed Las Cruces Dam in 2008, local stakeholders mobilised to safeguard the river's ecological integrity. Their petition to the Ramsar Secretariat triggered closer scrutiny of the project's compliance with environmental flow standards. Though conditionally approved in 2014, experts warned the dam would disrupt flow connectivity and nutrient transport to wetlands. Construction was deferred pending proof of compliance with 18 conditions, including maintaining 84 per cent of mean annual runoff at the river's mouth (Barrios Ordóñez et al., 2015; Salinas-Rodríguez et al., 2021; SEMARNAT, 2014).

The Usumacinta River showcases the scale and complexity of basin-wide conservation. As the largest river in Mesoamerica by discharge – nearly 20 times larger than the San Pedro Mezquital – the Usumacinta flows from Guatemala to the Selva Lacandona, one of Mexico's richest biodiversity hotspots, and discharges into the Gulf of Mexico. The basin hosts a variety of protected area types and designations. A proposed hydropower project in the region was rejected by the Ministry of the Environment due to its inability to meet the river's environmental flow standards, which requires 90 per cent mean annual runoff at the river's mouth to 99 per cent mean annual runoff in the Selva Lacandona, underscoring the power of legal safeguards and cultural resistance (Arthington et al., 2023; Salinas-Rodríguez et al., 2021). This case highlights the role of Indigenous governance and transboundary cooperation in maintaining connectivity. Sacred sites, traditional water use and community stewardship were central to the decision to not permit new infrastructure that threatened the river's integrity, highlighting cultural preservation in this case. Scientific analyses have reinforced the basin's ecological significance and the strategic value of environmental water reserves in protecting mega-basins (Salinas-Rodríguez, 2023).

Mexico's water reserve framework blends legal, scientific and cultural approaches to safeguard river connectivity.

Mexico water reserves. © Guy Wenborne

Beyond the San Pedro Mezquital and Usumacinta cases, reserves protect flow integrity across ~41,600 km of free-flowing rivers (31 per cent of the national network), linking 39 Ramsar wetlands, 54 federally protected areas, and supporting ~180 freshwater-dependent species (~80 protected; Salinas-Rodríguez & Martínez Pacheco, 2024). Mexico continues to improve monitoring of water reserves, for example, researchers have developed a low-cost remote sensing system to monitor flows in real time, with plans to expand across pilot basins.

Futaleufú and Puelo Rivers: Grassroots campaigns, permanent flow reserves and land conservation

The clear turquoise rivers of the Futaleufú and Puelo Rivers are emblematic of Chilean Patagonia. They serve as a backbone for local communities, supporting water supplies, farming and ranching, and vibrant ecotourism, such as horseback riding, whitewater rafting, kayaking, and fly-fishing—while being deeply woven into the region's cultural identity. Tied to the "cultura gaucha," the rivers tributaries have long provided drinking water, nourished animals, and offered cherished spaces for gathering and summer recreation– places where people have maintained a respectful relationship with the river and its seasonality for generations.

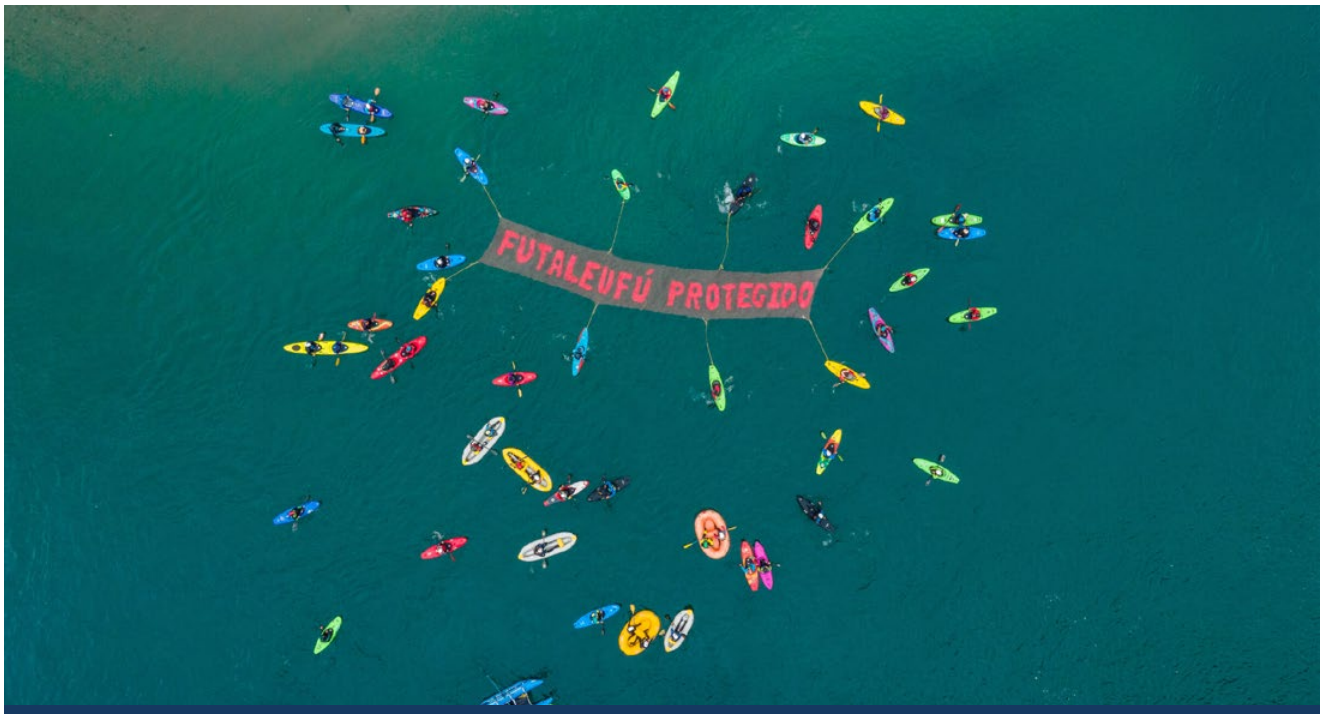
For decades, residents and community-led organisations such as Corporación Puelo Patagonia, Fundación Futaleufú Riverkeeper and NGO Bestias del Sur Salvaje, have mobilised to defend these rivers from large-scale hydropower projects and other extractive pressures that could irreversibly alter their flow, biodiversity, and the way of life they sustain. As part of the Patagonia Without Dams campaign, a movement emerged to raise awareness of the social and environmental costs of new hydropower dams, bringing the issue to communities, financiers and governments in Chile, Argentina and beyond (Blair et al., 2023). Following this regional campaign and coordinated local grassroots movement, in 2016, Endesa hydroelectric company relinquished its water rights and abandoned projects on the Puelo and Futaleufú Rivers. These efforts reflect environmental concern and a deep commitment to protecting the integrity of place, heritage and identity tied to free-flowing rivers.

Following the decision to abandon the hydropower plan, stakeholders mobilised to secure the river as free-flowing. Grassroots campaigns for the Puelo and Futaleufú Rivers emerged, leveraging the reformed Chilean Water Code to establish water flow reserves under a new 'ecosystem preservation' category. These efforts were built in partnership with mayors, regional authorities and public services, with technical support from research centres, civil society and NGOs.

In 2023, under the revised Water Code, the Ministry of Public Works and the National Water Authority issued decrees creating water flow reserves to protect the rivers for their ecological and community value, including ecotourism. A supporting technical report defines monthly water volumes to be reserved (Ministerio de Obras Públicas, Dirección General de Aguas, 2023). To uphold river values, the reserves will maintain approximately 80 per cent of unaltered flows, aligned with the presumptive standard for moderate ecosystem protection, allowing no more than 11–20 per cent daily flow alterations (Richter et al., 2011). The technical process is expected to conclude in 2025, with the reserves maintained as long as the decrees remain in force.

While some river sections overlap with protected areas (biosphere reserves, national reserves and other designations), Chile's decreed water flow reserves are the first to safeguard actual flow – its magnitude and seasonality (Ministry of Public Works, 2023). Conservation efforts continue, including a recent campaign by Puelo Patagonia to acquire and protect Hacienda Puchegüín, a 132,995-hectare parcel spanning a large portion of the Puelo River watershed.

Under Chile's Water Code and the Biodiversity and Protected Areas Service law, three mechanisms can be used to complement land protection by securing instream flows: (1) water flow reserves; (2) converting requested or purchased water rights to in situ or non-extractive rights; and (3) integrating rivers and wetlands into enforceable protected area management plans with clear objectives, standards, indicators and monitoring systems.



Communities and NGOs gather to support protection of the Futaleufú River. © Enoc Mansilla

This case underscores the power of community-led campaigns, paired with legal tools addressing both land and water rights. Protected Rivers, a national coalition, is now working to scale these efforts for rivers prioritised by local communities and ecological needs.

CONCLUSION AND RECOMMENDATIONS

River conservation requires a paradigm shift from conventional area-based land protection to include mechanisms that support ecological processes including flow regimes, sediment transport and aquatic connectivity. Rivers flow through communities and communities depend on them. Inclusive governance, community leadership, intergenerational equity and co-management are key elements for sustaining ecological and social outcomes.

Case studies consistently show that community-led efforts yield powerful, lasting results rooted in local ownership. In Gayini, Indigenous leadership was central, with the return of land rights enabling Traditional Custodians to restore environmental flows and cultural practices. Colombia's Bita River took a multi-stakeholder route, blending scientific input with community voices to secure Ramsar protection through participatory zoning, followed by recognition as an OECM. Mexico's water reserves leaned on legal frameworks to embed traditional values and halt harmful infrastructure, while Chile's grassroots movements leveraged cultural identity and legal reform to protect iconic rivers from hydropower threats. Though the methods varied from co-management and legal advocacy to basin-scale planning, the outcomes converged: enduring ecological resilience rooted in community ownership, cultural continuity and inclusive governance.

Through the summarised technical guidance and cases presented here, six key recommendations emerge to support practitioners and policymakers in closing the gap for river protection:

1. Provide focused conservation attention on rivers. Their condition is central to halting biodiversity loss, ensuring food and water security, and adapting to climate change. Practitioners must work with communities to identify rivers too critical to lose, assess values, threats, and evaluate protections within and beyond PCAs. Land conservation alone is insufficient; integrated land and river protections are essential and a diverse set of models exist.

2. Take direction from, and support, local communities who are already stewarding the rivers they depend on. This includes restoring land, water and resource rights to Traditional Custodians. As in the Gayini case, this should also include opportunities to provide direct and sustainable funding to local communities, which is often a major barrier to effective, equitable and durable protection. The co-development process and FPIC consultation to design, recognise and manage the Nushiño-Curaray-Villano Fluvial System also provides a model. Both this case and the Bita also highlight legal mechanisms for community governance of PCAs.

3. Assess and use the full spectrum of protection mechanisms. Begin with protected area policy to understand whether and how mechanisms provide opportunities for equitable governance, sustain connectivity, flows, water quality and habitat health. Where legal gaps exist, layered policy approaches or advocacy for new legislation may be needed over time. The cases of Gayini, Bita, Puelo and Futaleufú provide strong examples of layering conservation mechanisms with land protection tools, while the Mexico water reserve provides a standalone mechanism for conserving flow, sediment transport and cultural values.

4. In line with 30x30, set national targets for river protection. Globally, 17 per cent of river length flows through, or borders, existing PCAs. Assess the baseline within existing PCAs, and build outwards to set a target that supports effective well-connected networks. Mexico's water reserve framework provides a model for developing a national ambition tailored to rivers and the services they sustain. Rivers are nature's connectors – policy ambitions must reflect their role in linking ecosystems and communities.

5. Use a watershed lens in PCA network, site and connectivity corridor design. Integrated spatial planning across terrestrial, freshwater and marine ecosystems is vital for effective conservation. Site design should reflect ecological processes rather than administrative boundaries, ideally at basin scale and across borders. Freshwater-specific standards must guide management and remain adaptable to changing conditions and improved monitoring. The Bita and Gayini cases provide clear examples of watershed scale planning and site design, both leveraging the tool of zoning within watersheds to support a mosaic of needs ranging from strict conservation to sustainable use. The Bita also innovates on the concept of a connectivity corridor, establishing a management category that applies to both terrestrial and aquatic species.

6. For rivers within PCAs, integrate freshwater objectives into management plans and budgets. Review whether freshwater goals are embedded in management plans. Work with communities to understand their use and values for the rivers within and flowing through the area. The Puelo case highlights how protected area management plans, especially where legally binding, can be used to improve effective management of rivers in PCAs. Updating and resourcing these plans is a strategic entry point and can catalyse partnerships with upstream and downstream actors.

Conserving free-flowing rivers requires dedicated effort and investment, but the ecological returns are profound for freshwater biodiversity, the health of terrestrial and marine ecosystems and the services they provide. Proven models show river conservation is achievable. If the 196 signatories to the Convention on Biological Diversity (CBD) are serious about addressing biodiversity and nature loss, rivers and their stewards must be elevated in the implementation of the 30x30 target and beyond. This can start at the IUCN World Conservation Congress 2025 with the adoption of Motion 018 to advance river conservation globally.

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RESUMEN

Los ríos no son elementos aislados, sino fuentes de vida, y menos de un tercio de los grandes ríos del mundo siguen fluyendo libremente. Proteger los ríos que fluyen libremente requiere honrar a las personas que los sostienen y adoptar la conservación como una práctica compartida y relacional basada en la conexión, la reciprocidad y el cuidado. Los ríos que fluyen libremente favorecen los regímenes de caudal dinámicos, el transporte de sedimentos, la diversidad de especies, la migración y la resiliencia de los paisajes. Proporcionan servicios esenciales como agua limpia, seguridad alimentaria, regulación de inundaciones y valores culturales a millones de personas en todo el mundo. A pesar de su importancia, los ríos siguen estando muy amenazados y poco protegidos. Este documento se basa en las recientes directrices de la Comisión Mundial de Áreas Protegidas de la UICN sobre aguas continentales, en las que se detallan las medidas de protección de los ríos basadas en la comunidad que garantizan los caudales ambientales y la conectividad. Casos innovadores de la Amazonía ecuatoriana, Gayini en Australia, los ríos Puelo y Futaleufú en Chile, el río Bita en Colombia y los ríos San Pedro Mezquital y Usumacinta en México, destacan cómo las comunidades locales han trabajado con socios y gobiernos para establecer áreas protegidas y conservadas que mantienen sus cursos de agua conectados y fluyendo. El documento concluye con enfoques recomendados para elevar el estatus de los ríos y sus administradores en la implementación del objetivo de protección 30x30 y más allá.

RÉSUMÉ

Les rivières ne sont pas des éléments isolés, elles sont des artères vitales, et moins d'un tiers des grands fleuves du monde coulent encore librement. Protéger les rivières à écoulement libre nécessite de rendre hommage aux personnes qui les entretiennent et d'adopter la conservation comme une pratique relationnelle partagée, fondée sur la connexion, la réciprocité et l'attention. Les rivières à écoulement libre favorisent des régimes d'écoulement dynamiques, le transport des sédiments, la diversité des espèces, la migration et la résilience des paysages. Elles fournissent des services essentiels tels que l'eau potable, la sécurité alimentaire, la régulation des crues et des valeurs culturelles à des millions de personnes dans le monde. Malgré leur importance, les rivières restent très menacées et insuffisamment protégées. Cet article s'appuie sur les récentes recommandations de la Commission mondiale des aires protégées de l'UICN concernant les eaux intérieures, qui détaillent les mesures de protection des rivières mises en place par les communautés locales pour garantir les débits environnementaux et la connectivité. Des exemples innovants provenant de l'Amazonie équatorienne, de Gayini en Australie, des fleuves Puelo et Futaleufú au Chili, du fleuve Bita en Colombie et des fleuves San Pedro Mezquital et Usumacinta au Mexique, mettent en évidence la manière dont les communautés locales ont collaboré avec des partenaires et des gouvernements pour établir des zones protégées et conservées qui maintiennent la connectivité et le débit de leurs cours d'eau. Le document se termine par des recommandations d'approches visant à valoriser les rivières et leurs gestionnaires dans la mise en œuvre de l'objectif de protection 30x30 et au-delà.

PROTECTED AND CONSERVED AREAS IN AN AGE OF ECOCIDE

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ABSTRACT

Ecocide, incorporating either wilful or large-scale destruction of the environment, is a well-recognised problem, although it has still to come under the jurisdiction of international law. As instances of ecocide increase in both war and peacetime, the integrity of protected and conserved areas is increasingly compromised. Here, we highlight two forms of ecocide, namely broad-sense or large-scale environmental damage and narrow-sense or large-scale damage with intent. Then we examine notable cases of both broad and narrow-sense ecocide affecting national parks. In the Supplementary Online Material, we review the historical and contemporary definitions of ecocide. There are now significant efforts to establish effective legal frameworks aimed at criminalising ecocide, but these are advancing only slowly, and the threats to protected and conserved areas remain.

Keywords: Environmental destruction, International Criminal Court, legal framework, National parks, Rome Statute

INTRODUCTION

Ecocide has proved difficult to define. It can either refer to large-scale incidental environmental destruction or narrowly defined deliberate destruction requiring intent and prior knowledge on the part of perpetrators to destroy the environment. The latter definition carries with it the hope that ecocide could eventually be defined as a criminal offence that can stand up to scrutiny in the courtroom. Historically, there are definitions of both types (see Supplementary Online Material). An example of the former is "*The extensive damage to, destruction of or loss of ecosystem(s) of a given territory, whether by human agency or by other causes, to such an extent that peaceful enjoyment by the inhabitants of that territory has been severely diminished*" (Higgins et al., 2013). A prominent example of the latter is in the Rome Statute, appearing in Article 8(2)(b)(iv) *"Intentionally launching an attack in the knowledge that such attack will cause widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to military advantage"* (Heller & Lawrence, 2007). The Rome Statute is the foundational treaty that established the International Criminal Court (ICC) (UN General Assembly, 1998) and an amendment to the Rome Statute is required to put an international law like ecocide into place. As illustrations, these two ways of thinking about ecocide might respectively involve actions of poverty-stricken people who clear land extensively and thereby cause ecocide accidentally, whereas the latter might refer to the deliberate actions of a government or big company with power and money.

In practice, proving intent for ecocide is challenging, particularly during peacetime when environmental harm often arises from profit-driven "disregarded risk" rather than explicit intent to cause damage (Minkova, 2021). Thus Greene (2018) suggests that "*ecocide can be seen as a crime of consequence rather than intent*", and Westing (1974) argued that "*intent may not only be impossible to establish […], it is essentially irrelevant*". It has even been suggested that the definition of ecocide should involve elements such as "recklessness, or negligence" (Minkova, 2021). Megret (2017) proposed that different elements should correlate to different severities of punishment; in other words, narrow-sense ecocide would involve a higher punishment than broad-sense.

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Nonetheless, and this is critical to our argument, from the point of view of conserving protected and conserved areas (PCAs), the result is the same: widespread habitat destruction. For grassland or Coconut Crabs (*Brigus latro*), it is irrelevant whether intent was involved in their destruction. Moreover, the definition of ecocide in the Rome Statute refers only to instances during wartime, and again this caveat does not materially affect the fauna and flora being destroyed. In this article, we draw attention to the ways in which both types of ecocide affect PCAs in both war and peacetime. By giving examples of each, we find that PCAs are affected by more general interpretations of ecocide and less often by intent.

CONSEQUENCES OF ECOCIDE

Ecocide, in both the broad and narrow sense, causes long-term environmental harm by degrading ecosystems through deforestation and pollution, loss of ecosystem services, increased disaster risks, and contributing to climate change (Brown & Pearce, 2023; Smith et al., 2023; WWF, 2018). It can affect environments within PCAs or outside them. Land and water contamination through mining, oil spills, pesticide overuse, and improper waste disposal degrade soil, reduce agricultural fertility, and harm aquatic ecosystems within PCAs (Zahoor & Mushtaq, 2023). As natural habitats are lost outside PCAs, pressure mounts on PCAs themselves, as people exploit natural resources and encroach on their borders (Laurance et al., 2012). Marine protected areas also suffer from oil spills and destructive fishing practices like bottom trawling both outside and inside PCAs, which disrupt food webs and compromise essential ecosystem services such as climate regulation and oxygen production (Kingston, 2002; Vikas & Dwarakish, 2015). More existentially, unregulated industrial activities, biomass burning, gas flaring, chemical disasters and weaponry degrade air quality, destabilise ecosystems, and contribute to climate change and ozone depletion, which affect PCAs (Manisalidis et al., 2020).

Ecocide affects not only the environment but has social and economic implications. It can cause forced displacement and migration of communities dependent on the environment for their livelihoods. For example, Indigenous tribes in Brazil, including those living in PCAs, have been forced to resettle due to increased infrastructural development in the Amazon (Crook & Short, 2014; United Nations, 2022). Depleted resources disrupt economies, as seen in Kuwait's fishing communities that suffered income loss due to oil spills during the Gulf War (Linden et al., 2004). Overfishing results in a decline in fish abundance even within PCAs, causing increased effort and expense per catch and thus demand for cheap labour, resulting in poverty, food insecurity and higher social vulnerability as, for example, occurred in Thailand (Brashares et al., 2014). More generally, ecocide often disproportionately affects marginalised communities, those with fewer resources and less political power. In addition, most cases of ecocide are committed by large industries and powerful governments that rarely experience the direct effects of their harm. Ecocide thus amplifies existing social inequalities (IPCC, 2023).

EXAMPLES OF WARTIME ECOCIDE AFFECTING PCAS

Conflict often results in severe environmental damage due to intensified resource exploitation, destructive weapons and weakened environmental oversight (Gaynor et al., 2016). PCAs are frequently disregarded, with forests cleared for fuel and habitats destroyed by artillery. Table 1 highlights selected cases of wartime ecocide since 1960, including impacts on national parks.

Broad-sense ecocide: Rwandan genocide

During and after the 1994 Rwandan genocide, Akagera National Park experienced severe ecological degradation. As governance in Rwanda collapsed, the park was overrun by hundreds of thousands of refugees and livestock leading to widespread habitat loss (Moodley et al., 2011). Forests and wetlands were cleared for agriculture and settlement, and large mammals were hunted or displaced (REMA, 2009). The influx of people led to overgrazing, poaching and the destruction of key habitats, pushing many native species towards local extinction and a 64 per cent decrease in forested areas. (Apio et al., 2015; REMA, 2009). The park's northern third was officially degazetted in 1997 to accommodate displaced communities resulting in a permanent loss of 1,380 km² of protected land (Kanyamibwa, 1998). This case illustrates how conflict-driven displacement and governance breakdowns can lead to ecological collapse, even without the direct use of military force against the environment (Moodley et al., 2011). The degradation of Akagera highlights the limits of current international law: while the Rome Statute criminalises environmental destruction in war under Article 8, the threshold is high and applies only to international armed conflict (Higgins et al., 2013). Peacetime or civil war-related environmental degradation, such as in Rwanda, falls outside its scope despite having equally devastating effects. The protection of designated conservation areas should not be contingent on political stability; rather, it should be a binding obligation under international law. Encouragingly, Akagera has undergone a remarkable recovery in recent years, with the

Table 1: Details and justification of environmental harms during wartime since 1960, in national parks and elsewhere. Article 8(2)(b)(IV) is used to define ecocide. "*Intentionally causing widespread, long-term and severe damage to the natural environment within a war context*". This table is not exhaustive; many cases of environmental harm during wartime are less well documented.

