CONNECTIVITY CONSERVATION
SUSTAINING NETWORKS FOR ECOLOGY AND COMMUNITY
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Ensuring area-based conservation meets the twin challenges of biodiversity loss and climate change

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ABSTRACT

Protected and conserved areas must play a key role in managing the interrelated global crises of biodiversity loss and climate change. We are well past understanding the problem and the need for dramatic action is clear. The draft Global Biodiversity Framework of the Convention on Biological Diversity calls for at least 30% of the land and sea to be conserved in systems of protected areas and other effective area-based conservation measures by 2030. This is an enormous challenge for the world and for North America. Yet the governments of Canada, the United States, and Mexico, as well as those of 60 other countries, have committed to achieving this conservation target. The "at least 30%" figure is meant to encourage ambition and must be implemented using a range of quality considerations for protected and conserved areas. This article examines what must be considered in achieving this critical target by 2030.

A wildlife crossing on the Trans-Canada Highway heading eastbound in Banff National Park. COOLCAESAR / WIKIMEDIA COMMONS

INTRODUCTION: THE CHALLENGE

The evidence is clear that nature is rapidly disappearing, and the climate is changing, bringing into question the very survival of humanity. We toss around phrases like "the Anthropocene" or "existential crises" as code words, but simply put, we are in deep trouble. We are 7.8 billion people on Earth, a number projected to continue to grow until at least the end of the century. Human impacts across the world are enormous and growing. Evidence of human impacts of overfishing, nutrient run-off, and climate change occurs in more than 85% of the marine biomes, and more than three-quarters of the terrestrial world is affected by anthropogenic activities. The combined impact of unprecedented change to Earth systems by humans, together with a human-caused rapidly changing climate, means that up to 1 million species are at imminent risk of extinction (IPBES 2019). Wild mammals now constitute only 4% of the global mammal biomass, the remainder being people (36%) and domestic livestock (60%) (Bar-On et al. 2018). Even the World Business Council concludes that biodiversity loss and climate change are the two leading threats to humanity.

The impacts vary significantly from place to place. Across the terrestrial surface, about 17% of lands have been fundamentally changed by cities and agriculture. Lower-intensity developments and ranching impact more than 50% of shared lands, defined as places where more than half of the landscape is still largely untransformed. That leaves about a quarter of the earth as mostly intact areas (Locke et al. 2019). To avert global species extinctions will require a suite of different strategies depending on the condition of the place.

This set of essays in *Parks Stewardship Forum* is not meant to provoke despair; rather, it is a call to action. Political leaders, business leaders, and scientists all agree we need transformative change. Here we provide a diagnosis and a blueprint for what transformative change looks like for the world of protected and conserved areas.

In response to twin biodiversity and climate crises, humanity must define a new era for nature that transforms decades, even a century, of underwhelming responses to the global biodiversity crisis. Area-based conservation efforts, which include both protected areas and conserved areas, will need to change dramatically to meet this challenge.

What is clear, though, is that while protected and conserved areas are important in conserving biodiversity, the current protected area system is not adequately designed or managed for stemming biodiversity loss and climate change impacts. The era of often randomly selected protected areas, underfunded management, weak governance, and a focus on conservation of individual sites must be over. We need to take area-based conservation far more seriously, ensuring protected and conserved areas are fit for purpose and address conservation at meaningful spatial scales. In this essay we offer a set of eight essential elements that must be put in place to put protected and conserved areas at the heart of the solution to the conservation dilemma.

WHY AREA-BASED CONSERVATION?

The most significant direct drivers of biodiversity loss are habitat loss and fragmentation (changes in land and sea use) and direct exploitation, with over-exploitation being more significant in marine systems (Figure 1). Factors of climate change, invasive alien species, wildlife disease, and pollution are also important (Díaz et al. 2019). Many of these drivers of biodiversity loss can be managed through area-based conservation, with systems of protected areas connected to conserved areas (defined by the Convention on Biological Diversity, or CBD, as "other effective area-based conservation measures," or OECMs; CBD 2018) being the backbone. Because biodiversity loss is being driven primarily by habitat loss and fragmentation along with over-harvest, protected and conserved areas are key policy and practical solutions. Area-based conservation may be less effective for addressing some drivers, including widespread pollution, wildlife disease, and invasive species.