Conflict	Overview	Consequences	Justification of ecocide	Responsibility	National park / Damage description
National parks Broad-sense ecocide					
Colombian Conflict (1964–present)	Illicit plantations, deforestation, and drug trafficking.	Land and water contamination Deforestation	Illegal activities and the murder of conservationists imply intent (Arias-Gaviria et al., 2021).	Rebel parties	Sierra de la Macarena NP – illicit cocoa cultivation, armed presence, habitat destruction (Vargas, 2006).
Cold War Nuclear Testing (1970s–1991)	1,700+ nuclear tests in Siberia and Nevada.	Deforestation Ocean damage Land and water contamination Air pollution	Excessive in relation to military advantage (Khalturin et al., 2005).	Government	Nevada Test Site / near Death Valley NP – fallout risk, radioactive contamination (Rothman, 2004).
Angolan Civil War (1975–2002)	Deforestation and poaching due to conflict.	Deforestation Land and water contamination	Dismissal of poaching laws by armed groups (Braga-Pereira et al., 2020).	Government	Kissama NP – elephant and rhino populations decimated; rangers withdrawn (Erickson-Davis, 2014).
Indian Political unrest (1989–2003)	Ethnic militancy caused rangers to withdraw, leading to the destruction of the forest and poaching.	Deforestation Poaching	Systematic degradation of ecosystems under conflict, targeting wildlife and conservation assets.	Political factions	Manas NP – Militant occupation led to poaching, infrastructure loss, and biodiversity threats (Goswami & Tg, 2011).
Liberian Civil War (1989–2003)	Illegal mining to fund conflict. Deforestation and land clearing.	Deforestation Land and water contamination	Deliberate dismissal of mining regulations.	Militia groups	Mount Nimba NP – deforestation and habitat loss due to post-conflict settlements (Enaruvbe et al., 2019).
Croatian War of Independence (1991–1995)	Landmines and militant camps.	Deforestation Land and water contamination	Prolonged warfare damaging protected ecosystems.	Government	Plitvice Lakes NP— Hostilities caused landscape damage, loss of access, and pollution from military activity (Mužinić & Filipović, 2006).
Rwandan Genocide (1994)	Mass displacement of refugees led to deforestation and poaching.	Deforestation Poaching Land and water contamination	Collapse of environmental regulations.	Government and militia	Akagera NP— collapse of park's boundaries led to land clearing for agriculture and illegal mining (REMA, 2009).
Second Congolese War (1998–2003)	Land clearing, illegal charcoal mining.	Deforestation Poaching Land and water contamination	Intentional land clearing and ignorance of mining laws (UNESCO, 2024).	Militant groups	Virunga, Kahuzi-biega NP – Poaching of mountain gorillas and hippos (Virunga Foundation, 2022).
Côte d'Ivoire Civil War (2002–2011)	Illegal poaching by militia groups.	Deforestation Poaching	Prolonged disregard for infrastructure in place to protect environment.	Government, militia groups	Comoé NP – Unchecked exploitation and collapse of scientific monitoring systems (Fischer, 2013).
Sri Lankan Civil War (2006–2009)	Palmyra tree logging, mined landscapes.	Deforestation Land and water contamination	Systematic environmental degradation (Dathan, 2020).	Government and rebels	Wilpattu NP — mining and poaching (Akbarally, 2016).

Table 1: Continued

National parks Narrow-sense ecocide					
Russian Invasion of Ukraine (2022–present)	Kakhovka Dam destroyed, 12,000 Ha burnt.	Deforestation Land and water contamination Ocean damage	Indiscriminate and lasting harm (Solokha et al., 2023).	Government	Sviati Hory NP, Black Sea Biosphere Reserve – habitats submerged or eroded; fires and habitat (Peter & Hunder, 2024).
Iraqi Suppression of Marsh Arabs (1991)	Marshes drained using dams and canals.	Deforestation Ocean damage	Systematic destruction of an ecosystem (HRW, 2003).	Government	Hawizeh Marsh (UNESCO Wetland) – complete collapse of aquatic ecology (Moumin, 2007).
El Salvador Civil War (1980–1990)	Bombing of agricultural and forest lands.	Deforestation	Widespread long-term environmental damage (Hecht et al., 2006).	Government	El Impossible NP — forest loss from bombing, deforestation post-conflict (White, 2008).
Elsewhere Broad-sense ecocide					
Vietnam War (1961–1971)	Sprayed 76 million litres of herbicides (Agent Orange).	Deforestation Ocean damage Land and water contamination	Excessive damage in relation to military advantage (Frey et al., 2013).	Government	No record of damage to a national park.
Gulf War Oil Spills (1991)	One billion barrels of oil spilt into the Persian Gulf.	Deforestation Land and water contamination Ocean damage Air pollution	Deliberate environmental destruction (Linden et al., 2004).	Government and rebels	No record of damage to a national park.
East Timorese Crisis (1999)	Scorched earth tactics, forest fires.	Deforestation	Intentional burning of forest (Bouma & Kobryn, 2004).	Government and rebels	No record of damage to a national park.
Chechen Wars (1999–2009)	Fuel depots targeted, forests burned.	Deforestation Land and water contamination Air pollution	Intended destruction of environment (Yin et al., 2019).	Government and rebels	No record of damage to a national park.
Lebanon War (2006)	Bombing of power stations caused 30,000 tonnes of fuel to spill.	Land and water contamination Ocean damage	Disproportionate environmental impact (ICUN, 2007).	Government	No record of damage to a national park.

Figure 1: Large mammals in Akagera National Park, Rwanda © Tim Caro, 2023

Figure 2: Dried up Mesopotamian Marshes in 2001 © NASA, 2009

successful reintroduction of rhinoceroses and improved biodiversity outcomes under the management of African Parks, demonstrating what is possible with sustained investment and effective conservation governance (Figure 1) (African Parks, 2017; Apio et al., 2015).

Narrow-sense ecocide: Iraqi suppression of Marsh Arabs

During the late 1980s and throughout the 1990s, the Iraqi regime under Saddam Hussein carried out a systematic campaign of repression against the Marsh Arabs (Ma'dan), an ethnocultural group inhabiting the Mesopotamian Marshes in southern Iraq. Following the 1991 Shi'a uprisings after the Gulf War, the Iraqi government responded with brutal military force, targeting the Marsh Arabs for their perceived disloyalty and opposition to the regime (UNEP, 2001). This campaign extended beyond direct violence: it involved ecocidal tactics that destroyed the ecological and cultural foundations of Marsh Arab life.

The Mesopotamian Marshes, once among the largest wetland ecosystems in the Middle East and a globally significant PCA, were deliberately drained through the construction of massive canal systems, embankments and dams, effectively transforming the wetlands into arid wasteland (Richardson & Hussain, 2006). By 2000, more than 90 per cent of the marshland had been desiccated, leading to the collapse of unique freshwater ecosystems, the local extinction of species such as the Marbled Teal (*Marmaronetta angustirostris*) and African Darter (*Anhinga rufa*), and the mass displacement of up to 500,000 Marsh Arabs (UNEP, 2001).

This act of environmental destruction served a dual purpose: erasing the ecological base of the Marsh Arab culture and punishing political dissent. The regime's actions meet the criteria of narrow-sense genocide by intentionally targeting a specific ethnoreligious group through both direct violence and indirect means, including environmental manipulation designed to force their displacement or cultural erasure (HRW, 2003). The Mesopotamian Marshes case reveals how civil conflict and state violence can weaponise ecosystems, transforming protected landscapes into instruments of oppression.

Yet, international legal frameworks struggled to respond effectively. While the Rome Statute prohibits environmental destruction in international conflict under Article 8(2)(b)(iv), it provides no clear recourse for ecocidal actions committed during internal conflicts or those targeting civilian ecosystems as part of broader campaigns of persecution (Higgins et al., 2013). This legal blind spot has allowed ecological devastation on a par with war crimes to go largely unpunished.

Following the fall of the regime in 2003, local communities and international organisations launched restoration efforts. Partial reflooding of the marshes has enabled some species and habitats to return. The area was designated (Figure 2) a national park in 2013 and later became a UNESCO World Heritage Site (National Parks Association, n.d.; UNESCO, 2016). However, recovery remains incomplete, with ecological fragmentation, upstream damming, and political instability continuing to threaten long-term restoration (Richardson & Hussain, 2006). The case of the Marsh Arabs underscores the urgent need for international legal instruments to recognise and prosecute ecocide as a standalone crime, particularly when it intersects with cultural genocide and PCA destruction.

Figure 3: Mining camp in Canaima National Park, Venezuela © Luis Bartolome Marcos, 2004

Figure 4: Deforestation in Brazilian FLONA Jamanxim © Vinícius Mendonça/Ibama, 2017

EXAMPLES OF PEACETIME ECOCIDE AFFECTING NATIONAL PARKS

Although Article 8 of the Rome Statute addresses ecocide only during wartime, peacetime ecocide, characterised by prolonged, profit-driven activities such as illegal logging, mining, industrial fishing, fossil fuel extraction, agricultural encroachment, and unsustainable tourism, poses an ongoing threat to protected areas (Greene, 2018; Minkova, 2021). These activities gradually degrade ecosystems both within and at the boundaries of national parks. Table 2 presents selected examples of peacetime ecocide since 1960 and their impacts on protected areas.

Broad-sense ecocide: Illegal gold mining

Venezuela's national parks face severe degradation from illegal gold mining under weakened environmental governance during Nicolás Maduro's administration (Figure 3) (SOS-Orinoco, 2024; Stachowicz et al., 2023). National Parks Yapacana and Canaima, in particular, have experienced "extreme ecocide", with nearly 5,000 acres of Yapacana cleared for mining infrastructure (SOS Orinoco, 2019). The mining operations, often protected by armed groups, have caused significant ecological damage, including mercury contamination, fires and the disruption of Indigenous communities. Under-funded park authorities struggle to enforce laws amid reports of collusion with miners. Indigenous groups like the Yanomami and Pemon suffer health crises, displacement and violent clashes (Rendon et al., 2020, Singh et al., 2021). The case challenges how we define ecocide. While mining isn't inherently illegal, its occurrence within protected areas transforms environmental harm into a potential international crime. The scale, permanence and illegality of the damage, alongside state inaction or complicity, align with emerging legal definitions of ecocide as unlawful or reckless acts causing severe and lasting environmental harm (Stop Ecocide International, 2021).

Despite strong evidence, including satellite images and field reports, UNESCO and IUCN have not formally intervened in Canaima National Park. SOS Orinoco seeks its designation as a "World Heritage Site in Danger" but Venezuela's government has ignored international appeals (SOS-Orinoco, 2019). This highlights how ecocide thrives amid state collapse and impunity, reinforcing the urgent need for an international legal framework to recognise and prosecute ecocide where national protections fail. The inclusion of ecocide as a crime under international law would provide a critical legal tool to hold perpetrators accountable and prevent such large-scale environmental destruction in the future.

Narrow-sense ecocide: Deforestation of the Amazon

From 2019 to 2022, Amazon deforestation increased by 85 per cent, largely due to President Bolsonaro's weakening of environmental protections and the Ministry of Environment's authority. A 95 per cent cut to funding for Brazil's National Climate Change Policy purposefully accelerated agricultural expansion and infrastructure projects. Loosened regulations led to reduced enforcement, with illegal logging prosecutions falling and fines dropping by 30 per cent (Raftopoulos & Morley, 2020). Despite their protected status, Brazilian Amazon National Forests like Jamanxim, Altamira and Itaituba faced widespread deforestation from 2018 to 2021, mainly due to illegal but unofficially sanctioned cattle ranching (Gusmão et al., 2024). This destruction led to reduced carbon capture of the forest, decreased rainfall, ecosystem fragmentation and loss of unique

Table 2: Details and justification of environmental harm during peacetime since 1960, in national parks and elsewhere. The Proposal to the Rome statute drafted by Stop Ecocide International's Independent Panel in 2021 is used to define ecocide. "*Unlawful or wanton acts committed with knowledge that there is a substantial likelihood of severe and either widespread or long-term damage to the environment*" (Stop Ecocide International, 2021). This table is not exhaustive, and many cases of environmental harm go undocumented.

Case	Overview	Consequences	Justification	Responsibility	National park / Damage description
National parks Broad-sense Ecocide					
Oil dumping Ecuador (1964–1992)	68 billion litres of oil were dumped in the jungle.	Deforestation (4,500 km²) Land and water contamination	Surpassed regulations, resulting in long-term environmental damage (Akchurin, 2015; Durango-Cordero et al., 2018).	Corporation	Yasuní NP – Oil exploitation and spills. Deforestation and damage to ecosystems (Yasunidos, 2023).
Palm oil, Indonesia (1970s–current)	Peatland destruction for palm oil plantations.	Deforestation	Overruled scientific advice and surpassed regulations (Human Rights Watch, 2021).	Government	Gunung Leuser NP — Illegal plantations causing loss of critical habitat (Sullivan, 2005).
Alberta Tar Sands 1990–current)	Oil extraction site of 130 km².	Land and water contamination Air pollution Deforestation	Overruled scientific advice (Finkel, 2018; Timoney & Lee, 2009).	Corporation	Wood Buffalo NP — River contamination causing severe ecological stress (UNESCO, 2018).
Toxic waste dumping – Côte d'Ivoire (2006)	Illegal disposal of petroleum waste.	Land and water contamination	Surpassed regulations with no concern for safety (Amnesty International, 2012).	Corporation	Banco NP — waste dumping damaged forest habitat (Tia & Dago, 2016).
Belo Monte Dam (2011–Present)	Dam construction flooded/destroyed 6,500 km² of rainforest.	Land and water contamination Deforestation	Overruled scientific advice (Bratman, 2014).	Corporation	Xingu Indigenous NP — Floods and disrupted ecosystems (Royal Geographical Society, 2015).
National parks Narrow-sense ecocide					
Amazon rainforest deforestation (2019–2022)	Relaxed regulations led to an 85% increase in deforestation.	Deforestation Land and water contamination	Severe, long-lasting, and ignored warnings (Raftopoulos & Morley, 2020).	Government	Jamanxim, Altamira and Itaituba – affected heavily by deforestation (Gusmão et al., 2024).
Elsewhere Broad-sense ecocide					
Aral Sea disappearance (1960–2010)	The fourth-largest lake was drained by Soviet irrigation projects.	Ocean damage Land and water contamination	Knowledge of consequences implies intent (United Nations Economic Commission for Europe, 2005).	Government	No record of damage to a national park.
Mountaintop Removal Mining – West Virginia (1970s–2015)	Extraction of coal from mountaintops.	Deforestation (400 km²) Land and water contamination Air pollution	Overruled scientific advice (Greenberg, 2016).	Corporation	No record of damage to a national park.
Niger Delta oil exploration (1970s–current)	Illicit dumping, oil spills and gas flaring.	Land and water contamination Air pollution Ocean damage	Insufficient safety regulations imply intent (Sentamu et al.,, 2023; Ubani & Onyejekwe, 2013).	Corporation	No record of damage to a national park. Although in close proximity to Old Oyo NP.
BP oil spill (2010)	Millions of barrels of oil released into Gulf of Mexico.	Land and water contamination Ocean damage	Knowingly neglected environmental protection (Beyer et al., 2016).	Corporation	No record of damage to a national park. Although damage to MPAs was recorded.
Wastewater disposal – SW UK (2010–2015)	Billions of litres of raw sewage released into the sea.	Land and water contamination Ocean damage	Illegal disposal and attempted concealment (Ahmed et al., 2021; Environment Agency, 2022).	Corporation	No record of damage to a national park. Coastal marine reserves were affected.

biodiversity (Lapola et al., 2023) (Figure 4). Although ecocide lacks a legal definition during peacetime, extensive Amazon deforestation undeniably inflicts severe and far-reaching consequences on the environment. Ignoring NGO and international warnings, Brazil eased sanctions and promoted development in the region. In response, Indigenous chiefs and environmental organisations submitted an Article 15 communication to the International Criminal Court (ICC), citing harm to both Indigenous people and the ecosystem. However, prosecution is unlikely due to the absence of ecocide legislation outside wartime (Nascimento et al., 2023; Raftopoulos & Morley, 2020).

THE RELATIONSHIP BETWEEN ECOCIDE AND NATIONAL PARKS

Over the last century, the concept of PCAs, especially national parks, has grown from being a way to conserve elite hunting reserves or geological features to conserving the world's diminishing biodiversity, ecosystem services and cultural heritage. Over the last six decades, the concept of ecocide has gained increasing recognition as a crime against the environment (see Supplementary Online Material). At their core, both frameworks are underpinned by a shared imperative: to conserve nature by reducing large-scale destruction and stopping the continued onslaught on the natural world through a thousand cuts. They function as complementary approaches, ecocide as a potential legal mechanism to deter and punish environmental harm, and national parks as proactive conservation tools that protect vulnerable ecosystems before irreversible damage occurs. Moreover, within national parks ecocide not only affects biodiversity, it also constitutes cultural and economic loss. Many Indigenous communities live in or near PCAs and rely on them for their livelihoods and spiritual practices. When ecocide occurs, communities are displaced, their knowledge systems threatened, and their autonomy undermined (Crook & Short, 2014; United Nations, 2022).

International law has been slow to formally adopt ecocide as a criminal offence, in part because of legal and definitional issues, and with key proposals repeatedly blocked or diluted. In the face of this inertia, national-level park policy offers a practical opportunity: even if ecocide is not yet criminalised globally, its principles could be integrated into domestic environmental law, especially within protected area frameworks. National park legislation could adopt narrow ecocide-style language to define severe or intentional environmental damage as a criminal offence within park boundaries or buffer areas, creating a legal deterrent without waiting for international consensus. Some countries, like Ecuador, already recognise the rights of nature in their constitutions, providing a precedent for embedding strong environmental protections at the national level (Tanasescu, 2013). Moreover, several countries, including New Zealand, India and Colombia, have granted legal personhood to rivers, recognising them as rights-bearing entities. This legal innovation allows ecosystems to be represented in court, reinforcing accountability for environmental harm and offering a model for protecting natural areas through rights-based frameworks (O'Donnell & Talbot-Jones, 2018).

National parks can also help address some of the shortcomings of ecocide law. One major challenge for ecocide prosecution is proving intent, particularly when environmental harm is a byproduct of economic activity rather than an explicit goal (Westing, 1974). National parks, with their designated status, boundaries and management plans, provide a clear framework for monitoring changes, attributing responsibility, and measuring harm over time. The clarity of what is being protected can strengthen legal arguments and reduce ambiguity. Surveillance, ecological baselines and reports from parks can offer the evidence base that ecocide cases often lack in unprotected areas. Moreover, while ecocide law prosecutes after destruction has occurred, national parks operate on the principle of prevention. The existence of well-managed PCAs can reduce the likelihood of ecocide occurring in the first place by placing restrictions on resource extraction, deterring illegal activity through enforcement, and increasing public and political awareness of valuable ecosystems. Where ecocide law is weak or unenforced, PCAs can serve as a frontline defence.

In conflict zones or areas with weak governance, park boundaries are often ignored. Lack of funding, insufficient ranger presence, and poor community relations can leave parks vulnerable to illegal exploitation (National Park Service, 2006). Here, broad-scale ecocide law could fill the gap by providing an external legal framework to hold perpetrators accountable, even across borders or in post-conflict settings (Stop Ecocide International, 2021).

In summary, while ecocide law and national park and other conserved areas policies arise from different traditions, one legal, one conservationist, they are complementary. Where ecocide law falters in enforcement or definition, national parks provide specificity, visibility and ecological data. Where national parks struggle to deter large-scale destruction, ecocide law can provide the legal teeth. In the long term, embedding ecocide protections into all PCA laws could serve as a stepping stone towards broader international recognition and enforcement.

OUTSTANDING ISSUES

Laws to prevent ecocide, a concept very loosely defined as the extensive destruction of the natural environment by human activities, have been proposed by international and national bodies. However, there are still no international laws outlawing widespread habitat destruction and degradation. Nonetheless, to date, thirteen countries have incorporated variations of Article 26 of the Draft Code of Crimes Against the Peace into their domestic legislation, criminalising ecocide during peacetime (Vietnam, Uzbekistan, Tajikistan, Russia, Moldova, Kyrgyzstan, Kazakhstan, Ecuador, Belarus, Ukraine, Armenia, Georgia and France). None of these nations have established a means for measuring intent, despite using the term "intentionally" in their definition of ecocide (Higgins et al., 2013).

Environmental destruction often derives from cumulative small harms over time making it difficult to assign clear causation as no single person causes climate change or coral reef loss (Greene, 2018; Minkova, 2021). While laws against ecocide could address dramatic events, they might prove impractical against widespread environmental degradation caused by humanity at large.

Some would argue that corporations mining in sensitive areas, logging rainforests or producing polluting fertilisers are committing ecocide due to their widespread, long-term environmental harm. However, a key legal challenge is determining whether the harm is "wanton", clearly excessive in relation to anticipated social or economic benefits. Corporate leaders often argue they are meeting legitimate demands, such as providing raw materials, lowering food costs, and generating profits for shareholders, which they view as reasonable. In contrast, environmentalists may argue the ecological damage far outweighs these benefits, making the harm excessive. Such an argument leads to a slippery slope where a great many business enterprises could be classified as wanton and the meaning of ecocide could easily become diluted (Minkova, 2021). One proposed solution is to incorporate the valuation of nature into legal frameworks. With natural capital estimated at US$125 trillion annually (WWF, 2018), assigning monetary value to ecosystems could help courts assess environmental harm more objectively, although the scope of ecosystem services would have to be determined.

Apportioning blame for ecocide is a complex issue. For example, following the Rwandan genocide, hundreds of thousands of refugees caused deforestation, poaching and ecosystem degradation in Akagera National Park largely out of necessity for survival rather than malicious intent (REMA, 2009). This raises difficult questions about culpability in broader cases like Amazon deforestation, where perpetrators range from powerful multinational corporations to impoverished small-scale farmers. Determining who should be held responsible and where to draw the line is challenging. Assigning blame should consider both the severity of environmental damage and the intent behind the actions. Larger entities with greater resources, influence and control over environmental outcomes, such as multinational corporations, should arguably face stricter accountability standards. This is especially pertinent for less affluent countries that grapple with the imperative of development while mitigating ecological harm. Should these nations be granted the same developmental freedoms as their first-world counterparts historically had, even at the risk of ecocide? Policies should balance developmental needs with environmental protection, potentially offering support and alternatives to those who rely on environmentally harmful practices for their livelihoods.

CONCLUSIONS

Over the years, there have been considerable disagreements over the definition of ecocide, centring on intent, scale of damage, whether it is restricted to wartime, and responsibility. From the perspective of fauna and flora damaged by human activities, this debate may not be relevant except as a deterrent to prevent further instances of ecocide. Rather, the scale and severity of ecocide is important. We therefore propose a more relaxed definition of ecocide as "*The sufficiently extensive damage to, or destruction of the natural environment that results in substantial loss of biodiversity, wilderness and ecosystem function caused by human activity whether deliberate, reckless, or negligent*".

Using this definition, the number of instances of ecocide affecting PCAs since 1960 is of great concern (see Tables 1 and 2) and represents a serious threat to their integrity. Ecocide within PCAs is the manifestation of an extreme form of PADDD (Protected Area Downgrading, Downsizing and Degazettement), the legal changes that reduce or eliminate protected areas (Mascia & Pailler, 2011), which have been increasing rapidly over the last 20 years. They represent an ever-present threat to our ability to conserve habitats and species at a time when they are already under siege. Our goal of conserving 30 per cent of the world's area by 2030 (CBD, 2022) is insufficient if the integrity of those protected areas is not safeguarded.

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SUPPLEMENTARY ONLINE MATERIAL

Historical overview of the origin of the term ecocide

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RESUMEN

El ecocidio, que incluye la destrucción deliberada o a gran escala del medio ambiente, es un problema ampliamente reconocido, aunque aún no ha sido incorporado al ámbito de la jurisdicción del derecho internacional. A medida que aumentan los casos de ecocidio, tanto en tiempos de guerra como de paz, la integridad de las áreas protegidas y conservadas se ve cada vez más comprometida. Aquí destacamos dos formas de ecocidio, a saber, el daño ambiental en sentido amplio o a gran escala y el daño en sentido estricto o a gran escala con intención. A continuación, examinamos casos notables de ecocidio tanto en sentido amplio como en sentido estricto que afectan a los parques nacionales. En el material complementario en línea, revisamos las definiciones históricas y contemporáneas de ecocidio. En la actualidad se están realizando importantes esfuerzos para establecer marcos jurídicos eficaces destinados a tipificar como delito el ecocidio, pero estos avanzan lentamente y las amenazas a las áreas protegidas y conservadas siguen existiendo.

RÉSUMÉ

L'écocide, qui désigne la destruction délibérée ou à grande échelle de l'environnement, est un problème largement reconnu, même s'il ne relève pas encore de la juridiction du droit international. À mesure que les cas d'écocide se multiplient, tant en temps de guerre qu'en temps de paix, l'intégrité des zones protégées et conservées est de plus en plus compromise. Nous mettons ici en évidence deux formes d'écocide, à savoir les dommages environnementaux au sens large ou à grande échelle et les dommages au sens strict ou à grande échelle avec intention. Nous examinons ensuite des cas notables d'écocide au sens large et au sens strict affectant les parcs nationaux. Dans le matériel supplémentaire en ligne, nous passons en revue les définitions historiques et contemporaines de l'écocide. Des efforts importants sont actuellement déployés pour mettre en place des cadres juridiques efficaces visant à criminaliser l'écocide, mais ceux-ci ne progressent que lentement et les menaces qui pèsent sur les zones protégées et conservées demeurent.

RETHINKING URBAN CONSERVATION: CONSIDERING A NEW URBAN PROTECTED AREA CATEGORY OR OTHER FORMAL INTERNATIONAL RECOGNITION

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[1] These authors contributed equally to this work and share first authorship

ABSTRACT

Rapid urbanisation poses significant threats to biodiversity and ecosystem services, highlighting the critical role of urban protected areas (UPAs). However, UPAs face unique challenges due to their urban context and often lack formal recognition and integration into broader ecological networks. A central question arises: is a specific IUCN category or any other type of formal international recognition required to effectively recognise, manage and integrate UPAs in urban areas? This paper explores this question by examining the distinct characteristics and challenges of UPAs, social arguments for and against a specific categorisation, and proposing strategies for enhanced urban conservation and ecological network integration, drawing insights from various global experiences including Brazil, Colombia, Costa Rica, Canada, Singapore, South Africa and the UK, from literature review and interviews with experts across all the regions. A new category could help elevate UPAs in global agendas and strengthen technical guidance and investment; though, it may not be sufficient without strong local leadership and governance. We argue for a flexible approach that emphasises improved data tracking, tailored legal tools, inclusive planning, and sustainable financing. As hybrid spaces that blend ecological functions with civic value, UPAs demand integrated, participatory strategies in urban planning.

Keywords: urban protected areas, urban resilience, landscape planning, ecological connectivity, environmental governance, urbanisation

INTRODUCTION

Cities are home to most of the world's population. In the Global South, where 75 per cent of the world's urban population lives, 54.3 per cent of people live in urban areas, and 90 per cent of all population growth is taking place in the cities of emerging economies (Smit, 2021; UN-Habitat, 2024). By 2050, it is estimated that 70 per cent of the global population will be living in urban areas (United Nations, 2025). With an increasingly urbanised global population, urban landscapes are being shaped and reshaped in response to threats to biodiversity and ecosystem services.

The triple crisis – climate change, biodiversity loss and pollution – is increasingly threatening the safety, resilience and quality of life in urban areas. Several cities worldwide are already experiencing severe water scarcity, dangerous levels of air pollution, and escalating health crises, with rising cases of respiratory diseases, stress-related conditions and mental health disorders. The lack of access to natural spaces further exacerbates these challenges, leaving cities more vulnerable to extreme heat, flooding and other climate change impacts.

Urban protected areas (UPAs), while historically overlooked in conservation policies, offer a critical solution to these interconnected crises (Gârjoabăe et al., 2023; McNeely, 2001). By safeguarding biodiversity, regulating local microclimates, improving air and water quality, and providing much-needed recreational spaces, these areas play a vital role in enhancing urban resilience and delivering vital ecosystem services (Centre for Liveable Cities, 2015; McNeely, 2001; Tryzna, 2001). Their role has become even more evident in the wake of the COVID-19 pandemic, which underscored the social value of urban green spaces as places for recreation, exercise and social interaction (Moore & Hopkins, 2021).

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However, despite their growing importance, UPAs remain undervalued, underfunded and poorly integrated into urban planning frameworks (Carrillo Reyna et al., 2024; Richards & Parsons, 2004). Traditional urban planning often prioritises infrastructure and economic growth over ecological considerations, overlooking the integration of nature into urban environments (H. Méndez, personal communication, 28 April 2025).

The authors set out to consider the central question of whether a specific IUCN category or any other type of formal international recognition is needed for UPAs to achieve better recognition, management and integration into urban landscapes and ecological networks. This paper analyses the necessity and potential implications of a specific UPA category or grouping by exploring the characteristics of UPAs, the challenges they face, the arguments for and against formal categorisation, and identifying complementary strategies for effective urban conservation and ecological network building. It draws insights from a review of existing academic literature and summarises perspectives from seven interviews. By expanding this conversation in the urban arena, this paper aims to contribute to a more integrated and adaptive approach to managing UPAs within cities.

METHODOLOGY

The methodology of this paper combines a literature review and interviews with key experts with practical experience working in cities and protected areas from both the Global North and South.

The literature review drew on 17 core papers identified through targeted keyword searches (e.g. UPA, urban conservation, urban biodiversity, urbanisation, environmental governance, urban ecological connectivity) and selected to represent diverse geographies, governance models, and policy perspectives. To systematically analyse the literature, we applied a structured framework capturing both descriptive and analytical qualitative data, including geographic scope and scale, type of conservation model, authorship and governance structures, terminology employed, references to IUCN categories or Other Effective Area-Based Conservation Measures (OECMs), and policy relevance.

The second component of the methodology involved interviews conducted between April and May 2025. Interviewees were selected to capture a balance of regional representation (Africa, Europe, Latin America, Asia and North America), institutional affiliation (international organisations, national agencies, local governments, NGOs, and academia), and professional expertise (policy, governance, finance, and biodiversity conservation). The interviews explored perceptions of UPAs, their relevance, governance challenges, and the debate around whether a new IUCN category is warranted. A concise summary of interviewees, including region, role, affiliation and relevance, is presented in Table 1.

DEFINING AND UNDERSTANDING UPAS IN CONTEXT

The IUCN defines a protected area as "a clearly defined geographical space, recognised, dedicated and managed… to achieve the long-term conservation of nature" (Dudley, 2008). This definition, rooted in rural and remote conservation, often overlooks protected areas within urban settings. While the IUCN's six management categories – from strict nature reserves to sustainable-use areas – serve as reference points, none are designed for the unique challenges and opportunities of UPAs.

UPAs are formally protected spaces within or on the edges of cities, distinct from conventional urban green spaces by their defined conservation purpose. They safeguard natural habitats, hold high ecological value, or have potential for restoration (Trzyna et al., 2014; P. Menezes, personal communication, 7 April 2025). Beyond their ecological importance, UPAs provide essential social and cultural benefits, offering urban residents irreplaceable access to nature, well-being and ecosystem services.

UPAs can encompass remnant natural fragments, restored sites, or mosaics of semi-natural areas. They often represent the first point of contact with nature for urban populations, embedding experiences of 'wilderness' within the city (Sharma et al., 2025; Trzyna, 2001). This accessibility broadens conservation's reach to diverse audiences. Yet, UPAs vary dramatically in their characteristics across the globe. For instance, in some Asian cities the density of visitors within an urban green space may exceed that of entire formal urban districts elsewhere. In other contexts, UPAs can be extensive tracts of forested land forming metropolitan boundaries. Such diversity in scale, intensity of use and social dynamics underscores the need for context-specific approaches, drawing on the rich and varied research experiences from across regions.

Ecologically, UPAs function as biodiversity anchors amid urban pressures such as sprawl, pollution, and habitat fragmentation (González-García et al., 2022). Although often isolated within the urban matrix (Gârjoabă et al., 2023), they can enhance connectivity through green corridors, facilitating species movement and ecosystem resilience (McDonald et al., 2009; Moberg et al., 2024).

Table 1.

Interviewee	Affiliation	Role	Region	Relevance
Ingrid Coetzee	Local Governments for Sustainability (ICLEI Africa Secretariat, Cape Town)	Director, Biodiversity, Nature & Health / Lead on ICLEI Cities Biodiversity Center programmes	South Africa (Cape Town, with global programme reach)	Provides policy, finance, and governance insights on urban protected areas, with experience linking biodiversity, climate, and city planning
Alison Barnes	National Park City Foundation/ New Forest National Park Authority	Chief Executive, New Forest National Park; Co-founder and International Steering Group Member, National Park City	United Kingdom (England)	Provides leadership and policy insights on integrating people-nature connections, ecological networks, and urban protected areas within planning frameworks
Huberth Méndez	LCI Veritas School of Architecture	Professor at LCI Veritas School of Architecture, teaching courses on Urban Planning and Critical Analysis of the City	Costa Rica	Provides insights on Costa Rica's urban protected area category, governance gaps, and innovative approaches such as the "Sweet City" framework for integrating nature into urban design
Pedro da Cunha e Menezes	Brazilian Trails Network / Trilha Transcarioca	Director, Brazilian Trails Network; Founder, Trilha Transcarioca; former Executive Director, Tijuca National Park	Brazil	Provides experience in protected area management, environmental diplomacy, and policy, offering insights on governance, IUCN categories, and urban protected area guidelines
Dr Faisal Moola	University of Guelph	Associate Professor, Department of Geography, Environment & Geomatics	Canada	Provides expertise on biodiversity conservation, urban nature, and environmental justice, with a focus on connecting ecological science to community and policy decision-making
Diana Ruiz	Alexander von Humboldt Institute	Researcher in Urban Protected Areas & Biodiversity Management	Colombia	Provides research-based case studies and governance insights on urban protected areas in Colombia

However, proximity to dense human populations exposes UPAs to distinct challenges: security concerns, vandalism, littering, and intensified edge effects like invasive species and fire risk (Ananthanarayanan & Ang, 2024; McDonald et al., 2009).

In short, UPAs are both ecological sanctuaries and deeply social spaces. Unlike conventional protected areas, they operate within politically complex, densely populated environments. Their conservation depends on urban ecological connectivity and governance approaches that bridge environmental, social and planning domains to address recreation, education and cultural needs, while also managing risks like visitor pressure, human-wildlife conflict, and informal urbanisation.

CHALLENGES IN MANAGING UPAS

Management of UPAs remains largely inadequate and rooted in traditional conservation and planning models, even as urban populations demand greater access to green spaces and stronger governance from local authorities with clear engagement opportunities (Carrillo-Reyna et al., 2024; da Cunha e Menezes & Teixeira Mendes, 2001). The literature and interviews reveal distinct challenges and barriers facing UPAs, often rooted in inadequate regulatory frameworks, governance limitations, urban pressures and financial constraints.

Legal and regulatory frameworks for UPAs are often lacking or uncoordinated with urban planning, creating significant challenges in integrating conservation needs and navigating jurisdictional complexities. National policies frequently fall short in addressing the unique circumstances of urban areas, and current local, national or international policy frameworks are often outdated or inadequate (Castro et al., 2018; da Cunha e Menezes & Teixeira Mendes, 2001; F. Moola, personal communication, 1 May 2025). In Colombia, the temporary nature of protected lands within urban perimeters due to revisable Land Use Plans creates legal uncertainty (Montoya et al., 2018). In Argentina, UPAs risk isolation without broader management and collaboration (Pereira, 2021). Singapore's varying levels of legal protection for green spaces further underscore

limitations in legal safeguarding (e.g. 'gazetted' nature reserves versus less protected nature parks).

The governance and management of UPAs, influenced by land ownership and stakeholder coordination, involve diverse actors including governments, NGOs, businesses and community groups (Trzyna et al., 2014). Effective management of these socio-ecological systems necessitates inclusive and participatory governance and sustained engagement programmes with neighbours and locals. Yet chronic funding gaps, fragmented governance and poor inter-agency coordination persist (Moberg et al., 2024). Improving UPA integration into urban planning demands enhanced coordination among municipal agencies to avoid siloing, better collaboration between municipal, state and national agencies, and increased engagement with NGOs and civil society. This fragmentation often undermines planning and enforcement in cities with overlapping jurisdictions.

A continuous challenge for managing and governing UPAs relates to real estate speculation, the increasing value of land and the decreasing number of available spaces in cities to build. Weak public policy undermines conservation and worsens inequality (Godoy & Benini, 2024). In many cases, decision-makers and other interest groups prioritise short-term economic gains from urban expansion, often approving development with minimal long-term planning, which can cause piecemeal decision-making resulting in urban sprawl, environmental degradation, and social inequities, like heightened vulnerability for marginalised populations (González-García et al., 2022; Richards & Parsons, 2004). For instance, in Guadalajara and Monterrey, Mexico, urban natural protected areas are under threat from real estate expansion and poor land-use enforcement, eroding ecosystem services, and increasing vulnerability to flooding and heat (De La Mora-De La Mora & López-Miguel, 2022).

The conservation of UPAs often suffers from limited and inconsistent access to funding. Competing demands on city budgets and reliance on short-term grants undermine the continuity, monitoring and accountability necessary for long-term biodiversity outcomes (Centre for Liveable Cities, 2015; Sharma et al., 2025). The funding for nature in cities is very limited, and there is a critical need to increase it (I. Coetzee, personal communication, 11 April 2025; UNEP, 2024). UPAs often do not receive the same investment or policy attention as rural conservation areas, leading to a significant lack of funding and incentives for UPA development and maintenance (F. Moola, personal communication, 28 April 2025). Municipalities often have difficulty directly accessing global funds, too. UPAs may not be a national or local priority in budget allocation, competing with other urban demands like a city's basic needs for infrastructure, security, health and education, yet UPAs require mechanisms for financial sustainability. Their small size can also limit contributions to global targets like Global Biodiversity Framework Target 3, reducing funding and recognition (F. Moola, personal communication, 1 May 2025). Overall, UPAs seem to receive less and less consistent investment compared to other urban priorities, which makes the conservation of these spaces hard to prioritise.

Socio-cultural barriers can also significantly impede the effective and equitable management of UPAs. A lack of shared identity and social agreements, coupled with fragmented governance and the dominance of technical expertise, limits opportunities for partnerships and community engagement. This often leads to the exclusion or disenfranchisement of Indigenous, youth, and low-income communities from governance and planning processes, effectively erasing marginalised voices in urban conservation efforts (F. Moola, personal communication, 28 April 2025). Furthermore, communication difficulties between local communities and urban planners, often stemming from differing philosophical positions and training, reflect cultural barriers (Ananthanarayanan & Ang, 2024; Centre for Liveable Cities, 2015). The term 'protected' itself can generate resistance or scepticism, as seen in Singapore's past, where a lack of transparency in land use and conservation decisions led to a deliberate shift towards extensive public engagement and more inclusive planning in an effort to build public trust and legitimacy, driven by a more educated and informed citizenry (Ananthanarayanan & Ang, 2024; Hwang, 2022). Traditional UPA management has historically prioritised biophysical data, such as species count or carbon storage, over cultural, social, equity-related or biocultural outcomes or indicators (Moberg et al., 2024), and formal barriers to access, such as urban regulations on alcohol consumption or specific park uses, can effectively exclude non-traditional users from enjoying and engaging with UPAs (F. Moola, personal communication, 1 May 2025).

In summary, UPA challenges are multifaceted, spanning outdated legal frameworks, complex urban conditions, financial instability, and socio-cultural inequities. Definitions and management vary widely by region, complicating the adoption of international frameworks.

Rouge National Urban Park © Eddar27

OPPORTUNITIES IN MANAGING UPAS

While many challenges exist in managing UPAs, they can also provide unique benefits to local ecosystems, biodiversity, social connection and citizen engagement, urban planning, and combating edge effects, and their conservation can contribute greatly to global environmental goals.

In the case of Rouge National Urban Park (RNUP), Parks Canada Agency established its first UPA in 2015, spanning 79 km² across Toronto and surrounding municipalities in Ontario (Parks Canada, 2019). RNUP is in an ecologically significant area, having one of the region's largest marshes, the northern edge of the Carolinian ecosystem, and human history dating back over 10,000 years, including some of Canada's oldest known Indigenous sites. The Urban Park protects forests, wetlands, rivers and farmland, while supporting recreation and cultural stewardship. RNUP is the largest UPA in North America and is a global example of how a nationally managed UPA can deliver significant social and ecological benefits, while still confronting challenges that highlight key obstacles to successful implementation. While organising efforts go back to the 1970s, political momentum emerged in the late 1980s, and a Provincially protected area was opened in the 1990s. The federal government established the area as a National Urban Park in 2015, recognising it as having nationally significant lands and waters (Finkelstein, 2024). The RNUP Act notes that the UPA was established to protect and present the natural and cultural heritage of the park, promote its peri-urban environment, including a vibrant farming community, and act as a gateway for visitors to experience and connect with national protected areas (Canada, 2015).

The park must manage visitor pressure while still safeguarding sensitive habitats and at-risk species. It also balances conservation while maintaining working agricultural lands and recreational demands. Despite these challenges, RNUP has achieved notable ecological and social successes. By incorporating working agricultural lands, the park sustains farming practices alongside ecological restoration. It emphasises habitat connectivity, Indigenous co-governance, and equitable public access to nature. Home to over 1,700 species, the park has seen ecological successes such as the restoration of Rouge Marsh, where the removal of invasive species and reintroduction of native ones has supported greater biodiversity (Parks Canada, 2019). Socially, the park provides accessible green space for millions of urban residents and has prioritised the integration of Indigenous knowledge and storytelling into its public education and stewardship programmes. With these successes, RNUP stands as a model for large-scale, multifunctional urban conservation in North America.

The urban nature reserve, El Corredor, in Buenos Aires and the urban wetlands network in Valdivia, Chile, exemplify how UPAs can arise from local environmental and social initiatives, even in historically marginalised areas. In Buenos Aires, El Corredor was established in 2016 on a former landfill along the Reconquista River

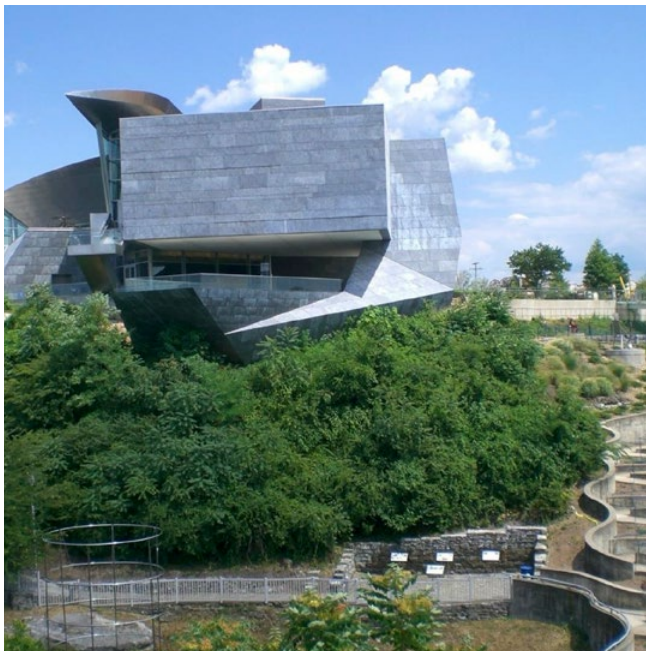
through a university thesis and municipal ordinance. This space quickly transformed into a vital socio-ecological hub for restoration, environmental education and community ecotourism. The reserve includes the coastal area, municipal nursery and bodies of water, forming a biological corridor that connects the city with the river and preserves cultural values (Wendler, 2020). This case demonstrates that UPAs can deliver environmental benefits, from regeneration and climate regulation to ecosystem services, while fostering local identity, health, recreation and civic participation, even without formal international regulatory support.

In Valdivia, Chile, the implementation of the Urban Wetlands Law has enabled collaboration between municipal government and civil society to protect biodiversity. This was achieved through the creation of the Community Wetlands Technical Committee, an informal body initiated by social actors and coordinated by the municipality. The committee brought together citizens, municipal officials, public services, academics, professionals and the private sector to assess the status of wetlands, address complaints, review regulatory frameworks, and develop public policy instruments (Lara, 2017; Ramsar Convention Secretariat, 2018). Both of these Latin American cases and their local success underscore the importance of a dedicated recognition category that legitimises these spaces, facilitates funding, guides their management, and enables their inclusion in global conservation goals (Wendler, 2020).

El Corredor Buenos Aires © Rorudak


Wetland Network in Valdivia, Chile © Julio Martinic

The National Park City initiative – adopted by cities like London (UK), Chattanooga (USA), Adelaide (Australia) and Breda (Netherlands) – highlights how UPAs can foster social cohesion, identity, and healthier, more ecologically beneficial urban environments. Inspired by National Parks, these long-term grassroots movements aim to better connect people, places and nature by encouraging collective action from citizens, governments, businesses and NGOs to create “greener, healthier, wilder, fairer and more resilient cities” (National Park City, n.d.). Alison Barnes promotes viewing cities at a landscape scale, as networks of nature-supporting spaces (A. Barnes, personal communication, 26 March 2025), a view supported by urban planning literature focused on ecological connectivity (De La Mora-De La Mora & López-Miguel, 2022). This aligns with the idea that nature thrives through “bigger, better, more joined up” human networks (A. Barnes, personal communication, 26 March 2025), a principle central to both the National Park City movement and UPAs.


Chattanooga National Park City Photo by GarnetJ

Gardens by the Bay Singapore Photo By Shiny things

Singapore's National Parks Board (NParks) illustrates how UPA recognition can support ecosystems, biodiversity, connectivity, social cohesion, and sustainable urban planning, while aligning with global conservation goals. As a dense island city-state, Singapore faces unique ecological challenges. Since British colonisation, deforestation and urbanisation reduced rainforest cover to under 10 per cent by 1965 (Centre for Liveable Cities, 2015). Early conservation focused on timber and watershed protection. Post-independence, Singapore embraced a green identity through policies like the Garden City vision and participatory urban planning, integrating biodiversity and sustainability into development.

Singapore now balances ecology and development through cross-sectoral, long-term planning (Ananthanarayanan & Ang, 2024; Centre for Liveable Cities, 2015; Hwang, 2022). Nature parks adjacent to reserves act as buffer zones, reduce edge effects, and provide recreation while supporting native biodiversity and species movement. Infrastructure like EcoLink@ BKE and the 500 km Park Connector Network further enhance connectivity across fragmented urban landscapes (Ananthanarayanan & Ang, 2024; Centre for Liveable Cities, 2015). Singapore's integrated, multi-stakeholder approach – engaging academics, experts, agencies and the public – combines technology and nature-based solutions to protect biodiversity, improve liveability and build climate resilience. This model shows how UPA recognition and visionary planning can drive effective urban nature integration.

These examples, a sampling of the various UPA conservation schemes that exist globally, provide valuable insights into the benefits UPA recognition can provide for cities, their ecosystems, biodiversity and social well-being.

RESULTS: THE CASE FOR AND AGAINST A NEW UPA CATEGORY

The literature review and interviews with conservation experts highlight the significant ecological, social, cultural and economic roles that UPAs play in cities. As urbanisation accelerates, cities are becoming critical arenas for climate resilience and reconnecting people with nature, and UPAs serve as essential strategies to foster this connection. This section synthesises the arguments for and against a new internationally recognised category for UPAs, drawing from expert interviews and academic sources. A summary of these arguments can also be found in Table 2.

Arguments for a new UPA category

The primary argument for a new UPA category, such as an IUCN category, is that it could significantly improve global recognition and policy inclusion. Proponents of this view contend that official recognition could bring UPAs into international agendas, where they have been largely absent. For example, one interviewee noted that a new IUCN category could align UPAs with global targets such as Target 12 of the Global Biodiversity Framework, thereby raising their profile and, ideally, investment in their priorities. This recognition could also boost status at the national level, calling for improved technical guidance, increased national funding, creating political incentives to support and report on UPAs, and improved planning and governance regimes (Montoya et al., 2018; H. Méndez, personal communication, 28 April 2025).

As social ecosystems shaped by diverse economic activities, cities often see urban planning conflict with biodiversity goals. A dedicated global UPA category, recognised by IUCN or similar, could highlight their unique socio-cultural roles, support context-specific management, reduce conflicts with development, and promote community ownership. UPAs differ from rural protected areas in their socio-ecological dynamics; a new category could better reflect and guide their distinct management needs, a point emphasised by multiple interviewees.

Several non-government and civil society organisations (CSO) have been working in conservation in UPAs that have public-private ownership, and a new UPA category could support these efforts (I. Coetzee, personal communication, 11 April 2025; UNEP, 2024). A UPA category could provide visibility as well as provide a reference framework for cities to direct more actions

Table 2.