MEETING THE TWIN CHALLENGES OF BIODIVERSITY LOSS AND CLIMATE CHANGE: SOLUTIONS

We see the following set of solutions as *all* being necessary to ensure area-based conservation is effective at meeting the challenges of biodiversity loss and climate change. None are novel in the literature, but few have been widely and effectively implemented. The challenge is that we need to broadly implement all of them. We do not include the obvious fact that we must arrest the human production of greenhouse gases as a precondition to success. This reduction of greenhouse gas emissions is outside the scope this essay on area-based

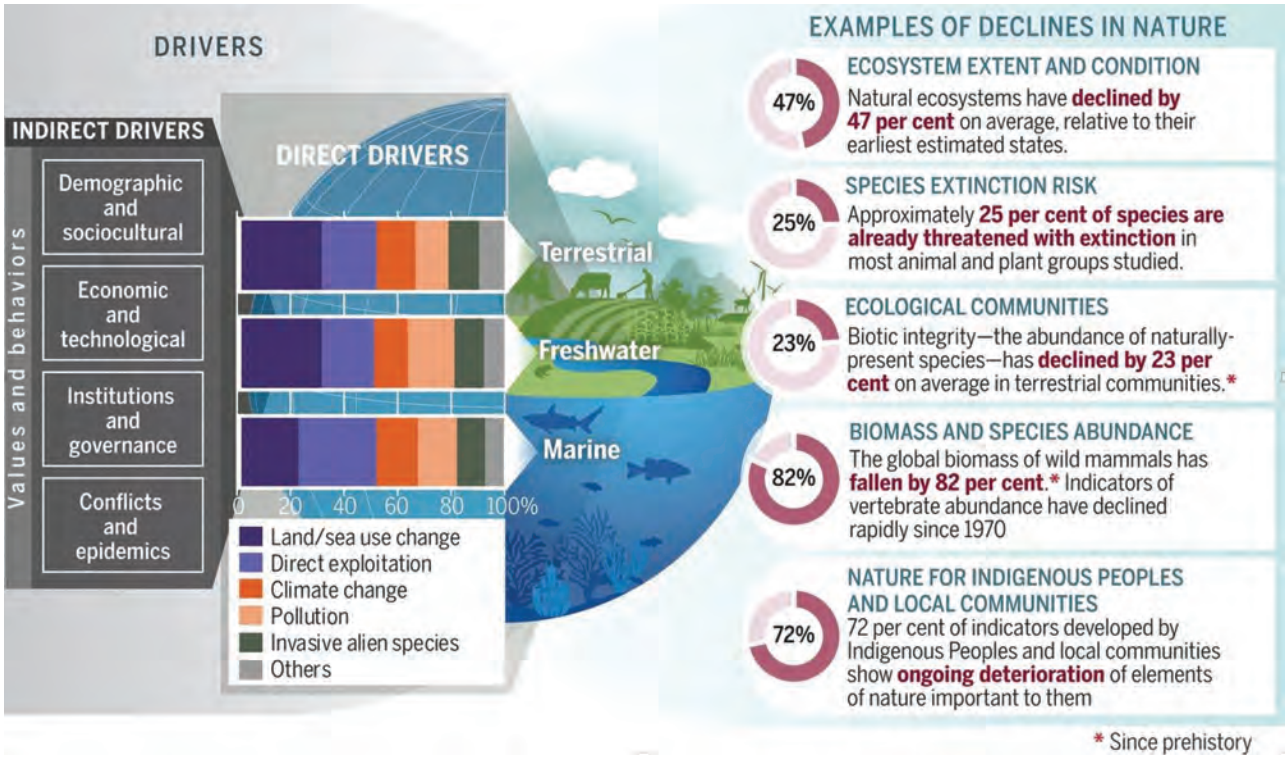

Figure 1. Examples of global declines in nature that have been and are being caused by direct and indirect drivers of change. Reproduced with permission from Diaz et al. 2019.

conservation, except for the role that protected and conserved areas can play in the sequestration and storage of carbon. The solutions are as follows.