Arguments for a new UPA category	Arguments against a new UPA category
Increased global recognition: Elevates UPAs on international agendas and aligns them with global conservation targets.	Limited effectiveness: A new category may not guarantee strong legal protections or effective management.
Enhanced national support: Creates political incentives, secures national funding, and improves planning frameworks.	Lack of local relevance: A one-size-fits-all category may not suit the diverse legal, social, and ecological contexts of different cities.
Tailored management: Acknowledges the unique socio-ecological dynamics of urban areas, differentiating them from rural protected areas.	Risk of top-down approaches: Can lead to the exclusion of local communities, undermining the success and ownership of conservation efforts.
Regeneration potential: Supports a proactive, transformative vision for urban lands, not just protecting remnants.	Existing alternatives: Many effective urban conservation models are already in place without a formal category, such as urban OECMs or private reserves.
Improved funding & visibility: Provides a framework for cities to direct more resources towards UPA conservation.	Overly permissive standards: The category could be too lax, lacking strong conservation standards, as seen in some national examples.
Data & tracking: Helps fill a critical data gap, as many urban protected areas are not currently included in global inventories.	Institutional barriers: Establishing a new category may face governance and leadership challenges, making a symbolic category more likely than a robust one.
Standardized definition: Helps resolve today's inconsistent UPA terms and criteria, enabling reliable global data, comparisons, and coordinated conservation policy.	

towards UPA conservation and allocate more resources for their technical and administrative management. A new category could increase the budgets to UPAs compared to traditional budgets for the maintenance of green areas in cities.

Ultimately, if a new international UPA category is developed, it should expand to include new approaches that integrate future-oriented regeneration potential within urban landscapes. UPAs should not only protect existing remnants but also transform degraded urban lands into restored natural areas. A category could support this proactive, transformative vision for a 20 to 50-year term. Current threats to biodiversity conservation necessitate new areas for regeneration to promote soil regeneration, insects and habitats. New ecosystems and their successional processes are a key component to ensure habitats for species that do not belong to old and mature ecosystems.

Arguments against a new UPA category

The most prominent argument against a new UPA category is that it may not guarantee effectiveness. For instance, in 2021 Costa Rica created Urban Natural Parks (PANU), yet it was only in 2025 that the first UPA was created, the Parque Natural Urbano Simón Bolívar in San José. The management of PANUs is delegated to national authorities due to their ownership of the land, for example, the PANU Simón Bolívar is managed by the Ministry of Culture. Here, local governments own less land than the national government. Due to this context, local governments and communities have little involvement in decision-making, and this top-down approach has complicated implementation as well as limited local input and ownership. Experts such as Huberth Méndez argue the category is considered too lax by many, lacking the strong conservation standards of other categories, raising the question of its effectiveness as a standard. Furthermore, a category can offer recognition without giving strong legal protection, which can be insufficient for conservation effectiveness. Similar cases to Costa Rica show that having a national designation for UPA does not guarantee success, but rather, the involvement of local communities and integrated management with the local government is key to effectiveness.

Another key concern is the one-size-fits-all approach a global category might impose on diverse urban settings. The legal, ecological and social contexts of urban areas are highly variable. This complexity is amplified by legal ambiguity, chronic underfunding and the frequent exclusion of local communities from planning processes – factors that risk turning UPAs into isolated 'green relics' disconnected from broader urban systems (Carrillo Reyna et al., 2024). Legal analyses across

regions, including Europe, Mexico and Colombia, show reliance on natural area legislation that fails to address the unique pressures and planning requirements of urban environments. These findings reveal a need for tailored legal and planning frameworks – at national or municipal levels – that reflect the specific social, ecological and governance dynamics of cities, such as municipally managed parks, co-managed spaces or Indigenous-led management areas. This perspective reinforces the idea that urban conservation is inherently place-based and must respond to localised realities to be effective (Gârjoabă et al., 2023; McNeely, 2001). Effective conservation governance requires adapting mechanisms to local challenges, even if it means moving beyond traditional categories. This prevents institutional and legal weaknesses that could undermine conservation goals over time. As UPAs will differ in size, shape and governance, a new category should acknowledge and recognise this diversity as part of their nature.

As previously discussed, the effectiveness of UPAs is not solely determined by international recognition or categorisation. There are several challenges to solve in how these areas are integrated into urban planning. Urbanisation, land-use change and development incentives are isolating UPAs from other green infrastructure elements within the urban landscape. While ideally large, UPAs in dense cities necessitate a landscape vision and connectivity for ecological function. Even small, degraded spaces, if linked, can support connectivity (A. Barnes, personal communication, 26 March 2025; P. Menezes, personal communication, 7 April 2025). This is why improving UPA integration into urban planning is crucial. This means incorporating nature-based solutions, buffer zones, residual-space designation, and territorial zoning to mitigate sprawl (Figueroa-Arango, 2020). Sharma et al. (2025) emphasise that urban ecological networks offer a transformative way to weave ecological connectivity into urban planning, benefiting both biodiversity goals and residents' quality of life.

Many urban conservation efforts are already operating effectively without formal recognition of an urban IUCN category. These include eco-cultural parks, urban wetland systems, urban OECMS, private nature reserves, education zones, buffer zones and green belts. This reflects the hybrid-use flexibility of urban conservation efforts.

Rather than proposing a new, distinct seventh IUCN management category, which could be difficult to implement due to the diverse management objectives already encompassed by the existing categories, alternative approaches for recognition, such as an 'overlay' category, similar to a biosphere reserve, or sub-classification within existing categories, could be more feasible (Bridgewater, 2008).

Finally, the lack of a standardised definition for Urban Protected Areas (UPAs) poses a major obstacle to creating a unified international category. With a wide array of terms and criteria used globally, from 'urban parks' to 'eco-cultural parks', this definitional variation makes it difficult to compare policies and their effectiveness across different cities. It also complicates data reporting, as inconsistent definitions prevent the reliable aggregation of global data on the number, size and ecological status of UPAs. Ultimately, this issue directly undermines the feasibility of an international category because a global standard requires a shared, clear definition to be meaningful and widely adopted, otherwise, it risks becoming a symbolic gesture rather than an effective tool for conservation.

The concerns highlighted by experts suggest that what is truly needed may not be a new category, but rather the development of clear, context-sensitive guidelines that can be applied across the existing IUCN framework and beyond. Concerns remain about whether the leadership and governance structures are currently in place to shape a robust and meaningful new category, rather than one that risks being overly permissive or symbolic.

DISCUSSION: OUR INTERPRETATION AND RECOMMENDATIONS

To conclude, a dedicated UPA category could help reorient urban conservation towards socio-ecological outcomes, acknowledging that while a new designation could bring significant benefits, it is not a silver bullet for the challenges facing urban conservation. We believe a new category should be developed with caution and paired with a broader strategic approach. The core issue, as we see it, is not just about recognition, but about integrating UPAs into urban planning on a landscape scale, and governance in a way that is flexible, inclusive and effective.

Key takeaways

We believe that urban conservation must shift its biophysical focus to a socio-ecological one. UPAs must address the needs of diverse urban populations – including Indigenous and marginalised groups – rather than focusing solely on biodiversity, recreation or horticulture. Current frameworks often emphasise biophysical metrics over social benefits. A new UPA category could integrate biocultural indicators for creation and management, ensuring conservation benefits both nature and people. To be effective, urban conservation must promote inclusive governance models involving

Table 3.

Desirable preconditions for UPA planning
Local government commitment: Strong political will and leadership from municipal authorities to champion urban conservation.
Community engagement: Active involvement of local communities, NGOs, and stakeholders in the planning and management process from the outset.
Flexible governance models: The willingness to adopt diverse and adaptive governance structures, such as co-management, public-private partnerships, or Indigenous-led management, to suit the local context.
Dedicated funding: Securing a long-term, diverse funding strategy, including municipal budgets, private sector investment, and grants, to ensure sustained management.
Clear legal and policy frameworks: Developing tailored national or municipal legislation that addresses the unique pressures of urban environments and provides a clear legal basis for conservation.
Integrated planning: Incorporating UPAs and broader green infrastructure into urban master plans, zoning laws, and development incentives. This includes incorporating nature-based solutions and connectivity.
Access to data: The ability to collect available biodiversity and social data from the site. Collecting data is an ongoing process, however, there should be information available that can support the ecological and social relevance of the site.
Public awareness: Educating and engaging the public about the benefits of UPAs to build broad-based support for conservation efforts.
Ecological connectivity: Identifying opportunities to link small, fragmented green spaces to create a cohesive urban ecological network.

multiple stakeholders (governments, communities, NGOs, private sector) and support co-management structures. Strengthening national and local legal and policy frameworks is therefore critical to supporting effective and locally rooted urban conservation. Instead of relying solely on a global designation, we advocate for the development of clear, context specific guidelines at the national and municipal levels.

Overcoming challenges and desirable preconditions

The challenges facing UPAs – legal ambiguity, underfunding and weak governance – require practical solutions. We propose that those working on urban conservation can increase their chances of success by focusing on establishing a set of desirable preconditions rather than waiting for a formal international category to be established. Table 3 lists these desirable preconditions.

THE PATH FORWARD

Whether through a dedicated IUCN category for UPAs or tailored guidelines, we believe effective urban conservation requires adaptive, integrated and socially responsive management approaches that balance conservation with human use, promote public engagement, and respect cultural and spiritual values.

As we look to a future with exponentially increasing urbanisation alongside a climate and biodiversity emergency, it is critical that we devise effective strategies to protect urban green and blue spaces and build a resilient future. IUCN WCPA Urban Conservation Strategies Specialist Group is committed to contributing to this important conversation, principally through a deep dialogue on how to ensure the applicability of international conservation categories in urban areas and through the development of updated guidelines to improve the management of UPAs in highly urbanised contexts.

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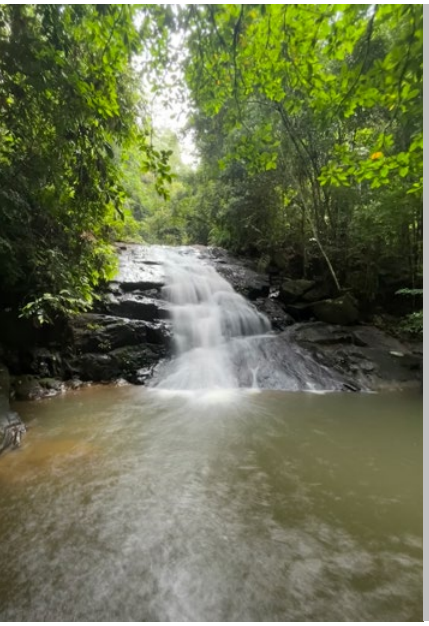
RÉSUMÉ

L'urbanisation rapide fait peser des menaces importantes sur la biodiversité et les services écosystémiques, soulignant le rôle essentiel des aires protégées urbaines (APU). Cependant, les APU sont confrontées à des défis uniques en raison de leur contexte urbain et manquent souvent de reconnaissance officielle et d'intégration dans des réseaux écologiques plus larges. Une question centrale se pose : une catégorie spécifique de l'UICN ou tout autre type de reconnaissance internationale officielle est-il nécessaire pour reconnaître, gérer et intégrer efficacement les APU dans les zones urbaines ? Cet article explore cette question en examinant les caractéristiques et les défis distincts des APU, les arguments sociaux pour et contre une catégorisation spécifique, et en proposant des stratégies pour améliorer la conservation urbaine et l'intégration des réseaux écologiques, en s'appuyant sur diverses expériences mondiales, notamment au Brésil, en Colombie, au Costa Rica, au Canada, à Singapour, en Afrique du Sud et au Royaume-Uni, ainsi que sur une analyse documentaire et des entretiens avec des experts de toutes ces régions. Une nouvelle catégorie pourrait contribuer à mettre les UPA au premier plan des agendas mondiaux et à renforcer les orientations techniques et les investissements ; toutefois, cela pourrait ne pas être suffisant sans un leadership et une gouvernance locaux forts. Nous préconisons une approche flexible qui met l'accent sur l'amélioration du suivi des données, des outils juridiques adaptés, une planification inclusive et un financement durable. En tant qu'espaces hybrides alliant fonctions écologiques et valeur civique, les UPA nécessitent des stratégies intégrées et participatives en matière d'urbanisme.

RESUMEN

La rápida urbanización plantea amenazas significativas para la biodiversidad y los servicios ecosistémicos, lo que pone de relieve el papel fundamental de las áreas protegidas urbanas (APU). Sin embargo, las APU se enfrentan a retos únicos debido a su contexto urbano y, a menudo, carecen de reconocimiento formal y de integración en redes ecológicas más amplias. Surge una pregunta fundamental: ¿se requiere una categoría específica de la UICN o cualquier otro tipo de reconocimiento internacional formal para reconocer, gestionar e integrar eficazmente las APU en las zonas urbanas? Este documento explora esta cuestión examinando las características y los retos distintivos de las UPAs, los argumentos sociales a favor y en contra de una categorización específica, y proponiendo estrategias para mejorar la conservación urbana y la integración de las redes ecológicas, a partir de las conclusiones extraídas de diversas experiencias globales, entre ellas las de Brasil, Colombia, Costa Rica, Canadá, Singapur, Sudáfrica y el Reino Unido, de la revisión de la literatura y de entrevistas con expertos de todas las regiones. Una nueva categoría podría ayudar a elevar las UPA en las agendas mundiales y reforzar la orientación técnica y la inversión; sin embargo, puede que no sea suficiente sin un liderazgo y una gobernanza locales sólidos. Abogamos por un enfoque flexible que haga hincapié en la mejora del seguimiento de los datos, las herramientas jurídicas adaptadas, la planificación inclusiva y la financiación sostenible. Como espacios híbridos que combinan funciones ecológicas con valor cívico, las UPA exigen estrategias integradas y participativas en la planificación urbana.



MOTIVATIONS AND CHALLENGES: EXPLORING MALAYSIA'S IUCN GREEN LIST EXPERIENCE

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ABSTRACT

The IUCN Green List of Protected and Conserved Areas provides an international benchmark for effective and equitable conservation management. This study examines the motivations and challenges of six different Malaysian protected or conserved areas agencies; covering government departments, private sector entities, and a community cooperative pursuing Green List recognition. Semi-structured interviews revealed that key motivations include enhancing international credibility, accessing funding opportunities, strengthening long-term protection, and achieving professional or organisational recognition. Community-managed sites additionally valued cultural heritage and ecosystem service preservation. Reported benefits of the process included improved documentation, strengthened management systems, enhanced staff capacity, and greater team cohesion. However, sites face significant challenges, such as procedural burdens, low technical capacity, and institutional constraints. Community-managed areas additionally face hurdles such as uncertain land tenure and constrained resources that hinder their involvement with the Green List. The findings highlight the enabling roles of strong leadership, donor support, and policy alignment, while underscoring the need for streamlined processes, targeted mentorship, and sustained institutional backing. Our insights offer practical recommendations to enhance Green List implementation in Malaysia and provide guidance for other countries navigating similar socio-political contexts in conservation governance.

Keywords: protected areas, community-managed sites, international recognition

INTRODUCTION

The IUCN Green List of Protected and Conserved Areas (Green List) was developed to help protected and conserved areas deliver successful conservation outcomes through effective and equitable governance and management. This is achieved by benchmarking sites' management practices, outcomes, condition of values, and threat mitigation against a global standard. Although voluntary, the Green List encourages sites to strengthen governance and management, with certification recognising those that have achieved successful conservation outcomes. To achieve Green List status, a site must demonstrate and maintain successful implementation of the Green List Standard, and this is evaluated in three phases: Application, Candidate and Green List Phases. The Green List Standard consists of four components, 17 criteria and 50 indicators. Since the first sites were added to the Green List in 2014, 84 sites worldwide have been listed, while 284 additional sites are in the process of nomination. The main objective of the Green List is to increase the number of protected and conserved areas that deliver successful conservation outcomes through good governance, sound design and effective and equitable management (Hockings et al., 2019).

There are only a few published papers using empirical evidence to showcase the motivations and challenges of sites seeking to achieve Green List certification. Wells et al. (2016) conducted a study with six Marine Protected Areas (MPA) that took part in a pilot programme to achieve Green List status and documented their experiences. The study interviewed managers involved to ascertain the benefits and challenges of the Green List process and identified areas for improvement. Another study in Australia's Lamington National Park assessed

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Table 1. Respondents interviewed and the agencies and sites they represented

Protected/ conserved area management agency	State of the site location	Name of site(s)	Green List status (as of August 2025)
R1. Reef Guardian	Sabah	1. Sugud Islands Marine Conservation Area	Green Listed on 16 May 2022.
R2. Sabah Forestry Department	Sabah	2. Pin Supu Forest Reserve	Green Listed on 16 May 2025.
		3. Lumaku Forest Reserve 4. Sook Lake Forest Reserve	Candidate: Site Self-Assessment for the 50 indicators
		5. Ulu Kalumpang-Wullersdorf Forest Reserve 6. Sugut Forest Reserve 7. PINTAR Forest Reserve 8. Timimbang-Botitian Forest Reserve	Application: Awaiting the Expert Assessment Group for the Green List (EAGL) confirmation
R3. Sawit Kinabalu	Sabah	9. Sungai Pin Conservation Area	Candidate: Site Self-Assessment for the 50 indicators
R4. Jagoi Cooperative	Sarawak	10. Jagoi Heritage Forest	Candidate: Site Self-Assessment for the 50 indicators
R5. Sarawak Forestry Corporation	Sarawak	11. Bako National Park 12. Santubong National Park	Candidate: Site Self-Assessment for the 50 indicators
		13. Gunung Lesong National Park 14. Gunung Buda National Park	Application: Site Self-Assessment
R6. Department of Wildlife and National Parks Peninsular Malaysia	Pahang, Peninsular Malaysia	15. Tengku Hassanal Wildlife Reserve	Application: Awaiting EAGL confirmation

the benefits of using the Green List for implementing effective park management and documented their journey (Tanner-McAllister et al., 2024). Building on these two publications, this paper intends to systematically document selected sites in Malaysia on their journey towards meeting the Green List standards, and to provide more empirical evidence in the published literature to aid other protected and conserved area managers seeking to achieve Green List certification. Specifically, the objective of our paper is to understand the motivations for seeking Green List certification, and the challenges faced while undergoing this process in Malaysia. These insights could be used to promote the benefits of the Green List, improve the process, and support the standard as a global benchmark for identifying well-managed protected and conserved areas, thereby delivering positive outcomes for biodiversity and society as the original intent of the Green List Programme (Hockings et al., 2019).

METHODOLOGY

One representative was interviewed from each of six protected or conserved area agencies or organisations in Malaysia (Table 1) that have either achieved Green List status, are currently at Applicant or Candidate stages or have started exploring the Green List Standard. As of August 2025, Sugud Islands Marine Conservation Area and Pin Supu Forest Reserve have achieved the Green List status. The other respondents manage sites in the Applicant or Candidate phases. As such, the benefits we present here are mostly on the process of achieving the Green List.

We used semi-structured interviews to assess the respondents' motivations for pursuing Green List status and their experience of the process. The respondents were chosen to provide perspectives from a variety of organisations, and identified as R1–R6 (Table 1). R1 is from a private non-profit company with a lease to manage a protected area. The other five representatives were from government agencies, an oil palm company and a local community cooperative. At the time of the interview, R6 was from an agency in Peninsular Malaysia that had yet to apply for Green List certification; therefore, the challenges reported are what R6 perceived would be faced once the process was underway. Moreover, we wanted representation from Malaysia's two geopolitical regions: Peninsular Malaysia, consisting of 11 states, and Borneo Island, with two states, Sabah and

The picturesque Sapi Cape at Bako National Park, Sarawak. © Sarawak Forestry Corporation

Sarawak. The Bornean states are semi-autonomous and have control over their land and natural resources as compared to all states of Peninsular Malaysia. Respondents R1–R5 were directly responsible for Green List nominations and listing for their organisations. Respondent R6 is the Director for the protected area programme at the Department of Wildlife and National Parks, Peninsular Malaysia and oversees the effective management of all protected areas in the region.

The questionnaire (Supplementary Online Material 1) was developed and tested with a volunteer knowledgeable about the research matter and improved in response to their comments. The interviews were conducted online and face-to-face in November and December 2024, and were recorded with the respondents' permission. Content analysis of the interview transcripts was performed by first reading all the respondents' answers to the same questions and coding them into four themes: (1) their motivations for pursuing the Green List, (2) the benefits of going through the process, (3) the factors enabling them to pursue the Green List and (4) the challenges they faced when undergoing the process. Next, the coded data were analysed by assessing the commonalities or unique answers in responses to each question, allowing for the identification of patterns, shared perspectives and divergent views across the four themes.

RESULTS AND DISCUSSION

Reasons sites in Malaysia seek Green List certification

All six respondents stated that the key motivation for pursuing Green List certification is the recognition that their sites are being managed according to international best practices. As R4 aptly stated, Green List status "*gives us boasting rights*". Across all sites, achieving Green List certification is perceived as a validation of adherence to rigorous conservation standards, enhancing the site's credibility, both nationally and globally. The case of Arakwal National Park in Australia, which was one of the earlier pilot sites that achieved Green List certification, supports this notion, demonstrating that the Green List serves as a benchmark for well-managed protected areas (Bushell & Bricker, 2017). Additionally, four respondents (R3, R4, R5 and R6) anticipated that Green List recognition of their sites would lead to financial incentives and funding opportunities, as funders and investors are perceived to more likely support protected and conserved areas with proven governance and management effectiveness. This was also reported by Wells et al. (2016) in their case studies of MPAs participating in the Green List pilot phase. In this regard, Green List certification functions similarly to other incentive mechanisms such as the Forest Stewardship Council (FSC), which operates on the assumption that consumers are willing to pay a premium for sustainably sourced timber (Fagundes, Schreiber, Nunes, & Fernandes, 2021; Richards, 2000). Likewise, in the Green List context, it is assumed that funders are

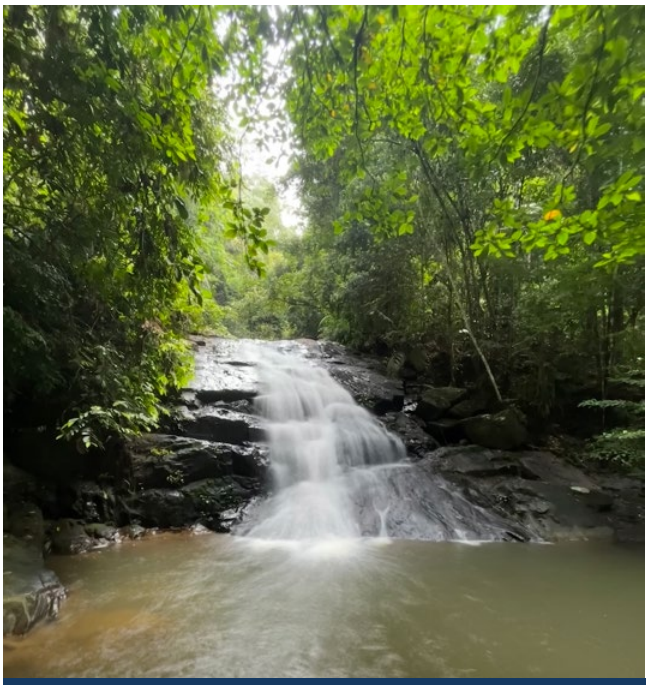
The oxbow lake at Pin Supu Forest Reserve, Sabah. © Rio Gatulik

more inclined to invest in protected and conserved areas that demonstrate strong governance and sustainable management practices. Eppich and Grinda's (2019) study found that World Heritage recognition enhances a site's credibility, visibility, and access to international support and donor networks, even though these sites continue to rely heavily on government funding. While FSC and World Heritage Sites have different objectives to the Green List, they are used for comparison because all three share a common underlying mechanism, which is the international recognition that the site has met certain standards, thereby enhancing its credibility as a well-governed site.

Green List certification is also viewed as a branding strategy, particularly for sites affiliated with private entities producing commodities. R3, a state-owned oil palm company, is seeking to become the first in Malaysia to achieve Green List certification on a 2,632 ha High Conservation Value Area (HCVA), thereby establishing a good reputation for managing their HCVA effectively. This distinction will enhance the company's environmental credibility and serve as a market differentiator, attracting buyers interested in sourcing sustainable palm oil. Similarly, R2, from a government department that once preferred FSC certification as a branding tool to demonstrate good management in its forest reserves, has shifted to pursuing Green List certification, driven by its significantly lower cost compared to FSC (Becker & Laaksonen-Craig, 2006).

Another motivation for site managers (R3, R4 and R6) to pursue Green List status is the belief that it can enhance the long-term security of their managed areas, and reinforce the permanence of their conservation status, thereby reducing the risk of land-use conversion. While this is viewed as a potential benefit, it should be noted that none of these sites are currently at risk of losing their protected or conserved status; rather, respondents perceive Green List recognition as an additional layer of protection. While Malaysian protected areas are officially considered 'permanent', they remain vulnerable to degazettement and downsizing, particularly in the event of political shifts that prioritise development over conservation. Although no research has directly established a correlation between Green List certification and prevention of degazettement and downsizing of protected areas, international recognition has previously played a role in safeguarding a natural area from further environmental degradation in Malaysia. A notable example is Chini Lake in Pahang, a UNESCO Biosphere Reserve that faced severe threats from mining and logging in 2022. In response to the risk of losing its UNESCO status, the Pahang state government took decisive action to prevent further deforestation by halting mining operations around the lake and designating it as a Permanent Forest Reserve. This case demonstrates that governments are often reluctant to jeopardise international recognition, particularly when it carries significant prestige. By extension, the Green List could serve as a similar safeguard, strengthening the conservation commitment of protected areas and disincentivising policy decisions that might lead to their degazettement or downsizing.

For some PA managers, the drive to achieve Green List accreditation stems from personal motivations to achieve recognition. R1 shared how their experience of being tasked to manage the Green List certification process has led to invitations to share their expertise with other sites seeking Green List certification. R6 sees pushing for Green Listing as a career legacy, contributing to a



A waterfall at Tengku Hassanal Wildlife Reserve, Pahang. © Munisha Cheng

long-term vision of expanding Green List-certified sites in Peninsular Malaysia.

R4, the respondent from a local community-managed site, had more community-oriented motivations. They decided to pursue Green List to preserve their cultural heritage and to provide a recreational space for communities living nearby. R4 sees the Green List as a tool for promoting both biodiversity conservation and community well-being, as well as a mechanism to secure continued protection of ecosystem services, such as protection of the water catchment.

The benefits of going through the process of Green Listing and achieving certification

Four respondents (R1, R3, R4 and R6) cited that by going through the Green List process, their documentation and management systems improved. The process encourages teams to organise their documents systematically, establishing proper filing systems that are also beneficial for sites pursuing multiple recognitions. Other Green List case studies have reported similar benefits in the improvement of their management systems (Bushell & Bricker, 2017; Wells et al., 2016). R1 reported that going through the process helped ensure the adoption of more effective management strategies, based on a clear framework according to international standards. Another benefit reported by R2, R3 and R5 was the improved capability of staff, as team members gained essential skills in wildlife monitoring, data collection, structured reporting, and outcome-based management, thus improving overall management capability. A similar outcome was noted in Lamington National Park, Australia, where the Green List process contributed to uplifting the capacity and capability of the park's staff by highlighting gaps in its management, leading to better linkages between strategic planning and day-to-day operations (Tanner-McAllister et al., 2024). R3 and R5 reported that the process and framework also improve team cohesion, as it fosters stronger coordination among the teams working towards a common goal. Such cohesion helped promote organisational improvement in the MPAs that participated in the pilot phase of the Green List (Wells et al., 2016). Furthermore, all respondents reported that achieving Green List certification will enhance a sense of pride and motivation among their team members.

Factors enabling the pursuit of Green Listing

Respondents (R1, R3, R5 and R6) indicated that leadership and internal advocacy were crucial enabling factors for pursuing the Green List. They noted that strong support from a dedicated individual within the organisation or department significantly influenced the decision to pursue certification. Those with prior exposure to the Green List like R1, who was previously a member of the Malaysian EAGL, were particularly instrumental in driving the process forward. External support from conservation organisations, notably the World Wide Fund for Nature Malaysia (WWF-Malaysia), proved essential for R2, R4 and R5. As a well-funded conservation organisation, WWF-Malaysia played the role of a boundary spanner, which is an individual or organisation that connects different types of actors and enables interactions through logistical, facilitation and financial support (Bodin, 2017; Goodrich et al., 2020). WWF-Malaysia introduced the Green List into Malaysia, mentoring selected sites, funding Green List meetings and serving as an implementing partner.

Likewise, federal government funding through Ecological Fiscal Transfers (EFT) and its annual budget allocation provided further momentum. State government departments as reported by R5 and R6 accessed EFT funds specifically allocated to support the Green List process, ensuring financial stability to proceed with certification. Alignment with state strategies and policies reinforced the Green List's significance within governmental frameworks. The Sabah Forest Policy 2018 and the Sarawak Post-COVID-19 Development Strategy 2030 explicitly emphasised the importance of international recognition for protected areas. Similarly, within the strategic plan of the Department of Wildlife

and National Parks Peninsular Malaysia (DWNP), international accreditation has been institutionalised as a framework to ensure conservation excellence and effective protected area governance.

Challenges of Green List nomination

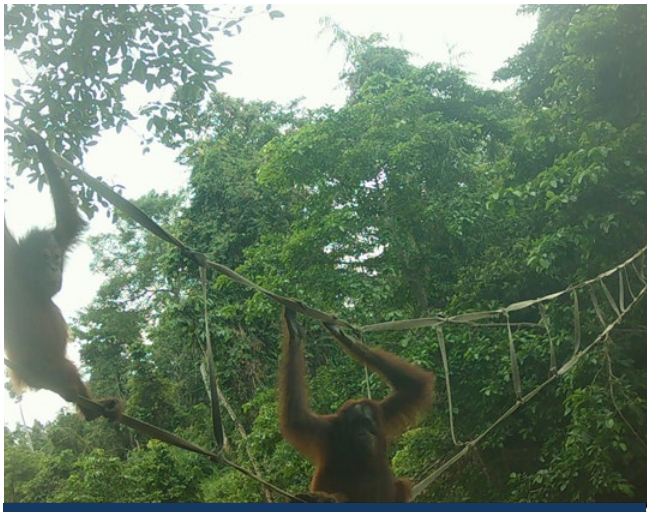
Capacity of protected and conserved areas to meet the Green List standard

All respondents indicated that the process of reporting on the 50 Green List indicators presents significant challenges for protected or conserved area managers, especially when they do not have an existing or organised information management system to monitor and evaluate their management effectiveness. One of the primary difficulties is the time-consuming nature of locating and uploading the necessary documents onto COMPASS (IUCN Green List's digital platform that facilitates site applications). Writing site justifications for the indicators adds another layer of complexity, as site managers (R2, R3, R4, R5 and R6) struggle with the technical aspects of answering the indicators, necessitating the guidance of a mentor. All sites except R1 mentioned that the most challenging indicators pertained to natural values and thresholds, as many sites lack the necessary data to support their claims, potentially due to the absence of a monitoring framework within the sites. R1, the lead marine biologist for their site for over 15 years, found it relatively easier because they had the necessary expertise to address the indicators, unlike the managers at other sites, who were primarily administrators without in-depth technical knowledge. The challenges described above were also faced by the six MPAs that participated in the pilot phase of the Green List in Wells et al. (2016).

R2, R4 and R5 reported that the sheer volume of 50 indicators can feel overwhelming, particularly for those who are not working on the Green List full time and have other responsibilities. Specifically for the government-managed sites (R2, R5 and R6), staff turnover presents a risk, as successors may not be interested in continuing the efforts, which can result in delays or the abandonment of the process altogether.

The findings above regarding the technical aspects of the 50 indicators do not suggest that the Green List standard should be made easier to achieve; rather, they point to key areas where many Malaysian protected and conserved areas must build capacity, improve data systems, and strengthen technical skills to meet global standards. The Green List process itself has acted as a catalyst for such improvements. For example, R3 reported that since beginning the process, their team has been collecting higher-quality data and conducting regular biodiversity monitoring. Similarly, to build their own capacity, R2 partnered with other organisations to help fill in their gaps, such as assistance and training in biodiversity monitoring.

Seagrass habitat for Green Turtles. Underneath the jetty of Lankayan Island, SIMCA. © Archier



Caught on camera. Bornean orangutans using a man-made bridge to cross a river at Sungai Pin Conservation Area, Sabah. © CBU, Sawit Kinabalu

Community-conserved area challenges

For the community-conserved area (R4), securing land rights to their site remains a significant obstacle due to the complex process of legal recognition. This makes it challenging to meet the fundamental requirement of having a clearly defined and documented governance structure, as outlined in Indicator 1.1.1 of the Green List Standard. This is a common challenge when it comes to other certification schemes like the FSC. As pointed out by Becker and Laaksonen-Craig (2006), tenure rights are needed so that communities can manage and sustain the land in the long term, consistent with the requirements in the certification standards. R4 reported that the pace

Conservation education camp organised by KOPEL, the local community cooperative at Pin Supu Forest Reserve, Sabah. © Rio Gatulik

at which the application progresses causes them to lose momentum and interest. The prolonged timeline of the Green List process is particularly discouraging for local communities because they often lack the resources and capacity to sustain interest and motivation, in addition to the lack of opportunities to access funding compared to sites managed by government agencies.

Using COMPASS

R1 reported that the COMPASS platform poses additional barriers, especially to sites located in remote areas with unreliable internet connectivity, resulting in the site manager facing difficulties in accessing and inputting information into the online platform. Furthermore, R4 found that COMPASS lacks a user-friendly interface, making it challenging for individuals with limited computer literacy. This challenge is particularly pronounced for those unfamiliar with digital tools, such as members of local communities or more mature participants, who may struggle to complete the process within COMPASS.

Misunderstandings regarding the Green List

R2 and R5 observed that within their departments, there was limited understanding of the time and requirements involved in achieving Green List certification, leading to expectations that did not align with the process. In R2's case, prior experience with FSC certification contributed to an assumption that the Green List would follow a similar timeline and evaluation approach, despite substantial differences in scope and methodology. In Peninsular Malaysia, R6 noted that some state governments may be hesitant to engage with the Green List due to perceptions of potential financial implications or concerns about state jurisdiction over protected areas.

CONCLUSION AND RECOMMENDATIONS

This study examined the motivations of selected sites pursuing Green List status in Malaysia, alongside the challenges encountered throughout the process. While representatives of protected or conserved areas clearly value the Green List for the international recognition it confers, its alignment with global best practices, improvements in monitoring systems, and its perceived potential to attract funding and enhance protection, the pathway to gaining recognition remains complex, time-consuming and resource intensive. Our findings highlight the need for more coordinated and strategic support from within the Green List community (e.g. mentors, EAGLs, implementing partners, Operations Team) and from the broader conservation community to improve the processes and its benefits, and to keep the sites engaged. At the same time, our findings suggest that engaging in the Green List process helps sites identify gaps and strengthen their capacity, enabling them to progressively align with international best practices, which is a core intention of the standard.

To strengthen the uptake of the Green List process in Malaysia and the rest of the world, the IUCN and the global Green List community could work towards linking Green List accreditation to tangible incentives, such as access to performance-based grants and increased international visibility like the World Heritage Sites.

Addressing the equity challenges encountered by Malaysian community-conserved areas in the Green List application process is of particular importance. This can be achieved by offering targeted support to community-managed sites that are facing systemic challenges such as securing land tenure documentation and meeting

technical reporting requirements. Implementing partners can play a pivotal role by prioritising and strategically appointing experienced mentors and connecting site managers to technical experts for site-specific guidance and oversight.

To address the capacity gaps, improve mentor development and promote better understanding of the Green List process, former EAGL members have recently established the Malaysian EAGL Alumni group. The Alumni retain and pass on EAGL expertise to mentored sites and further support their efforts by introducing the Green List programme to a wider audience. In addition, a national Green List Community of Practice is being developed to foster peer-to-peer learning, reduce feelings of isolation, and build staff confidence at sites aspiring to become Green List certified. It is recommended that both initiatives are acknowledged and officially documented (such as in the *IUCN Green List Malaysia Handbook*) to support their role in implementing the Green List Programme in Malaysia.

Donors and boundary spanners have a key role in enabling success. They can advocate for Green List sites and candidate sites to be prioritised in government and donor funding streams, thus reinforcing the Green List as a credible and recognised standard of protected and conserved areas excellence. Encouraging relevant government agencies to institutionalise support for Green List certification by integrating it into national and state conservation strategies (particularly for the states in Peninsular Malaysia) and providing dedicated resources for implementation at the state level would further enhance the sustainability and impact of the initiative in Malaysia.

These recommendations could be extended beyond Malaysia and offer valuable guidance for other countries seeking Green List recognition. By sharing Malaysia's experience and case studies, the authors hope to contribute meaningfully to the continuous refinement of the Green List process and reinforce its significance as a global standard for protected and conserved areas. Ultimately, the Green List can only fulfil its aim to deliver impactful conservation outcomes through deliberate, sustained support and decisive on-the-ground implementation.

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SUPPLEMENTARY ONLINE MATERIAL

Research questionnaire and objectives.

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RÉSUMÉ

La Liste verte des aires protégées et conservées de l'UICN fournit une référence internationale pour une gestion efficace et équitable de la conservation. Cette étude examine les motivations et les défis de six agences malaisiennes différentes chargées de la protection ou de la conservation des aires protégées, parmi lesquelles des départements gouvernementaux, des entités du secteur privé et une coopérative communautaire qui souhaitent obtenir la reconnaissance de la Liste verte. Des entretiens semi-structurés ont révélé que les principales motivations sont notamment le renforcement de la crédibilité internationale, l'accès à des possibilités de financement, le renforcement de la protection à long terme et l'obtention d'une reconnaissance professionnelle ou organisationnelle. Les sites gérés par la communauté accordaient en outre une grande importance à la préservation du patrimoine culturel et des services écosystémiques. Parmi les avantages signalés, on peut citer l'amélioration de la documentation, le renforcement des systèmes de gestion, l'amélioration des capacités du personnel et une plus grande cohésion de l'équipe. Cependant, les sites sont confrontés à des défis importants, tels que les lourdeurs administratives, le faible niveau de capacités techniques et les contraintes institutionnelles. Les zones gérées par les communautés sont en outre confrontées à des obstacles tels que l'incertitude du régime foncier et la limitation des ressources, qui entravent leur participation à la Liste verte. Les résultats soulignent le rôle déterminant d'un leadership fort, du soutien des bailleurs de fonds et de l'alignement des politiques, tout en mettant en évidence la nécessité de rationaliser les processus, de mettre en place un mentorat ciblé et d'assurer un soutien institutionnel durable. Nos conclusions offrent des recommandations pratiques pour améliorer la mise en œuvre de la Liste verte en Malaisie et fournissent des orientations à d'autres pays qui s'engagent dans cette voie.

RESUMEN

La Lista Verde de Áreas Protegidas y Conservadas de la UICN proporciona un punto de referencia internacional para una gestión eficaz y equitativa de la conservación. Este estudio examina las motivaciones y los retos de seis organismos diferentes de áreas protegidas o conservadas de Malasia, entre los que se incluyen departamentos gubernamentales, entidades del sector privado y una cooperativa comunitaria que aspira a obtener el reconocimiento de la Lista Verde. Las entrevistas semiestructuradas revelaron que las principales motivaciones son mejorar la credibilidad internacional, acceder a oportunidades de financiación, reforzar la protección a largo plazo y lograr el reconocimiento profesional u organizativo. Los sitios gestionados por la comunidad valoraban además la preservación del patrimonio cultural y los servicios ecosistémicos. Entre los beneficios del proceso se mencionaron la mejora de la documentación, el fortalecimiento de los sistemas de gestión, la mejora de la capacidad del personal y una mayor cohesión del equipo. Sin embargo, los sitios se enfrentan a retos importantes, como las cargas procedimentales, la escasa capacidad técnica y las limitaciones institucionales. Las áreas gestionadas por la comunidad se enfrentan además a obstáculos como la inseguridad de la tenencia de la tierra y la escasez de recursos, que dificultan su participación en la Lista Verde. Las conclusiones destacan el papel facilitador de un liderazgo fuerte, el apoyo de los donantes y la armonización de las políticas, al tiempo que subrayan la necesidad de procesos simplificados, tutorías específicas y un respaldo institucional sostenido. Nuestras conclusiones ofrecen recomendaciones prácticas para mejorar la implementación de la Lista Verde en Malasia y proporcionan orientación a otros países que están navegando por este proceso.

MANAGING SMALL GRASSLAND RESERVES: BIRD RESPONSE TO REGENERATIVE GRAZING IN A PRIVATE RESERVE IN ARGENTINA

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ABSTRACT

In the grassland biomes of southern South America, high agricultural land value limits the expansion of protected areas, making conservation on private lands through voluntary schemes essential. These frequently limited in size reserves require livestock grazing management to maintain biodiversity, yet the effects of specific regimes like regenerative grazing on birds remain unstudied in the hill grasslands of the Pampean region. We evaluated the bird assemblage response to experimental regenerative grazing by comparing it to traditional grazing and no-grazing controls on a ranch with a Private Reserve in the Tandilia Hills in the Pampean region of Argentina. We recorded 36 bird species, including 24 habitat generalists and 12 grassland specialists. Bird abundance was affected by grazing conditions. Grassland specialists were positively associated with increased grassland structure, while generalists showed the opposite response. Vegetation structure was lower with traditional grazing, intermediate with regenerative grazing and maximum without grazing. The frequency and timing of grazing should allow for rest to ensure a complex vertical structure for grassland birds during the nesting period. Innovative grazing in small reserves supports sustainable use and habitat continuity in the Tandilia Hills, but its application requires cautious timing to avoid compromising grassland bird habitat during breeding season.

Keywords: Livestock, grassland birds, small area, private, reserve, Tandilia, South America

RESUMEN

En los pastizales del sur de Sudamérica, el alto valor económico de la tierra para la agricultura limita la expansión de las áreas protegidas, lo que hace que la conservación en tierras privadas mediante esquemas voluntarios sea esencial. Estas reservas, a menudo de pequeño tamaño, deben manejarse con pastoreo para mantener la biodiversidad, pero los efectos de regímenes específicos como el pastoreo regenerativo sobre las aves siguen siendo una incógnita en los pastizales serranos de la región Pampeana. Se evaluó la respuesta del ensamble de aves a un manejo experimental de pastoreo regenerativo comparándolo con sitios control de pastoreo tradicional y sin pastoreo en una estancia con Reserva Privada que conserva pastizales serranos de la región Pampeana en Argentina. Se registraron 36 especies de aves, incluyendo 24 generalistas de hábitat y 12 especialistas de pastizal. La abundancia de aves fue afectada por las condiciones de pastoreo. Las aves de pastizal se asociaron positivamente con el aumento de la estructura de los pastizales, mientras que las especies generalistas mostraron la respuesta opuesta. La estructura de la vegetación fue menor en la condición de pastoreo tradicional, intermedia en la condición de pastoreo regenerativo y máxima sin pastoreo. La frecuencia y el momento del pastoreo deberían permitir el descanso para garantizar una estructura vertical compleja para las aves de pastizal durante el periodo de nidificación. Métodos innovadores de manejo del pastoreo en pequeñas reservas son valiosos para el uso sostenible y la continuidad del hábitat en las Sierras de Tandilia, pero su aplicación requiere una sincronización cuidadosa para evitar comprometer el hábitat de las aves de pastizal durante la temporada de reproducción.

INTRODUCTION

Protected areas are designated geographic spaces aimed at long-term nature conservation, representing a crucial strategy to mitigate the expansion and impact of human-induced stressors on biodiversity and ecosystem services (Convention on Biological Diversity, 2023; IUCN, 1994). Globally, these areas face three main challenges: insufficient coverage across biomes, small size, and fragmentation of habitats, complicating conservation efforts (Schauman et al., 2023). Expanding the number and size and reducing levels of fragmentation of protected areas are pressing conservation challenges. In regions where land value is high, adding new public conservation areas becomes increasingly difficult. Consequently, the conservation of private lands through voluntary schemes gains importance (Kamal et al., 2015). Such initiatives significantly contribute to meeting conservation targets set by the Convention on Biological Diversity, which aims to protect at least 30 per cent of each biome (Convention on Biological Diversity, 2023; Garibaldi et al., 2020). These privately managed areas, often small and maintained by landowners, must be effectively managed to meet conservation requirements.

The Southern Grassland Biome of South America has experienced extensive agricultural development for over two centuries (Azpiroz et al., 2012). The economic value of these lands for agriculture has limited the expansion of protected areas, which currently cover less than 1 per cent of the biome's surface area (https://sifap.gob.ar/areas-protegidas). Therefore, incorporating private lands into conservation efforts presents a valuable alternative. However, managing private protected areas in grassland biomes is challenging. Grasslands evolved with natural disturbances like grazing and fire, essential for maintaining biodiversity and productivity (Paruelo et al., 2022). Without these moderating disturbances, grasslands can degrade over time, reducing biodiversity (Barzan et al., 2021; Isacch et al., 2004; Isacch & Cardoni, 2011; Isacch & Martínez, 2001; Laterra et al., 1998; Marino, 2008).

In the Pampas region of Argentina, agroecosystems have largely replaced natural grasslands, which now persist mainly in areas unsuitable for intensive agriculture (Bilenca & Miñarro, 2004). Parts of the Pampas, characterised by rocky soils, still support patches of grasslands where cattle grazing is the predominant activity. These grasslands provide crucial habitat for bird species adapted to tall grass cover. However, poorly managed grazing, which reduces grass cover from tall to short, negatively impacts specialised grassland birds (Cozzani & Zalba, 2009; Dias et al., 2017; Isacch & Cardoni, 2011; Vaccaro et al., 2020). Therefore, adopting grazing management practices that balance biodiversity conservation with agricultural production is essential (Aldabe et al., 2024; Codesido & Bilenca, 2021; Isacch & Cardoni, 2011; Marino, 2008; Pírez & Aldabe, 2023; Vaccaro et al., 2020).

Livestock grazing has been and continues to be one of the main drivers generating and maintaining grassland heterogeneity worldwide (Adler et al., 2001; Cid & Brizuela, 1998; Jacobo et al., 2006). The historically dominant herbivore in the Pampas region, the Pampas Deer (*Ozotoceros bezoarticus*), is now almost extinct due to habitat loss (Carro et al., 2019). Since organisms respond differently to the intensity of grazing, cattle grazing can functionally replace the role of native herbivores in already altered environments (Fuhlendorf & Engle, 2001). The effects of livestock grazing on grassland biodiversity dynamics are complex and often closely dependent on grazing intensity (Evans et al., 2015). While intensive grazing is detrimental to plant growth and survival, and therefore to ecosystem functioning, grazing practices that modulate the frequency, intensity and seasonality of grazing can be beneficial for biodiversity (Fuhlendorf et al., 2006; Isacch & Cardoni, 2011; Pírez & Aldabe, 2023). One such practice is regenerative grazing management in which the timing and distribution (density) of livestock grazing is carefully planned, managed and monitored with the aim of improving rangeland productivity and overall livestock system resilience (Garnett et al., 2017; Teague & Barnes, 2017). Regenerative grazing has been gaining popularity among producers and in academic circles (Giller et al., 2021; Massy, 2017). In a recent review, Morris (2021) shows evidence that regenerative grazing creates benefits for soil biota, but the evidence is not clear for other groups of organisms, especially birds, where more negative than positive effects have been reported. The contrasting evidence and the increasing uptake of this management regime require regional studies to assess the effects of regenerative grazing on different components of biodiversity. Despite growing evidence of the compatibility of grassland birds with certain grazing methods in the Pampas region (Aldabe et al., 2023; Aldabe et al., 2024; Codesido & Bilenca, 2021; Cozzani & Zalba, 2009; Dias et al., 2017; Isacch & Cardoni, 2011; Modernel et al., 2016), there are no specific studies assessing the effects of regenerative grazing on birds in this region (except for Pírez & Aldabe, 2023).

Our aim was to evaluate the bird assemblage response to an experimental regenerative grazing management approach compared to traditional grazing (almost continuous grazing on pastures with large paddocks) and control (no grazing) on the Paititi Private Natural Reserve. In 2021,

Paititi Private Natural Reserve (Tandilia Hill System, Pampas region, Argentina). One of the main management practices carried out in the reserve comprises controlled cattle grazing, to prevent fires and promote highland grasslands heterogeneity © Esteban González Zugasti.