1. Dramatically upscaling conservation

Under the Strategic Plan for Biodiversity of the CBD, Aichi Target 11 called for the protection of 17% of Earth's terrestrial area and 10% of its marine area by 2020. These targets were not based in science, as there is no published research that supported Aichi Target 11 as being adequate for the area-based conservation of biodiversity, either on land or sea (see review by Woodley et al. 2019). Biodiversity is simply too endangered to safeguard it by protecting relatively small percentages of the global surface.

Universally, when conservation targets are based on the scientific research, they far exceed targets set to meet political or policy goals. This conclusion is supported by a global survey of conservation scientists conducted in 2017, who massively supported very large percentage area targets to conserve biodiversity (Woodley et al. 2019).

There is no unequivocal answer to the question of what percentage of the earth, or a region, should be protected in order to maintain biodiversity. Each additional conservation value selected for protection raises the percentage targets. For example, selecting only for endangered or rare biodiversity value results in a lower percentage area than if ecological connectivity or ecological processes are also considered. Studies that include a more complete set of values universally result in targets that are very high, well over 50% and up to 80%. Studies that include a narrower subset of biodiversity values result in lower targets, but are never under 30% and always include caveats that they are likely inadequate and represent minimum estimates.

Mexico, the United States, and Canada all have government endorsement to conserve 30% of global land, seas, and freshwater by 2030. This is a remarkable policy development by government, but it is strongly supported by science, as well as public opinion. Mexico and Canada are formal members of the High Ambition Coalition for Nature and People of countries supporting this level of protection in the Global Biodiversity Framework in the Convention on Biological Diversity. With an executive order, the president of the United States promised to protect 30% of US land and 30% of its oceans by 2030.

The key conclusion from a review of the evidence is that calls for the global protection of a minimum of 30% and up to 70% or even more of the land and sea on Earth are supported in the literature, whether through studies based on species-area curves, systematic conservation planning, or minimum system size approaches. The call for conserving 50% of the earth is a mid-point of these values and is supported by a range of studies. More importantly, there are no studies that argue that we can maintain biodiversity with low percentage coverage targets.

Gwaii Haanas National Park Reserve and Haida Heritage Site, Canada, is co-governed by the Haida Nation and Parks Canada STEPHEN WOODLEY

2. Putting protected and conserved areas in the right places: Assessing conservation impact

Biodiversity is unevenly distributed on our planet and we have tended to establish protected areas where they have the least conflict with human needs (Venter et al. 2018). Thus, the world's protected areas are biased toward lands and seas that are less productive and (in the case of land) at higher elevations. We have good tools to guide placing of protected and conserved areas where they will have the most conservation impact, but we have most often failed to use these tools. There is good agreement in the literature that placement of new protected and conserved areas should focus on areas of importance for biodiversity, including Key Biodiversity Areas (IUCN 2016), Ecologically or Biologically Significant Marine Areas (EBSAs; **https://www.cbd.int/ebsa/**), and equivalent national and open-ocean priorities. These tools require countries to have good information on places that are important for biodiversity and then to use that information in systematic conservation planning. If countries prioritize areas important for biodiversity, they can effectively meet their conservation goals in a smaller overall area. As a part of that planning, consideration must be given to redundancy in the system of protected areas and accommodation for the changes and biome shifts that will come from climate change, including identifying sites that may act as climate refugia.

3. Significantly improving the management and governance of protected and conserved areas

Area targets alone are insufficient to halt biodiversity loss. They must be accompanied by a focus on quality, and this quality includes both sound governance and effective management, as well as putting protected areas in places where that have the most impact, as just noted.