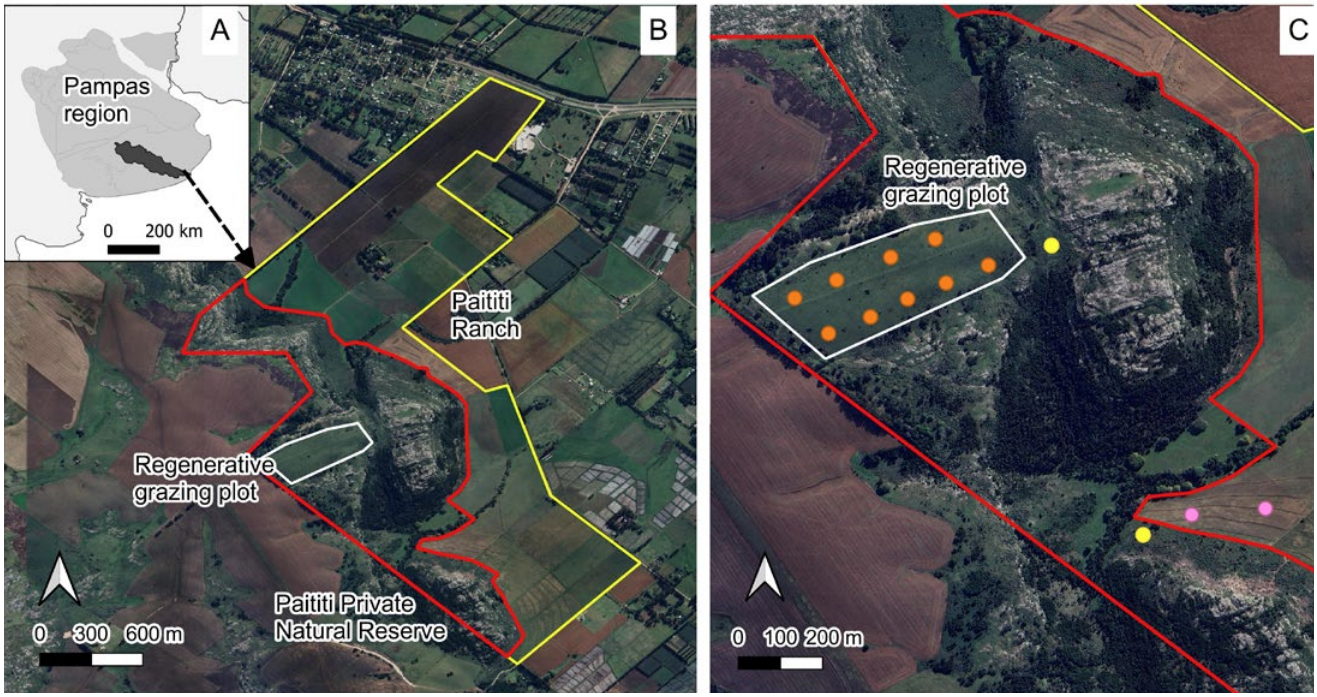


Figure 1. A- The Tandilia Hill System (dark grey area) within the Pampas Region (grey area) in Argentina. B- Location of the experimental plot with regenerative grazing (white polygon) in the Paititi Private Natural Reserve (red polygon) within the Paititi Ranch (yellow polygon). Note the agricultural matrix surrounding the reserve. C- Zoom to the study area marking the sampling points in each grazing condition (Traditional grazing: pink, Regenerative grazing: orange, Grazing exclusion: yellow).

the reserve began a regenerative grazing trial in highland grasslands to explore alternative methods for natural highland grasslands management. Our fieldwork was conducted to take advantage of this management.

STUDY AREA

The study area is in the Paititi Private Natural Reserve (37°54' S, 57°49' W) in the Southern Pampas region of Argentina within the Tandilia Hill System (Figure 1). The Tandilia System forms an arc of discontinuous elevation of approximately 1.4 million ha in the Pampas Plain. It is characterised by eroded hills (*sierras*) and small rocky outcrops (*cerrilladas*) surrounded by an undulating relief with deep soils, where agriculture is the dominant land use (Herrera et al., 2016). The average annual temperature in this region is 14°C, and the average annual precipitation is 800 mm (Burgos & Vidal, 1951). A grassland community named *flechillar* develops on the top of cerrilladas, dominated by grasses like *Nassella neesiana*, among others. There are small patches of a few hectares of mixed *pajonal* represented by *Paspalum quadrifarium*, and scattered shrubs (*Baccharis*

dracunculifolia ssp. *tandilensis*, *Colletia paradoxa* and *Dodonaea viscosa*) (Cabrera & Zardini, 1978; Echeverría et al., 2023). Grassland patches represent important biodiversity hotspots (Herrera & Laterra, 2011) especially of endemic species (Gilarranz et al., 2015; Kristensen et al., 2014), and are sources of ecosystem services (Barral & Maceira, 2012).

The Paititi Ranch, a 430 ha agricultural establishment, is in the south of this hill system (37°54' S – 57°49' W) and is part of the *Alianza del Pastizal* (Grassland Alliance), dedicated to the conservation of grasslands and its associated fauna. Within this ranch, the Paititi Reserve covers an area of 220 ha, which mainly includes the hills of the ranch, where natural grasslands and rocky communities occur. It is considered a Valuable Grassland Area (Bilenca & Miñarro, 2004), with a high value for conservation and ecotourism (Chebez, 2005), and is part of the Argentine Network of Private Nature Reserves (https://reservasprivadas.org.ar/). The main activities and management practices carried out in the reserve are environmental education for students, control of invasive species and controlled grazing to prevent fires and promote grasslands heterogeneity.

METHODS

Grazing management and sampling design

The fundamental principles of regenerative grazing are to "limit the duration of grazing to avoid regrazing of forage plants and to employ the herd effect to trample down dead plants, break up hard soil crusts, and incorporate dung, urine and plant organic matter into soils to improve soil carbon, increase water infiltration and retention, and accelerate nutrient flow for grass regrowth" (Savory & Butterfield, 2016; Teague & Barnes, 2017). This approach uses multiple small temporary paddocks that are successively stocked with large herds of livestock for a few days followed by long resting periods for vegetation recovery (many months) (Savory & Butterfield, 2016).

Regenerative grazing conditions were surveyed in a 14 ha field, where a large plot defined by permanent electric fences was successively divided by temporary electric fencing into 12 smaller temporary livestock paddocks (1.2 ha/paddock). The grazing experiment was conducted from 10 May to 31 July 2021. The rotation period averaged 6 days (SD = 2) and the stocking rate averaged 21.3 cows/ha (SD = 2.7). Two grassland patches with traditional grazing (almost continuous grazing on pastures in large paddocks) and two tall grassland patches with grazing exclusion at least two years before the experiment were included as controls (Figure 1).

Bird and vegetation surveys

We surveyed birds fortnightly to monthly between June 2021 (one month before grazing ceased) and March 2022. We used a fixed-width strip transect (100*30 m) to record the number of individuals per species (Conner & Dickson, 1980) along nine fixed transects evenly distributed within the experimental area, two fixed transects in patches with traditional grazing and two fixed transects in control patches (grasslands with grazing exclusion). Each species was classified according to habitat preference (see *Data analysis*).

We used a modification of the pole method described by Robel et al. (1970) to measure vegetation visual obstruction. In the centre of each transect we placed a 2 m pole (divided into 20 10-cm segments) and made visual obstruction readings (VOR) from a 5 m distance, with the observer's eyes at a height of 1 m (Robel et al., 1970). The height of the uppermost VOR band with ≥25 per cent vegetation cover (Toledo et al., 2010) was used as a proxy of vegetation structure.

Data analysis

We classified bird species according to habitat preference as habitat generalist or grassland specialist (Supplementary Online Material). Each species can only belong to one group, not both. This classification was adapted to the highland grassland system from personal observations and the following references: Codesido et al. (2011), Comparatore et al. (1996), Isacch and Cardoni (2011) and Pretelli et al. (2018).

To evaluate whether generalist and grassland birds varied with vegetation structure and grazing condition, we performed a Generalised Linear Mixed Model (Negative binomial family with log as the link function). We included the number of individuals (per transect) as the response variable and vegetation structure (height of the uppermost VOR band with ≥25 per cent vegetation cover), bird habitat preference (generalist or grassland specialist), grazing condition (traditional grazing, regenerative grazing, grazing exclusion) and their interactions as predictors. To account for the non-independence of repeated measurements on the same transect or date, transect ID and date were included as random factors. This approach created one value of bird abundance per date, habitat preference and transect. The model was fitted using the *glmmTMB* function from the *glmmTMB* R package (Brooks et al., 2017). We followed a model selection approach by sequentially removing non-significant terms from the original model (first the three-way interaction, then two-way interactions one by one) until no further terms could be removed (Zuur et al., 2009), based on the maximum likelihood criteria, always

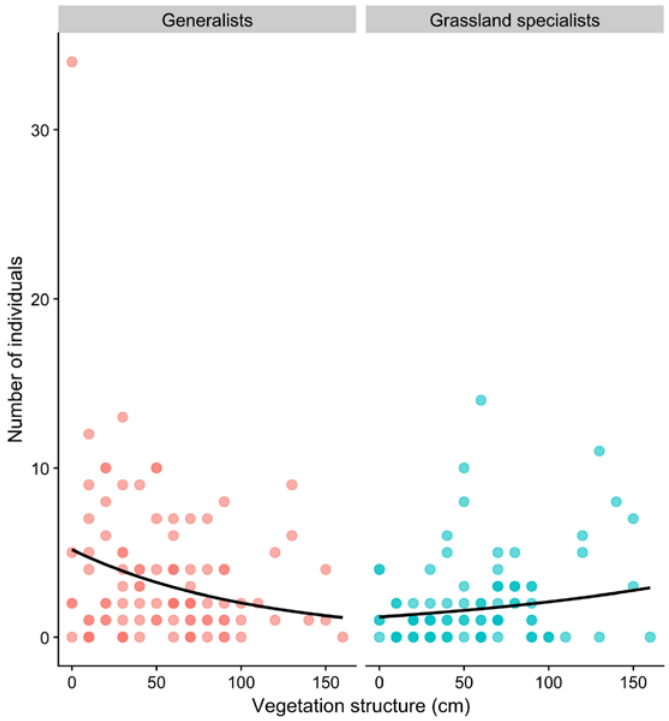


Figure 2. Bird abundance (number of individuals/transect) of generalist and grassland-specialist species in relation to vegetation structure (height of the uppermost VOR band with ≥25% cover) in highland grasslands of the Paititi Private Natural Reserve in the Tandilia Hill System. Solid lines show negative binomial GLMM predictions (95% CI omitted for clarity); darker symbols indicate overlapping points.

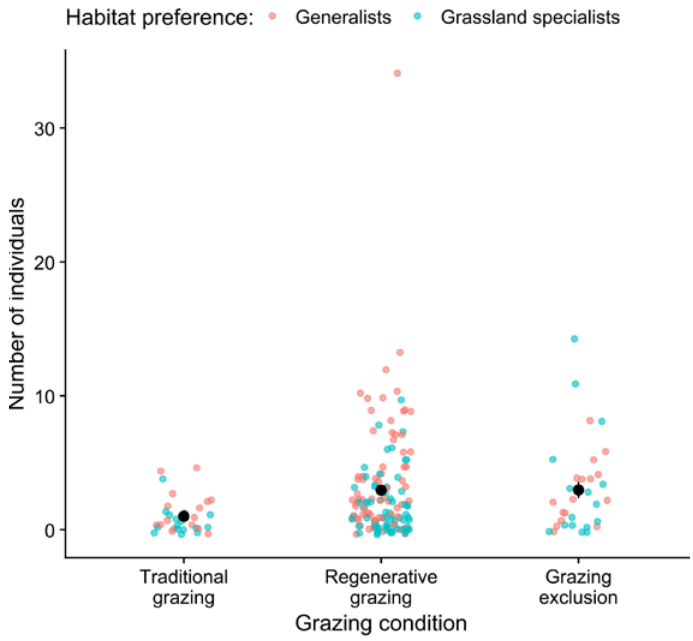


Figure 3. Bird abundance (number of individuals/transect; mean ± SE in black) across grazing conditions (traditional grazing, regenerative grazing, grazing exclusion) in highland grasslands of Paititi Private Natural Reserve, Tandilia Hill System. Smaller colored symbols represent individual values registered across the entire study (habitat generalists: coral, grassland specialists: seagreen).

Natural highland grasslands represent important biodiversity hotspots, providing crucial habitat for bird species adapted to tall grass cover. Cattle grazing is the predominant activity within these patches along the Tandilia Hill System © Esteban González Zugasti.

consistent with the AIC criterion. We evaluated the significance of individual slopes (bird abundance vs vegetation structure, either for generalists or grassland specialists) using the *emtrends* function from the *emmeans* package (Lenth, 2024). We considered temporal autocorrelation using the Ornstein–Uhlenbeck covariance structure for unevenly spaced sampling periods, but it was not significant. We also tested multicollinearity by the Variance Inflation Factor (VIF) using the *check_collinearity* function from the *performance* package (Lüdecke et al., 2021). Model assumptions were evaluated and met (Supplementary Online Material) using the *DHARMa* package (Hartig, 2024). Data management and statistical analyses were carried out using R software, version 4.3.3 (R Core Team, 2024).

RESULTS

We recorded 36 bird species across all transects with grassland specialists accounting for one third of the species (Supplementary Online Material). Bird abundance differed with vegetation structure for generalists and grassland specialists (interaction between vegetation structure and habitat preference; all statistical test results available in the Supplementary Online Material). The abundance of generalists decreased with vegetation structure, while grassland specialists tended to be more abundant in tall-grass areas (Figure 2). Bird abundance differed among grazing conditions, with fewer birds occurring in the traditional grazing management area (main effect of grazing; Figure 3). The effect of grazing condition was independent from those of other variables (i.e. interactions involving grazing condition).

Grass Wren (*Cistothorus platensis*), a typical grassland specialist bird that inhabits in tall grassland patches in the Pampas region © Tomás O'Connor.

However, the vegetation structure was lower (mean ± CI 95%: 21.9 ± 8.21) in the traditional grazing condition, intermediate (mean ± CI 95%: 53.9 ± 5.55) in the regenerative grazing condition and maximum (mean ± CI 95%: 93.8 ± 10.9) in the grazing exclusion condition (Figure 4; $\chi^2 = 79.24$, DF = 2, $p < 0.001$).

DISCUSSION

The patchy highland grasslands of the Pampas region are considered biodiversity hotspots surrounded by one of the most intensively used agricultural matrices in South America (Sabatino et al., 2010). Given the threatened nature of these grasslands, there is an urgent need to introduce grassland conservation and/or restoration, that prioritises grassland connectivity, in public and private environmental agendas. Our experiments with innovative grazing management methods in the Tandilia Hill System are useful in the search for management alternatives for these last grassland remnants (Herrera et al., 2017).

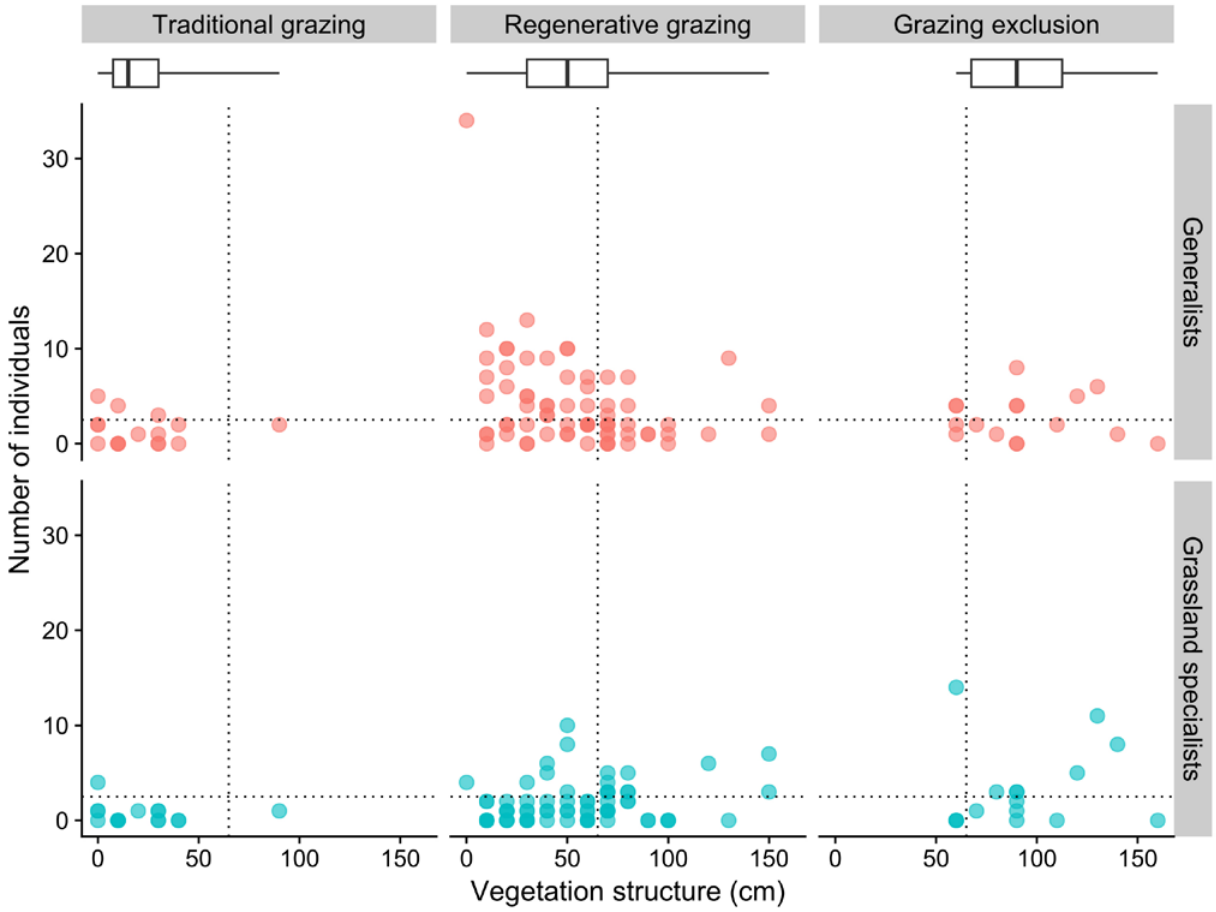
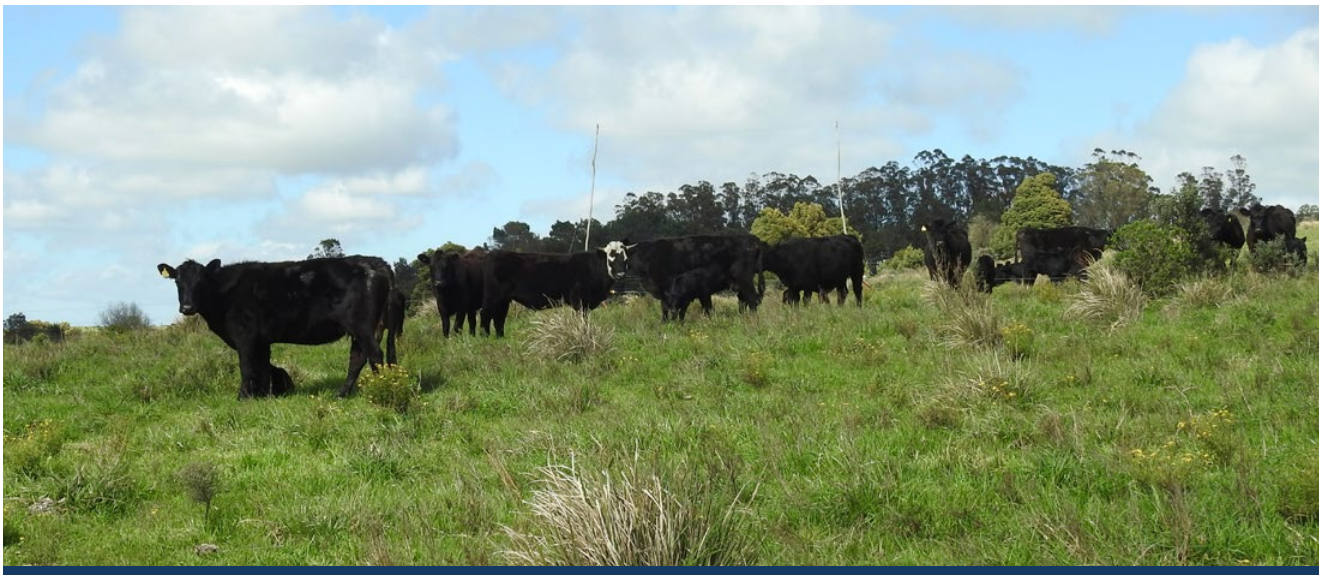


Figure 2. Bird abundance (number of individuals/transect) of generalist and grassland-specialist species in each grazing condition (traditional grazing, regenerative grazing, grazing exclusion) in relation with vegetation structure (height of the uppermost VOR band with ≥25% vegetation cover) in highland grasslands of the Paititi Private Natural Reserve, Tandilia Hill System. Darker symbols indicate overlapping points. Dotted vertical and horizontal lines are included for visual comparison across panels. Box-plots on top of the panel summarise different measurements of vegetation structure across the entire study; the central line represents the median value, the box includes all observations between quartiles 1 and 3, and whiskers depict the range of values observed in a given condition.



Cattle within one of the temporary livestock paddocks of the regenerative grazing experiment, displayed as an alternative method for natural highland grasslands management in the Paititi Private Natural Reserve, Tandilia Hill System © Juan Pablo Isacch.

Our results show that bird abundance is influenced by both vegetation structure and grazing management. Regenerative grazing maintains intermediate vegetation structure and higher bird abundance compared to traditional grazing, which shows lower vegetation and fewer birds. Bird–habitat association changed with vertical vegetation structure, since grassland specialists benefit from higher vertical structure, while generalist species decline as vertical structure increases. These patterns were recorded in other grasslands in the Pampas region, as more vulnerable pampean bird species are associated with tall grass cover (Aldabe et al., 2024; Cozzani & Zalba, 2009; Dias et al., 2017; Isacch & Cardoni, 2011). Rotation frequency should allow the grassland to rest to enable regrowth and ensure the availability of vertical structure for grassland-specialist birds (Aldabe et al., 2024; Codesido & Bilenca, 2021; Cozzani & Zalba, 2009; Dias et al., 2017; Isacch & Cardoni, 2011; Pírez & Aldabe, 2023; Vaccaro et al., 2020). In terms of bird abundance, regenerative grazing shows similar patterns to grazing exclusion. We found no evidence that grazing condition effects differed between generalists and grassland birds, hence it would be interesting to perform long-term studies with more replicates to assess this pattern focusing on the abundance of grassland birds.

In our study, grazing was mostly concentrated during autumn, leading to short grass cover that persisted until spring. Some common tall-grassland bird species can use alternative habitats such as pasturelands and croplands during the winter season (Pretelli et al., 2018), however they need tall grass cover during spring-summer to nest (Cozzani & Zalba, 2009; Pretelli et al., 2013; 2015). In this sense, regenerative grazing pulses in autumn-winter should be recommended providing sufficient time for vegetation to recover to ensure coverage of tall grasses during the birds' reproductive period (i.e. spring-summer). However, it should be considered that although structure can be adequate, there is no information about the effects of regenerative grazing on food availability for birds (i.e. insects and seeds).

Some members of the team conducting the bird census within the experimental area in the Paititi Private Natural Reserve, Tandilia Hill System © Juan Pablo Isacch.

Our study highlights certain limitations typical of this type of research: a small protected area and limited replication over time. Despite these constraints, we recognise that experimental management initiatives like ours can offer valuable insights for similar reserves characterised by small size and tall grasslands.

Globally, there is a growing interest in regenerative grazing management, which is perceived to enhance both

Anthus sp., pipit that commonly occur in grasslands and other open areas © Juan Pablo Isacch.

production and conservation outcomes (Morris, 2021). Consequently, there is a likelihood that such practices will be increasingly adopted in protected areas, especially to manage tall grasslands and mitigate fire risks. Despite the valuable insights provided by our study, we urge caution in implementing these systems more widely in small reserves due to their significant impact on grassland structure and bird diversity. Our results suggest that, with sufficient rest from grazing, plots managed under regenerative grazing can develop heterogeneity and create suitable habitat conditions for tall-grassland specialist birds. Grazing pulses should be timed to align with grassland recovery periods, ensuring availability of tall grasses during the grassland birds' breeding season (October–January; Cozzani & Zalba, 2009; Dias et al., 2017; Isacch & Cardoni, 2011; Pretelli et al., 2013; 2015).

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SUPPLEMENTARY ONLINE MATERIAL

Results tables and model assumptions.

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RÉSUMÉ

Dans les biomes de prairies du sud de l'Amérique du Sud, la valeur élevée des terres agricoles limite l'expansion des zones protégées, rendant indispensable la conservation des terres privées par le biais de programmes volontaires. Ces réserves, souvent de taille limitée, nécessitent une gestion du pâturage du bétail afin de préserver la biodiversité, mais les effets de régimes spécifiques tels que le pâturage régénératif sur les oiseaux n'ont pas encore été étudiés dans les prairies vallonnées de la région de la Pampa. Nous avons évalué la réponse de l'assemblage d'oiseaux au pâturage régénératif expérimental en le comparant au pâturage traditionnel et à des contrôles sans pâturage dans un ranch doté d'une réserve privée dans les collines de Tandilia, dans la région de la Pampa en Argentine. Nous avons recensé 36 espèces d'oiseaux, dont 24 généralistes et 12 spécialistes des prairies. L'abondance des oiseaux a été affectée par les conditions de pâturage. Les spécialistes des prairies ont été associés de manière positive à une structure accrue des prairies, tandis que les généralistes ont montré une réponse opposée. La structure de la végétation était plus faible avec le pâturage traditionnel, intermédiaire avec le pâturage régénératif et maximale sans pâturage. La fréquence et le calendrier du pâturage devraient permettre un repos afin de garantir une structure verticale complexe pour les oiseaux des prairies pendant la période de nidification. Le pâturage innovant dans les petites réserves favorise l'utilisation durable et la continuité de l'habitat dans les collines de Tandilia, mais son application nécessite un calendrier prudent afin de ne pas compromettre l'habitat des oiseaux des prairies pendant la saison de reproduction.

RESUMEN

En los biomas de pastizales del sur de Sudamérica, el alto valor de las tierras agrícolas limita la expansión de las áreas protegidas, lo que hace que la conservación en tierras privadas a través de programas voluntarios sea esencial. Estas reservas, a menudo de tamaño limitado, requieren una gestión del pastoreo del ganado para mantener la biodiversidad, pero los efectos de regímenes específicos como el pastoreo regenerativo sobre las aves siguen sin estudiarse en los pastizales de las colinas de la región pampeana. Evaluamos la respuesta de la comunidad de aves al pastoreo regenerativo experimental comparándolo con el pastoreo tradicional y los controles sin pastoreo en un rancho con una reserva privada en las colinas de Tandilia, en la región pampeana de Argentina. Registramos 36 especies de aves, entre ellas 24 generalistas del hábitat y 12 especialistas de los pastizales. La abundancia de aves se vio afectada por las condiciones de pastoreo. Las especies especialistas de los pastizales se asociaron positivamente con el aumento de la estructura de los pastizales, mientras que las generalistas mostraron la respuesta opuesta. La estructura de la vegetación fue menor con el pastoreo tradicional, intermedia con el pastoreo regenerativo y máxima sin pastoreo. La frecuencia y el momento del pastoreo deben permitir el descanso para garantizar una estructura vertical compleja para las aves de pastizales durante el período de anidación. El pastoreo innovador en pequeñas reservas favorece el uso sostenible y la continuidad del hábitat en las colinas de Tandilia, pero su aplicación requiere una sincronización cuidadosa para evitar comprometer el hábitat de las aves de pastizales durante la temporada de reproducción.

SHORT COMMUNICATION:
REFLECTIONS FROM INTERDISCIPLINARY RESEARCH ON THE SOCIAL IMPLICATIONS OF IMPLEMENTING 30×30: FIVE WAYS FORWARD

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ABSTRACT

Area-based conservation is critical for conserving biodiversity, but its success depends on understanding and addressing its social dimensions. Here we share key reflections from an interdisciplinary working group studying the social implications of expanding area-based conservation under the Kunming-Montreal Global Biodiversity Framework's Target 3, also known as 30×30. Over two years, our interdisciplinary working group collaborated through workshops, quantitative spatial analysis and qualitative case studies to explore how approaches to implementing Target 3 may create challenges and opportunities for people living in and around protected and conserved areas, particularly since international and even national priorities can sometimes conflict with local aspirations. Our reflections emphasise that implementing Target 3 is not only an ecological challenge but also a profoundly social one. Based on insights from our collective work, we identify five ways forward for a socially just Target 3: (1) fostering dialogue across perspectives to support more inclusive solutions; (2) giving greater attention to who is affected; (3) balancing the focus on 'where' conservation is implemented with more attention to 'how' it is governed and managed; (4) mainstreaming social data in conservation planning; and (5) connecting insights across scales.By sharing these reflections, we aim to support ongoing efforts to foreground social considerations in conservation policy and practice.

Keywords: Target 3; Kunming-Montreal Global Biodiversity Framework; Equitable conservation; Just conservation; Social data; 30 by 30

INTRODUCTION

Target 3 of the Kunming-Montreal Global Biodiversity Framework (KMGBF), also known as the 30×30 target, aims to:

> Ensure and enable that by 2030 at least 30 per cent of terrestrial and inland water areas, and of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing indigenous and traditional territories where applicable, and integrated into wider landscapes, seascapes and the ocean, while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognizing and respecting the rights of indigenous peoples and local communities, including over their traditional territories (CBD, 2022).

The target's ambitious scale – almost doubling global coverage of protected and conserved areas by 2030 (UNEP-WCMC & IUCN, 2025) – has made it central to conservation discourse among conservation organisations, researchers and practitioners. However, while some view the target as a crucial opportunity to halt biodiversity loss and strengthen Indigenous and

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community rights (Campaign For Nature, 2022; High Ambition Coalition for Nature and People, 2020), others have raised concerns about risks such as displacement, exclusion, or insufficient attention to social issues in conservation expansion (Kedward & Poupard, 2024; Survival International, 2022). Navigating these tensions is crucial to enable just and effective future conservation (Sandbrook et al., 2023).

This paper emerges from the 'The Social Implications of 30×30' working group funded by the Science for Nature and People Partnership (SNAPP; https://snappartnership.net/), which worked from 2023 to 2025. The group brought together around 30 researchers and practitioners across disciplines, sectors and geographies. Our activities have included developing global- and national-scale quantitative analyses of the potential social implications of 30×30, as well as qualitative analysis of how case study countries have sought to incorporate social considerations into their planning, with initial outputs already published (Sandbrook et al., 2023). Drawing on insights from a series of group discussions held throughout the project, including five workshops, we identify five ways forward that can help address Target 3's social dimensions, illustrated with quotes from a questionnaire completed by working group members at the end of the project (*see* Supplementary Online Material *for details*).

TARGET 3 INTEGRATES MULTIPLE SOCIAL AS WELL AS ECOLOGICAL OBJECTIVES

Although often understood as an ecological target, Target 3 is also profoundly social in nature, as evident in the explicitly social elements embedded in its language. This reflects the fact that millions of people rely on access to landscapes and seascapes for their livelihoods in areas that are already or might become protected (Allan et al., 2022; Schleicher et al., 2019).

Recognising the social nature of Target 3 means asking not only what areas to conserve, but also who will be affected, what impacts may arise, who makes decisions and how, and which values and knowledge systems are prioritised. This is essential for informing social safeguards, but also for identifying potential co-benefits such as for health, empowerment, security, employment, or inter-generational equity, and the pathways by which these might be achieved. Recognising such dimensions is key to engaging both conservation and development actors towards fairer, more effective implementation of Target 3.

Lamington National Park, Queensland, Australia © James Fitzsimons

DOMINANT GLOBAL NARRATIVES OVERSIMPLIFY THE REALITY OF AREA-BASED CONSERVATION

Public, policy and scientific debates around 30×30 often portray it either as a powerful solution to biodiversity loss that can also advance rights and human well-being (Campaign For Nature, 2022; High Ambition Coalition for Nature and People, 2020), or as a neocolonial agenda that risks harming local people and territories (Büscher, 2025; Survival International, 2022). These contrasting narratives, while effective for advocacy, often emerge from and reinforce polarised positions, reducing space for interdisciplinary learning – even when participants share many underlying values (Sandbrook et al., 2019).

In practice, governance of protected areas and other effective area-based conservation measures (OECMs) differs widely across countries, as do their ecological and social implications. For example, Australia recognises a mix of public, private and Indigenous protected areas, characterised by diverse governance and conservation models (Fitzsimons et al., 2023). Canada incorporates Indigenous-led conservation initiatives emphasising rights and collaboration (Mansuy et al., 2023). In contrast, recent forced evictions tied to protected area expansion in Tanzania highlight serious governance challenges and human rights issues (Human Rights Watch, 2024), which can in turn also jeopardise conservation objectives. This diversity of approaches also extends to recognition of the role of Indigenous peoples and local communities under Target 3. Perhaps because of the multiplicity of existing governance approaches, how additional

territories will be recognised (or included as protected areas or OECMs) remains undefined (e.g. Lumosi et al., 2025), creating ambiguity about this aspect of the target's implementation.

Oversimplified narratives can obscure risks, suppress difficult questions, or suggest that technical solutions alone can resolve deeply socially challenged realities. Researchers and practitioners have called for more interdisciplinary approaches that recognise these complexities and centre equity and human rights (e.g. Gurney et al., 2023; Rakotonarivo et al., 2025; Sandbrook et al., 2023). Recognising these issues, we see moving beyond polarised framings as both possible and necessary. With Target 3 now agreed, there is an opportunity – and an imperative – to clarify and develop narratives that embrace the social complexity of area-based conservation. Our work responds to these calls by engaging with the social implications of 30×30 and offering interdisciplinary insights into practical ways forward.

WAYS FORWARD FROM OUR INTERDISCIPLINARY WORK TOWARDS A SOCIALLY-JUST TARGET 3

There is no single way to implement Target 3 that will work well for people and nature across all contexts. Below we share reflections from our interdisciplinary discussions, synthesised into five ways forward to inform approaches to implementation that better account for social dimensions.

Foster dialogue across perspectives

Effective implementation of Target 3 depends on dialogue across disciplines, sectors, and knowledge systems, since each brings different priorities and no single perspective can capture its ecological and social complexity (Bennett et al., 2017; Reed, 2008). Engaging across perspectives can reveal what is missing from individual approaches and encourage new ways of thinking. Our experience highlighted both the value and the difficulty of this process. Within the group, even widely used terms like 'impact' or 'local communities' carried different meanings across disciplinary traditions or languages, creating misalignment. Building mutual understanding took time, and the pressure to reach consensus sometimes flattened disagreement. For instance, as one of our group members said, "Some held back to maintain cohesion … much like diplomacy." Even inclusive processes can inadvertently reproduce exclusion, particularly when urgency prioritises agreement over pluralism (Matulis & Moyer, 2017).

Wilsons Promontory National Park, Victoria, Australia
© James Fitzsimons

Consider who is affected

Implementing Target 3 requires recognising who might be affected by conservation, what social characteristics and needs they bring, and how this shapes both social outcomes and ecological effectiveness. An interdisciplinary perspective shaped our discussions about what existing data could reveal about people living in and around areas that might be protected and conserved under Target 3. Rather than focusing narrowly on population size or standard economic proxies of conservation-related costs, a broader framing – for instance, attending to development status, livelihoods and other social characteristics such as age, gender or Indigenous identity – can open space for more context-sensitive and equitable planning (Ban et al., 2013; Stephanson & Mascia, 2014). In our work, this led us to explore indicators of development status and nature-based livelihoods to reflect socio-economic diversity across geographies.

It is also important to reflect on which groups are visible in analyses, and which remain overlooked. This led us to refrain from using some datasets – for instance, those capturing forest-proximate populations but missing harder-to-detect forest dwellers and lacking equivalents for other ecosystems – because they risked incomplete or misleading representation of groups (Cobb et al., 2024; Watmough et al., 2019). As one group member reflected, "Interdisciplinarity enabled discussions about who gets overlooked (e.g. non-forest dependent people, local communities outside the tropics, etc.)." The group's thinking shifted from asking how many people might be present to asking who they are and how they interact with local environments.

Attend to the 'how' of conservation

Moving towards a socially just and effective Target 3 implementation requires greater attention to the 'how' of conservation (the concrete governance and management arrangements adopted) alongside the 'where' and the 'what' (the areas identified for conservation and the values that are prioritised) by planners and research. Assessing the impact of different approaches on people remains highly complex and context-dependent, often involving trade-offs that create both winners and losers (Meyfroidt et al., 2022). Case studies, literature reviews and data-driven analyses can offer insight on this complexity, but many gaps remain. Ultimately, effective and equitable implementation depends on context-specific decisions involving stakeholders that balance local, national and international interests (Meyfroidt et al., 2022). Interdisciplinary groups, particularly those that bring practitioners and researchers together, can help spotlight empirical regularities in social considerations and trade-offs to inform decision-making.

Mainstream social data in conservation

Using a wider range of social data can help ensure that Target 3 implementation reflects diverse human realities (Polasky, 2008; Stephanson & Mascia, 2014). Conservation planning often relies on socio-economic indicators such as land use, anthropogenic pressures, or costs (Ban et al., 2013; Kukkala & Moilanen, 2013), which are useful to estimate trade-offs but offer limited insight into local realities (Adams, 2024; Adams et al., 2010; Cobb et al., 2024; Larrosa et al., 2016). A broader range of spatially explicit social data, including poverty and development status (e.g. Chi et al., 2022; Sherman et al., 2023; Watmough et al., 2019), different types of livelihoods (e.g. Lesiv et al., 2019; Wells et al., 2024) and local cultural values (e.g. Pironon et al., 2024; Whitehead et al., 2014), can offer a more meaningful picture of who is present, how they rely on natural systems, and what engagement is needed (Hinchley et al., 2023; Whitehead et al., 2014). As one participant put it, "There's a need to bring in broader social datasets into conservation planning, not just for ethics but for long-term feasibility."

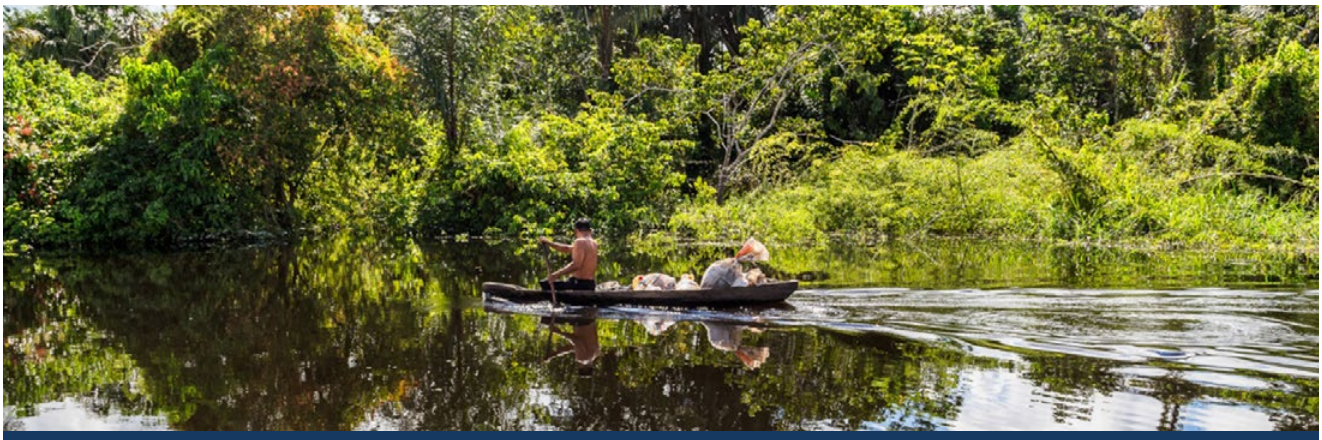
Integrating such data is challenging. Data availability and quality remain uneven, especially at global levels, with gaps across regions and inconsistent resolution. Some key dimensions – such as tenure, identity or governance – require on-the-ground research or national datasets. Indigenous and local knowledge offers critical insight into ecological values and governance, but demands intentional inclusion pathways (Hinchley et al., 2023). Understanding derived from large-scale datasets cannot replace direct engagement with local communities,

Local transport and tourism activities in Altos de Lircay National Park, Chile © Javier Fajardo

Indigenous peoples, or institutions, but interdisciplinary, data-driven approaches can help shift how practitioners think about conservation evidence. As one participant noted, "It gave me confidence to look at area-based conservation not just through a biophysical lens but through a social one too."

Connect insights across scales

Insights from global, national and local scales each provide distinct perspectives, and connecting them contributes to balance broad patterns with place-specific realities. Global perspectives can help frame the broader picture but must be interpreted carefully (Wyborn & Evans, 2021). Aggregating information at global or regional levels can reveal large-scale patterns, support advocacy, and shape high-level policy debates, but global datasets often lack relevance or resolution for national or local decision-making. Our experience highlighted the value of connecting insights across scales, while recognising the distinct role each scale plays in conservation. Our project linked work across scales, from global to national, which allowed participants to appreciate the value and limitations of each scale, and to challenge scepticism towards other levels. Engaging at local scales can both enrich high-level analyses and bring critical information about global changes to local decision-making. As one participant reflected, "I was initially sceptical that we would be able to say much with global data, but I now understand the power of aggregating information to tell a global story – even if local realities remain complex." Connecting insights across scales, without assuming that one can stand in for another, is key to effective implementation.



Food transport by canoe on the Mazan River, Loreto, Peru © Javier Fajardo.

CONCLUSIONS

Target 3 will shape area-based conservation for years to come. Its outcomes – for both biodiversity and human well-being – will depend on how implementation engages with its social dimensions. The target's text acknowledges rights, governance and equity, but how these principles translate into practice remains unclear.

As one group member reflected, "Identifying breakthrough solutions is difficult. 30×30 is a hard, complex topic riddled with trade-offs. The enabling conditions for success are not available in many countries." Acknowledging this complexity and drawing on diverse perspectives and knowledge systems is essential to ensuring conservation outcomes are effective, fair, lasting and grounded in realities. The reflections we have shared in this short communication, many of which extend beyond Target 3 to other KMGBF area-based targets such as Targets 1 and 2, offer practical ways forward that can inform these debates and support the integration of social dimensions into implementation. As the conservation community comes together in spaces like the IUCN World Conservation Congress in 2025 and the IUCN World Protected and Conserved Areas Congress in 2027, there is a pressing need to turn this recognition into action by making dialogue, equity and social justice central to how Target 3 is implemented.

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SUPPLEMENTARY ONLINE MATERIAL

End-of-project questionnaire: Summary of the reflective questionnaire used to gather voluntary participant insights on the SNAPP working group and its collaborative process.

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RÉSUMÉ

La conservation fondée sur les zones est essentielle pour préserver la biodiversité, mais son succès dépend de la compréhension et de la prise en compte de ses dimensions sociales. Dans cet article, nous partageons les réflexions d'un groupe de travail interdisciplinaire qui a étudié les implications sociales de l'extension de la conservation fondée sur les zones dans le cadre du Cadre Mondial de Biodiversité de Kunming-Montréal, Cible 3, également connue sous le nom de 30×30. Pendant deux ans, ce groupe a collaboré à travers des ateliers, des analyses spatiales quantitatives et des études de cas qualitatives afin d'examiner comment les modalités de mise en œuvre de la Cible 3 peuvent créer des défis et des opportunités pour les populations vivant à l'intérieur et autour des zones protégées et conservées, en particulier lorsque les priorités internationales, voire nationales, peuvent entrer en conflit avec les aspirations locales. Nos réflexions soulignent que la mise en œuvre de la Cible 3 ne constitue pas seulement un défi écologique, mais aussi un défi profondément social. Sur la base des connaissances issues de notre travail collectif, nous identifions cinq voies à suivre pour une mise en œuvre socialement juste de la Cible 3 : (1) favoriser le dialogue entre différentes perspectives pour soutenir des solutions plus inclusives ; (2) accorder une plus grande attention à ceux qui sont directement concernés ; (3) équilibrer l'accent mis sur le 'où' de la conservation avec une attention accrue au 'comment' en matière de gouvernance et de gestion ; (4) intégrer davantage les données sociales dans la planification de la conservation ; et (5) relier les enseignements tirés entre les différentes échelles. En partageant ces réflexions, nous visons à soutenir les initiatives en cours qui mettent en avant les considérations sociales dans les politiques et les pratiques de conservation.

RESUMEN

La conservación basada en áreas es fundamental para preservar la biodiversidad, pero su éxito depende de comprender y abordar sus dimensiones sociales. En este artículo compartimos reflexiones derivadas de la colaboración de un grupo de trabajo interdisciplinario que investigó las implicaciones sociales de la expansión de áreas protegidas y conservadas bajo la Meta 3 del Marco Mundial de Biodiversidad de Kunming-Montreal, también conocida como 30×30. A lo largo de más de dos años, este grupo desarrolló talleres e investigaciones que incluyeron análisis espaciales cuantitativos y estudios de caso cualitativos, con el fin de explorar los desafíos y oportunidades que la implementación de la Meta 3 puede suponer para las personas que viven dentro y alrededor de áreas protegidas y conservadas, en particular considerando las tensiones que pueden surgir entre aspiraciones locales y prioridades nacionales e internacionales. Las reflexiones que presentamos enfatizan que implementar la Meta 3 no constituye únicamente un desafío ecológico, sino también uno profundamente social. Identificamos cinco vías para lograr una implementación socialmente justa de la Meta 3: (1) fomentar el diálogo entre distintas perspectivas para apoyar soluciones más inclusivas; (2) prestar mayor atención a quienes se ven directamente afectados; (3) complementar el enfoque en el "dónde" conservar con una mayor atención al "cómo" se conserva; (4) avanzar en la integración de datos sociales en la planificación de la conservación; y (5) conectar el conocimiento generado a través del estudio de distintas escalas de análisis. Al compartir estas reflexiones, nuestro objetivo es promover una consideración más adecuada de las dimensiones sociales de la conservación en el diseño de políticas y prácticas.

SHORT COMMUNICATION:

PROTECTED AND CONSERVED AREAS IN A CHANGING WORLD: KEY THEMES FOR A GLOBAL RESPONSE

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ABSTRACT

Much has changed in the ambition for and challenges to protected and conserved areas since the last IUCN World Parks Congress in 2014. As such, the IUCN World Protected and Conserved Areas Congress 2027 (WPC27) will be a critical milestone for global conservation, arriving at a time of ecological urgency and profound societal shifts. WPC27 will be organised around three integrated themes, each designed for their transformative potential: 1) Global Change and Biodiversity – Opportunities and threats for protected and conserved areas; 2) Scaling Effective Conservation – Securing gains and catalysing scalable, sustainable action; and 3) Conservation and People – Rights, responsibilities and relationships in a changing world. This paper synthesises the thematic vision and proposes sub-themes and key outcomes for each, outlining how they can inspire action, innovation and investment at scale. Although the themes were developed for the IUCN World Protected and Conserved Areas Congress 2027, the challenges and opportunities are relevant to discussions on protected and conserved areas at the World Conservation CCCongress 2025 and other global meetings leading up to 2030 and beyond. The programme of WPC27 will be developed to influence and inform a range of related multilateral meetings and negotiations.

Keywords: Protected area networks, OECMs, IUCN World Protected and Conserved Areas Congress, Kunming-Montreal Global Biodiversity Framework, 30x30

INTRODUCTION

Much has changed since the last IUCN World Parks Congress in 2014. A significantly more ambitious global target for protected and conserved area coverage was agreed as part of the Kunming-Montreal Global Biodiversity Framework (GBF) in 2022 – at least 30 per cent of terrestrial and inland water areas and of marine and coastal areas by 2030 (Target 3; CBD, 2022). There has been greater understanding of the role and contribution of privately protected areas (Bingham et al., 2021; Mitchell et al., 2018; Stolton et al., 2014). Other effective area-based conservation measures (OECMs; among other conserved areas) have been defined (IUCN-WCPA Task Force on OECMs, 2019; Jonas et al., 2024a), debated (e.g. Fitzsimons et al., 2025a) and are increasingly being recognised at national levels and reported to global databases (Jonas et al., 2024b). The role of Indigenous and traditional territories and their importance to global conservation targets are increasingly recognised (Lumosi et al., 2025; Oliva et al., 2025; Stevens et al., 2024), as is the crucial role of protected and conserved areas for climate change mitigation and adaptation – representing a key mechanism to jointly address biodiversity loss and climate change impacts (Duncanson et al., 2023; Pörtner et al., 2021). During this time, protected areas have been challenged by a global pandemic and related restrictions of movement (Hockings et al., 2020; Waithaka et al., 2021), and, despite the popularity of the 30x30 target by residents of most countries surveyed (Fitzsimons et al., 2025b; Michaelsen et al., 2025), political and economic upheaval are challenging support in some regions (e.g. Villagomez & Hidayat, 2025).