A large proportion of protected areas are not well managed. On land and sea, governments have failed to invest in adequate staff and other kinds of capacity

to ensure protected areas are successful. Globally, protected area failure is driven by a lack of staff and funding, and by corruption (Barnes et al. 2017; Gill et al. 2017). In large regions of the world, the rate of deforestation inside protected areas is identical to, or just slightly less than, the rate outside them. During the Covid 19 pandemic, this problem has only worsened, driven by the diminishment of tourism revenues to adjoining communities.

Importantly, countries with high national development scores (as measured by the Human Development Index, or the HDI, which assesses life expectancy, health, access to knowledge, and living standards) have experienced more successful protected areas over the past 15 years (Geldmann et al. 2019). Thus, national success in protected areas depends on establishing governance conditions that promote higher HDI scores. Governance is a broad challenge that requires governments, private industry, development banks, and others to adhere to ethical standards of development and investment that are based on conserving biodiversity.

Ultimately the measure of success of protected areas is whether or not they conserve the ecological values and biological diversity that they contain, and this depends on systems of management and governance as much as on ecological design.

4. Broadening the range of governance types

The majority of the world protected and conserved areas are established and run by governments, but governance by Indigenous and community groups, privately protected areas, and mixed models are quickly rising in importance. Privately protected areas, in particular, are now very important in many countries, such as the United States, where land trusts, conservancies, and other types of private ownership cover a staggering 56 million acres, an area of protected land that is double the size of all the land in national parks across the lower 48 states.

Indigenous Peoples manage or have tenure rights over, at a minimum, 38 million km^2 in 87 countries. This is a quarter of the world's land surface, and includes about 40% of all terrestrial protected areas and ecologically intact landscapes (Garnet et al. 2018). Many of these land tenures are not well recognized or supported by governments. It is essential that Indigenous Peoples are supported to exercise their traditional land stewardship rights as a contribution to implementing global agreements on biodiversity conservation and climate change.

5. Broadening the range of area-based conservation tools

We have used the terms "protected and conserved areas" throughout this essay because of the agreement under the CBD to broaden the concept of area-based conservation to include "other effective area-based conservation measures," or OECMs. While this term was introduced in 2010, the parties to the convention did not agree on a definition and guidance until 2019. The International Union for Conservation of Nature (IUCN) followed quickly that year with a published guideline on recognizing and reporting OECMs (IUCN 2019). An OECM is defined as "a geographically defined area, other than a Protected Area, which is governed and managed in ways that achieve positive and sustained outcomes for the in-situ conservation of biodiversity, with associated ecosystem services and cultural and spiritual values" (CBD 2018). The core distinction between a protected area and an OECM is that whereas protected areas must have conservation as the primary objective of management, OECMs are defined by outcomes rather than objectives (i.e., an OECM must deliver the effective in-situ conservation of biodiversity, regardless of the area's management objectives). The concept of OECMs is very new to the conservation world and it is too early to say what contribution it will make to the biodiversity and climate challenges. However, OECMs offer opportunities for other management approaches that effectively conserve nature and thus are an important conservation opportunity.

6. Formalizing and creating ecological corridors

Most of the world's protected and conserved areas are not big enough to sustain large-scale ecological processes, or seasonal migrations, or otherwise provide everything their organisms need, and thus require functional ecological connectivity within and between these areas. Ecological connectivity increases the effective size of protected and conserved areas because it builds smaller units into ecological networks. Ecological connectivity is particularly critical with global climate change, because many species' ranges are already shifting to adapt to new conditions. Those species that cannot move through human-modified landscapes especially

An increase in protected and conserved will bring a wide range of additional benefits, including recreation and the health benefits of being in nature. Algonquin Provincial Park, Canada STEPHEN WOODLEY

need conserved ecological corridors (Hilty et al. 2019). Ultimately, ecological networks of protected and conserved areas and ecological corridors offer an ecological design solution to best manage climate change and habitat fragmentation.

The United Nations Convention on Migratory Species (CMS) defines ecological connectivity as "the unimpeded movement of species and the flow of natural processes that sustain life on Earth" (CMS 2020). This definition importantly recognizes that ecological connectivity is not just about the movement of individual organisms but about supporting the function of entire ecosystems. Loss of function due to human-induced habitat destruction and fragmentation, or the breaking up of once-continuous habitat into smaller pieces, ultimately leads to the slow unraveling of the ecosystem. This can imperil organisms dependent on those processes and intact habitats as well (Ceballos 2017).

IUCN's *Guidelines for Conserving Connectivity through Ecological Networks and Corridors* was only published in 2020 (Hilty et al. 2020), but the concept of ecological connectivity is not new and has become increasingly visible in the global policy arena over the last decades. The CMS (https://www.cms.int/), formed in 1979, which concerns itself exclusively with providing a global platform to address the needs of migratory species moving between countries, and the CBD, formed in 1992, which focuses more broadly on the conservation, sustainable use, and sharing of benefits of biodiversity, laid the legal foundation for coordinated international conservation measures. Despite the widespread recognition of the need for ecological connectivity, most countries in the world

still operate their protected and conserved areas as individual sites, without serious efforts to establish formal and effective ecological corridors.

7. Moving to conservation networks

Ecological corridors are the necessary element in the creation of ecological networks of protected and conserved areas. Ecological networks offer the best conservation design solution to manage climate change and habitat fragmentation. Such networks have emergent properties that enable the network to better conserve biodiversity and ecological processes than would individual protected and conserved areas in isolation.

There are many wonderful examples of ecological networks in place in the world. Design principles and global examples are provided in IUCN's *Guidelines for Conserving Connectivity through Ecological Networks and Corridors* (Hilty et al. 2020). The move from protected "sites" to protected and conserved areas "systems" that act as ecological networks must be the future.

8. Keeping ecosystem-based carbon in place

Nature stores massive amounts of carbon in ecosystems. The conversion of natural ecosystems to cities and agriculture is responsible for up to 30% of the current greenhouse gas problem. As with biodiversity, this carbon is unevenly distributed around the world. We must ensure the most carbon-rich ecosystems of the earth are protected as part of the overall climate change strategy (Goldstein et al. 2020). In practice this could be accomplished by combining the efforts of two key nature treaties, the United Nations Framework Convention on Climate Change and the CBD. There treaties were meant to work together when first formed in Rio de Janeiro, but they have tended to operate in silos. Combining CBD goals with development and climate goals would create an integrated, overarching direction for global agreements toward an equitable, nature-positive, carbon-neutral world. This integration would recognize that none of the goals is achievable without the others and would encourage a much-needed focus on synergies among the goals.

CONCLUSION

There is now a global movement to rapidly increase the protected areas estate to at least 30% of the planet by 2030—"30x30." The High Ambition Coalition now has over 60 member countries and support from most of the world large non-governmental organizations. Canada, the United States, and Mexico have all formally supported 30x30. This is exciting news, rooted in an understanding that protected and conserved areas are essential policy tools to halt the loss of biodiversity, mitigate climate change, and regenerate nature. To be effective, these areas need to be selectively located, properly designed, equitably governed, and managed as large-scale ecological networks. This will require a significant change in the way area-based conservation is currently done, including the embracing of Indigenous communities and private partners. This also requires greater collaboration between the often-siloed sectors of traditional nature conservation, historic preservation, science, sustainability, public health, ecosystem services and environmental justice (Machlis and Jarvis 2018). Protected and conserved areas, ecologically connected and operated as conservation networks, are an essential path for a bright future for nature and humanity.

Out of necessity, we have not had the space in this essay to make the case for the additional benefits to humanity of a movement to large-scale conservation. We end by noting that the benefits are many. In addition to conserving nature and mitigating climate change, protected nature offers a whole host of ecosystem services to people: provision of clean water, mental health, recreation, crop pollination, and the list goes on. We also note that there is great inequity in access to nature and this must also be addressed for its many benefits to be had by all. When valued economically, properly protecting and conserving at least 30% of the world's land and ocean delivers benefits that outweigh the costs by a ratio of at least 5-to-1 (see Waldon et al. 2020). Protected and conserved areas are our best chance to regenerate nature and ensure humanity's well-being and survival.

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