In addition to the Convention on Biological Diversity's Conference of the Parties meetings, global summits such as the IUCN World Conservation Congress 2025 and IUCN World Protected and Conserved Areas Congress 2027 provide important and focused opportunities to advance thinking and discuss progress towards the Global Biodiversity Framework, particularly Target 3.

THE IUCN WORLD PROTECTED AND CONSERVED AREAS CONGRESS 2027

The IUCN World Protected and Conserved Areas Congress 2027 (WPC27) will be a critical milestone for global conservation, arriving at a time of ecological urgency and profound societal shifts. Since the last WPC in 2014, climate impacts, biodiversity decline, inequality and socio-political fragmentation have intensified. WPC27 is uniquely positioned to respond, bridging the final years towards meeting the 2030 targets of the Kunming-Montreal Global Biodiversity Framework with a bold agenda for the ensuing decade.

Alpine grasslands, Alpine National Park, Victoria, Australia
© James Fitzsimons

To fulfil this ambition, WPC27 will be organised around three integrated themes, each designed for their transformative potential. These themes are not just topical entry points, they are frameworks for action, each capable of shaping global and local strategies for lasting conservation impact. The themes were shaped during a workshop held at the BfN International Academy for Nature Conservation in Vilm, Germany, from 21 to 24 July 2025. The workshop brought together experts from across IUCN networks along with partners for the first time to begin framing the WPC27 programme. Building on the Congress's legacy since 1958 as the only large-scale global gathering dedicated to all aspects of protected and conserved areas, the workshop reviewed lessons from 2014, identified potential objectives and outcomes, explored thematic priorities, and initiated mapping of the preparatory process. Its remit was clear: to set the foundation for an event that both reflects the diversity of today's conservation practice and delivers concrete pathways for nature-positive outcomes.

The agreed themes, which are grounded in the WPC mandate, are:

1. Global Change and Biodiversity – Opportunities and threats for protected and conserved areas;
2. Scaling Effective Conservation – Securing gains and catalysing scalable, sustainable action;
3. Conservation and People – Rights, responsibilities and relationships in a changing world.

This paper synthesises the thematic vision and proposes sub-themes and key outcomes for each, outlining how

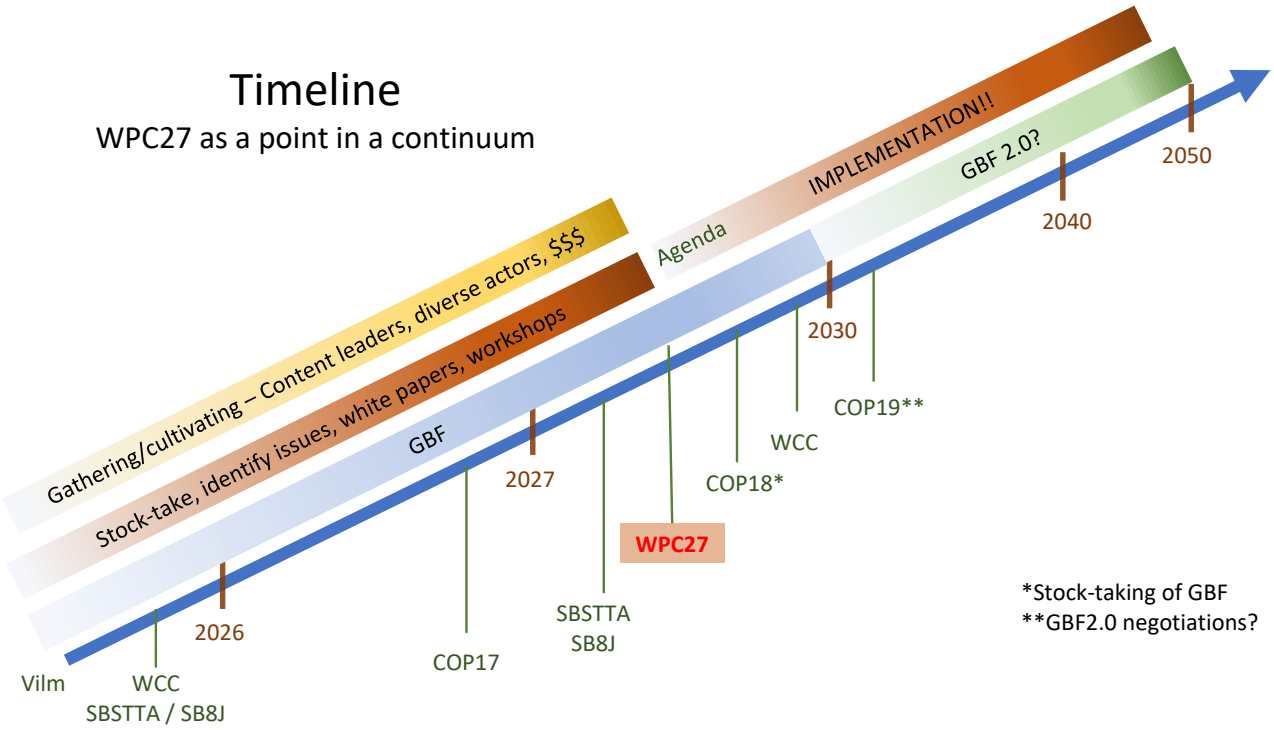

Figure 1. Timeline with major meetings leading up to 2030 that have relevance for protected and conserved areas, Target 3 of the GBF and the development of post-2030 global biodiversity goals. (SBSTTA = Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity; SB8J = Subsidiary Body on Article 8(j) - Traditional Knowledge, Innovations and Practices of the Convention on Biological Diversity)

they can inspire action, innovation and investment at scale, similar to the work of Sandwith et al. (2014) ahead of the IUCN World Parks Congress 2014. Although the themes were developed for the IUCN World Protected and Conserved Area Congress 2027, the challenges and opportunities are relevant to discussions on protected and conserved areas at the IUCN World Conservation Congress 2025 and other global meetings leading up to 2030 and beyond. In fact, the programme of WPC27 will be developed to influence and inform a range of related multilateral meetings and negotiations (Figure 1).

Theme 1. Global Change and Biodiversity: Opportunities and threats for protected and conserved areas

The core question for this theme is: "How can protected and conserved area (PCA) systems be made more resilient to the impacts of global change factors such as climate change, human movement and land use changes, and how can they contribute meaningfully to global responses to climate, ecological and socio-economic disruption?". The ten-year outcome statement is: Resilient and adaptively managed PCA systems are at the heart of global strategies to respond to climate change, systemic uncertainty, and planetary risk including those related tipping points (Deutloff et al., 2025).

Sub-themes and focus areas

1. Shaping political will and systems thinking

- → Transforming global narratives to position PCAs as solutions to planetary crises
- → Incorporating suggestions from the IPBES Transformative Change report (IPBES, 2024)
- → Engaging policymakers, civil society and industry with stories of success and urgent need
- → Advancing partnerships that align commitments on climate, health, peace and biodiversity (e.g. International Partnership on MPAs, Biodiversity and Climate Change, 2025)

2. Designing for resilience and uncertainty

- → Developing PCA networks that are resilient: responsive to shifting climatic zones, human migration, species migration and ecosystem change
- → Tools for decision-making under uncertainty, scenario planning, and trade-off management (e.g. increasing popularity of biodiversity offsets, despite well-documented problems)
- → Mainstreaming ecosystem services (e.g. urban water security, health, disaster risk reduction) into PCA design and management

Women in Sa Pa Vietnam © IvesIves@unsplash

3. **Strengthening connections** between urban PCAs and wider PCA networks to ensure ecological and social integration

4. **Shifting financial flows for nature-positive outcomes**
   - → Redirecting perverse incentives, investing in nature-based solutions (IUCN, 2020) such as PCAs, and integrating PCAs into sovereign economic strategy
   - → Engaging Ministries of Finance, Environmental, Social and Governance (ESG)-aligned investors, and nature-based markets (e.g. carbon, biodiversity credits)
   - → Addressing corruption, illegal economies and new threats

Theme 2. Scaling Effective Conservation: Securing gains and catalysing scalable, sustainable action

The core question for this theme is: "How can we move beyond quantity to ensure quality in PCA expansion and embed conservation as a shared societal and economic goal?". The ten-year outcome statement is: A globally scaled, well-governed, resilient system of protected and conserved areas forms the backbone of national development and sustainability strategies. Scaling includes spatial expansion, replicating working models in multiple locations, building up human capacity and emphasising quality consideration.

Sub-themes and focus areas

1. **Reframing/elevating conservation in society and policy**
   - → Positioning conservation as a foundational value, not a marginal pursuit
   - → Enabling PCA integration into food, health, urban development and national economic planning
   - → Creating public narratives that elevate PCAs as infrastructure for resilience and well-being

2. **Integrating PCAs across landscapes and sectors**
   - → Designing systems embedded within broader landscapes and seascapes, and integrated within wider sectoral planning (e.g. water, agriculture, cities)
   - → Supporting transboundary and mosaic conservation approaches, especially in globally significant biomes, such as tropical rainforests, and the High Seas
   - → Advancing spatial planning and cross-sectoral governance mechanisms (e.g. Giokoumi et al., 2025; Grantham et al., 2024)

3. **Strengthening internal capacities and financing for resilient and healthy PCAs**
   - → Investing in the PCA workforce: rangers, stewards, planners and community leaders
   - → Scaling what works: successful conservation models, effectiveness frameworks with an emphasis on conservation outcomes

- → Blending finance to strengthen PCAs for effectiveness and climate and biodiversity outcomes: public, private and community sources
- → Building real-time monitoring and decision support systems through technology and data analytics

Theme 3. Conservation and People: Rights, responsibilities and relationships in a changing world

The core question for this theme is: "What would it take for PCAs and conservation to be fully inclusive and participatory – especially those already stewarding nature, and how do we shift power and resources accordingly?". The ten-year outcome statement is: A globally supported and locally led conservation movement that recognises and supports diverse custodians, communities and knowledge systems.

Sub-themes and focus areas

1. Rights, responsibilities and recognition by and for nature stewards

- → Recognising, supporting and amplifying the leadership of Indigenous peoples, local communities, and civil society custodians of nature
- → Expanding legal recognition and governance diversity (e.g. OECMs, territories of life, co-management) (e.g. Stevens et al., 2024)
- → Addressing threats: criminalisation, environmental defenders, land tenure conflict, and green extractivism (appropriating natural resources, such as minerals for renewable energy technologies or land for carbon sequestration)

2. Planet and people on the move

- → Reimagining conservation and more significantly, economic growth and human development for a mobile world: climate migration, urbanisation, shifting socio-ecological landscapes
- → Innovating governance models for urban–nature relationships and transboundary responses
- → Actively promoting new models for One Health (an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals and ecosystems, human–wildlife cohabitation, zoonotic risk management)

3. Society, culture and technology

- → Embracing arts, culture, sport, and digital storytelling in building conservation movements
- → Addressing risks and potentials of technology: AI, surveillance, misinformation, digital inclusion
- → Building inclusive and evidence-based learning systems: education, mutual learning, capacity sharing

Ranger Anton Mzimba, South Africa © Soiuth Africa Parks

WPC27 AS A TURNING POINT FOR THE FUTURE OF NATURE CONSERVATION

These three themes reflect the interconnected crises and opportunities of our time. They challenge the conservation community not only to protect more space, but to transform power, systems, narratives and economies. WPC27 must be more than a gathering, it should be the catalyst for a new phase of global conservation, one that is effective, equitable, scalable and transformative. Momentum is building now to gather information over the next two years, so that the event can look forward to the challenges of the ensuing decades.

To that end, WPC27 will deliver:

- Preparatory white papers and global position briefs for each theme (in advance of the Congress) to document the state of play, lessons learned, barriers, and related insights, to explore new pathways forward;
- Coalition-building platforms that are initiated on the road to Congress and extend beyond the event itself;
- Commitments from governments, cities, business, local communities and others; and
- A shared 2030+ vision anchored in outcomes, not only intentions, to address the implementation crisis.

Ranger in Bhutan © Rohit Singh WWF

NEXT STEPS

The WPC27 International Steering Committee (ISC), to be formed in late 2025, will develop the final programme, in consultation with the host country. The themes identified in this paper will inform that programme. The ISC will engage and consult widely on these themes and subthemes, helping to shape the final programme, which will be informed by this summary but not constrained by it.

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RESUMEN

Mucho ha cambiado en cuanto a las ambiciones y los retos de las áreas protegidas y conservadas desde el último Congreso Mundial de Parques de la UICN en 2014. Por ello, el Congreso Mundial de Áreas Protegidas y Conservadas de la UICN 2027 (WPC27) será un hito fundamental para la conservación mundial, ya que llega en un momento de urgencia ecológica y profundos cambios sociales. El WPC27 se organizará en torno a tres temas integrados, cada uno de ellos diseñado por su potencial transformador: 1) Cambio global y biodiversidad: oportunidades y amenazas para las áreas protegidas y conservadas; 2) Ampliación de la conservación eficaz: asegurar los logros y catalizar acciones escalables y sostenibles; y 3) Conservación y personas: derechos, responsabilidades y relaciones en un mundo cambiante. Este documento sintetiza la visión temática y propone subtemas y resultados clave para cada uno de ellos, esbozando cómo pueden inspirar la acción, la innovación y la inversión a gran escala. Aunque los temas se desarrollaron para el Congreso Mundial de Áreas Protegidas y Conservadas, de la UICN los retos y oportunidades son relevantes para los debates sobre las áreas protegidas y conservadas en el Congreso Mundial de la Naturaleza de 2025 y otras reuniones mundiales que se celebrarán hasta 2030 y más allá. El programa del WPC27 se desarrollará con el fin de influir e informar una serie de reuniones y negociaciones multilaterales relacionadas.

RÉSUMÉ

Beaucoup de choses ont changé depuis le dernier Congrès mondial sur les parcs de l'UICN en 2014 en ce qui concerne les ambitions et les défis liés aux aires protégées et conservées. À ce titre, le Congrès mondial sur les aires protégées et conservées de l'UICN 2027 (WPC27) constituera une étape cruciale pour la conservation mondiale, à un moment où l'urgence écologique et les profondes mutations sociétales sont à leur comble. Le WPC27 s'articulera autour de trois thèmes intégrés, chacun conçu pour son potentiel transformateur : 1) Changement mondial et biodiversité – Opportunités et menaces pour les aires protégées et conservées ; 2) Développer une conservation efficace – Sécuriser les acquis et catalyser une action évolutive et durable ; et 3) Conservation et populations – Droits, responsabilités et relations dans un monde en mutation. Le présent document synthétise la vision thématique et propose des sous-thèmes et des résultats clés pour chacun d'entre eux, en soulignant comment ils peuvent inspirer des actions, des innovations et des investissements à grande échelle. Bien que ces thèmes aient été élaborés pour le Congrès mondial sur les aires protégées et conservées de l'UICN, les défis et les opportunités qu'ils soulèvent sont pertinents pour les discussions sur les aires protégées et conservées qui auront lieu lors du Congrès mondial de la nature de 2025 et d'autres réunions mondiales jusqu'en 2030 et au-delà. Le programme du WPC27 sera élaboré de manière à influencer et à éclairer toute une série de réunions et de négociations multilatérales connexes.

BOOK REVIEWS

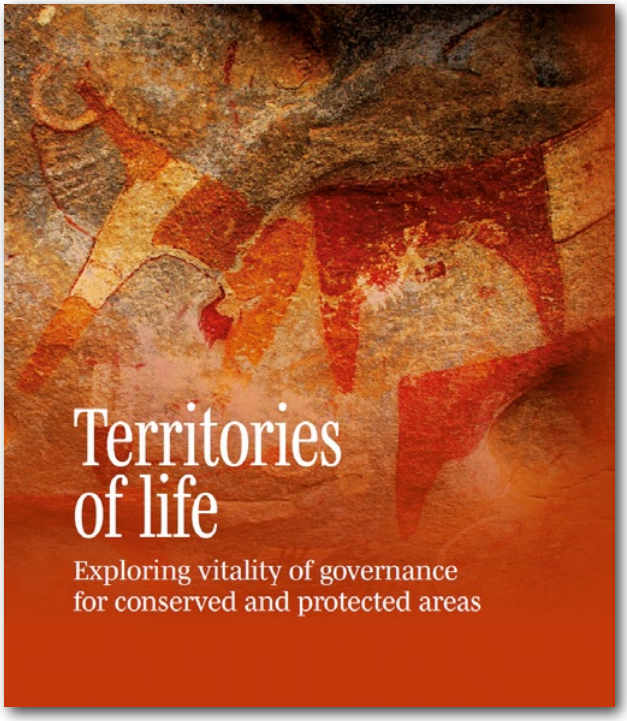
Strengthening vitality in conservation

A review of Territories of Life: Exploring vitality of governance for conserved and protected areas by Grazia Borrini-Feyerabend with Tilman Jaeger (open access pdf in English, forthcoming in Spanish and French https://volume.territoriesoflife.org/)

Reviewed by David Barkin, Universidad Autónoma Metropolitana, Mexico City

About fifteen years ago, a network of Indigenous peoples and communities, committed to protecting their territories, bootstrapped itself into a volunteer association. It included activist-scientists and organisations that had worked together since the early 1990s, developing mutual trust in efforts at enhancing equity in the policies and practices of the International Union for Conservation of Nature (IUCN), to which they were variously affiliated. As it developed, the network became known as the ICCA Consortium. The meaning of 'ICCA' went through several iterations but mostly stood as an abbreviation for "areas governed, managed and conserved by indigenous peoples and local communities".[1] Today, even that is superseded as ICCAs are internationally known as 'territories of life' (non-capitalised) – a name derived from Spanish. Officially established under Swiss Law, the Consortium has hundreds of member organisations and individuals on all continents. I joined the association in its early days and saw it go through a whirlwind of constant change. And I loved its unbounded vitality.

This work is an extraordinary tribute to the conservation concepts and practices that enlivened the Consortium as it flourished, some of the most innovative to emerge for decades. Beautifully written by one of the uncommon individuals who accompanied the Consortium's growth from its beginning, the text is enriched by vivid pictures and dozens of case-examples of conserved and protected areas – an entry into the history, cultures and worldviews of custodian communities and their territories. For the scholarly reader, the text is complemented by 1,700 footnotes and



25 pages of references. For readers in general it is good to know that the volume is open access online.

The volume can be approached from different perspectives and sections. I was first caught by the stories of peoples who overcame oppression, theft of their territory and attempts to erase their cultures, languages and existence. Those were balanced by communities who celebrate life, enrich their traditions and learn from their societies. In splendid diversity and against the odds, some do not fall into the traps of the global system, the adoration of material abundance and alienating rhythms of competitive advancement. And some seem to thrive. Why so? How?

1 Sajeva, G., Borrini-Feyerabend, G. & Niederberger, T. (2019). *Meanings and more*..., ICCA Consortium Policy Brief No. 7, Tehran: ICCA Consortium and CENESTA.

The first of three concepts explored by Borrini-Feyerabend emerged as she coordinated the governance stream at the 2014 World Parks Congress in Sydney, Australia. The volume begins by highlighting the remarkable diversity and vitality of institutions governing protected and conserved areas, demonstrating their capacity to function through time and under challenging circumstances. Vital institutions are thus capable of "navigating change and nurturing meaning". The work describes a variety of common traits and draws lessons to govern conserved and protected areas in meaningful and inspiring ways.

We find that some institutions that function well through time exhibit "strategic adaptability", others appear "creative and empowered" (autonomously active) and others are "well-connected and capable of collaboration". While all three characteristics are convincing, I found the latter most telling considering my experience with members of the Consortium in Latin America, where alliances are crucial to negotiate and defend autonomy and avoid the deleterious dynamics of competition. A fourth characteristic of governance vitality is "wisdom from local knowledge", described by James Scott as mētis.[2] This reminded me of the conflicts between scientific solutions and solutions unique to territorial governance institutions. Finally, a fifth crucial characteristic is the presence of "inspiring collective values", expression of the culture and worldview of each community.

The five characteristics are frequently encountered in traditional governance institutions – those of mobile pastoralists, shifting cultivators and communities caring for sacred sites or their commons – forests, wetlands, high-level pastures and coastal fisheries. The work takes us on a journey across conserved and protected areas and identifies "a wise mix of biological purpose, culture-based meaning and emotions" as necessary to keep governance institutions functioning through time. Such a mix, however, is not sufficient. Witness to this are the countless communities throughout history that strenuously defended their territories but were defeated. Overpowering forces or lack of indispensable support may overcome even the most vital institutions. In other words, there is no infallible recipe: we need our collective best efforts, aid from nature, and a dose of luck to keep ourselves in the game. To stress the point, the work explores recent history, the hubris of modernity and the colonial and neo-colonial patterns trampling biological and cultural diversity on Earth. Before doing that, it introduces two other concepts in conservation discourse.

2 Scott J. C. (1998). Seeing like a State, New Haven, USA: Yale University Press.

An almost poetic section describes communities capable of direct, profound, meaningful and respectful relationships in nature across generations. The mix of biological purposes, culture-based meanings and emotions that maintains such governance institutions offers a powerful example of bonding between people and nature. The concept of custodianship describes such bonding – an affective relation of caring between a community and the territory supporting its life and culture. Custodianship takes place in countless ways wherever individuals in solidarity with one another perceive their territory as heritage – much beyond property or a legal management role. Heritage is collective identity and autonomy: it is unthinkable to sell or monetise it. Heritage is a source of shared morality, a common understanding of what is good, precious and just for the community and territory. Crucially, custodianship reveals a territory of life – one that sustains the livelihood of a community while nourishing relations among its members and adding meaning to their lives.

Evident in many examples, the communities that identify themselves as custodians of territories of life ensure more than their own survival and material well-being. They govern, manage, restore and revitalise their territories, but also themselves. We explore the mutual responsibility and collective care that characterise them as we celebrate their territories of life as protected and conserved areas. The work does not dwell in celebrations and soon moves to considerations of political economy. An insightful critique of development accompanies us from the enclosure of the commons to the post World War II decades, including the last fifty years as an uneven "discovery of community conservation" takes place in international policy. She explores such discovery in parallel with the muscular advance of conservation economics, from the omnipresent fight against poverty across the end of the past millennium to the market-based conservation instruments and economic evaluation of nature that characterise the new one.

By juxtaposing the custodianship of territories of life and the commercialisation of nature, Borrini-Feyerabend highlights a series of difficult and politically incorrect questions. These span from "Are legal land rights and financial support the most important needs custodians should meet?" to "Could those usher new conflicts and problems?" and "Is self-strengthening utopian?". These questions have been debated among the members of the Consortium and are far from resolved. The idea of endogenous strengthening (also expressed as 'resurgence' or 'de-colonisation') is crucial, and it is notable that a key Consortium product is its guidance to a self-strengthening process – lessons and tools from

communities to communities.[3] In the *Territories of life* volume, self-awareness, self-strengthening and mutual support among custodians are described as essential for custodian self-determination – a path for conserving cultural and biological diversity in the new millennium.

Some readers will enjoy exploring governance institutions as systems and comparing vitality with other concepts, from 'resilience' to 'subsidiarity'. Others may use the insightful indicators and tools offered for self-assessing vitality. Hopefully, some decision-makers will be inspired by the policy options outlined to promote custodianship in conserved and protected areas. Borrini-Feyerabend ends with a ground-breaking lexicon, from the most challenging question ("What is conservation?") to an insightful comparison of definitions among conserved areas, protected areas and other labels.

No one knows how long the governance institutions and custodians of territories of life will remain alive and vital. Custodians embed great capacities and strengths. They also face an onslaught of commercialisation in our increasingly inequitable, militarised societies. In a digital age when many processes accelerate towards unclear ends, it is rare and somehow touching to read words of hope, to be invited to strengthen our vitality. This work does that. It stimulates us to understand and accompany the many institutions of caring that still exist for territories of life, the "many worlds"[4] that humanity so desperately needs.

3 See https://ssprocess.iccaconsortium.org/

4 This citation characterises the long-lived Zapatista Front of National Liberation in Mexico. See https://enlacezapatista.ezln.org.mx and de la Cadena, M. and Blaser, M. (2018). *A World of many worlds,* Durham, USA: Duke University Press.