Technical Note

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ROLE OF PROTECTED AREAS IN CLIMATE CHANGE MITIGATION AND BIODIVERSITY CONSERVATION

KEY MESSAGES

1. Widespread consensus has emerged that biodiversity loss and climate change are twin crises that must be addressed together to achieve success in either one.
2. Protected and Conserved Areas (PAs) are the most effective tool to address both biodiversity loss and climate change within a time-frame that reflects the required urgency.
3. New PAs, the expansion of existing PAs and support for OECMs can target places where carbon richness and high biodiversity overlap to create 'carbon stabilization' areas.

Broad Policy Consensus

There is general consensus that biodiversity loss and climate change are twin crises requiring integrated, comprehensive and holistic approaches. As aptly articulated by António Guterres, Secretary-General of the United Nations, the twin global challenges of climate change and biodiversity loss have to be tackled in a more coordinated manner: "climate change threatens to undermine all efforts to conserve and sustainably manage biodiversity and [that] nature itself offers some of the most effective solutions to avert the worst impacts of a warming planet". The creation of new Protected areas (PAs), the expansion of existing ones, protecting and establishing conservation corridors that connect PAs, and better PA management are the first and most effective policy tools to address these global crises.

At COP25 Parties to The United Nations Framework Convention on Climate Change (UNFCCC) recognized the contribution of nature to addressing climate change and the need to address biodiversity loss and climate change in an integrated matter[2]. They added the importance of protecting nature at COP 26[3].

Likewise, The United Nations Convention on Biological Diversity (CBD) recognized the importance of the climate change/biodiversity nexus [4], including in the Kunming Declaration from COP15 Part 1, 2010 Aichi Biodiversity Targets (targets 10 and 12) and the draft Post 2020 Global Biodiversity Framework (GBF) (targets 2, 8 and 11). A nature-positive world, as promoted by the 95 country signatories to the *Leaders Pledge for Nature*, embodies this collective understanding of the interdependence of biodiversity loss, ecosystem integrity, climate change impacts and human well-being.

Example of a carbon-rich, high biodiversity tropical rainforest
Yasuni National Park, Ecuador Photo: Maris Maskalans/istock

Status of Biodiversity and Climate Change Targets

Some significant successes have been achieved in protecting natural ecosystems and biodiversity. From 2010 to 2020 terrestrial protected areas have increased from about 10% of the land to over 16.6%, and marine protected areas have increased from 3% to almost 8%. Since 2010 an additional 2.1 million km^2 of land and inland water ecosystems, and 18.8 million km^2 of coastal waters and the oceans has been protected. Forty-two percent of the area now within PAs has been added since 2010[5]. As well, a decrease in the rate of deforestation by about a third has been achieved (although it seems to be on the rise again). In spite of these successes, most indicators of ecosystems and biodiversity are showing rapid decline, with 75% of the land surface significantly altered, 66% of the ocean area experiencing increasing cumulative impacts, over 85% of wetland area having been lost, and 25% of assessed animal and plant species threatened[6]. Climate change is now one of the top five drivers of biodiversity loss globally [6,7].

Since the Paris Agreement in 2015, greenhouse gas (GHG) emissions increased every year, except for a small decline in 2020 due to the COVID-19 pandemic. As well, the concentration of CO_2 in the atmosphere continued to grow[8] and atmospheric concentrations of CO_2 reached an all-time high in September 2022 of 419 parts per million (ppm), from 280 ppm in the mid-1700s. Natural carbon sinks on land and in the ocean absorbed about half of the CO_2 emitted each year between 2011 to 2020. The other half accumulated in the atmosphere[9].

All pathways to attaining the Paris Agreement target of limiting average global temperature increases to 1.5°C of pre-industrial levels require protecting the global carbon sinks and reservoirs in natural ecosystems, in addition to rapid and drastic declines in GHG emissions. One fundamental and well-recognized tool is the protection of carbon-rich ecosystems such as primary forests, peatlands, grasslands, coastal blue carbon and marine biota, as well as the restoration of lost and damaged terrestrial, freshwater, coastal and marine ecosystems. These ecosystems are often referred to as 'carbon-rich' because they sequester and store more carbon than other ecosystems.

Example of a carbon-rich, high biodiversity mangrove forest
Krabi, Thailand. Photo: tonaquatic/istock

Supporting Evidence

The science agencies supporting the UN Rio Conventions all identified the important role of protected areas in realizing the synergies between the two conventions. The sixth assessment report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) acknowledged area-based conservation, protection and restoration of ecosystems as effective strategies to reduce the vulnerability of biodiversity and humans to climate change[1,10]. It also concluded that actions to protect ecosystems with a high biodiversity value, such as forests, and particularly primary forests, coastal vegetated wetlands, peatlands, savannas and grasslands offer the highest total and per area mitigation value of any action in the Agriculture, Forestry and Other Land Uses (AFOLU) sector. And at the lowest cost.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystems Services (IPBES), in its *Global Assessment Report* recognizes the increasing impacts of climate change on biodiversity and the unlikelihood of reaching the Sustainable Development Goals or the Paris Agreement without addressing the relationship between nature and people. A joint IPBES-IPCC workshop on *Biodiversity and Climate Change* has also demonstrated the interdependence of biodiversity and climate change and the need to explore solutions that address both crises[11].

Recent analyses, drawing on multiple lines of evidence, suggest that maintaining the resilience of biodiversity and ecosystem services at a global scale depends on effective and equitable conservation of approximately 30 to 50% of Earth's land, freshwater and oceans[12].

Role of Protected Areas

The purpose of protected areas has evolved over time. The original concept of protecting scenic landscapes, culturally important areas and areas where people can connect to nature, was supplanted by the concept of maintaining populations of iconic and threatened species. As threats from climate change have intensified, there has been an increasing understanding of the value of PAs in protecting carbon sinks and stores, as well as other ecosystem services. The *Protected and Conserved Areas Joint Statement on Climate Change and Biodiversity Crises*, signed at the UNFCCC COP26, recognizes this expanded role for PAs. It encourages "better conservation and restoration of nature, especially of carbon-rich ecosystems, and better connectivity of these spaces to become the heart and anchors of nature recovery networks globally".

Protecting existing carbon-rich ecosystems, such as primary forests, peatlands, grasslands, mangroves, seagrass beds and salt marshes has multiple benefits for biodiversity and people. Emissions benefits are achieved quickly (*i.e.* within a time-frame compatible with the urgency of the climate and biodiversity crises). The cost per tonne of CO_2 is low[13]. Much of the carbon in these ecosystems has accumulated over centuries or longer: if released by human activities it is essentially irreplaceable in a time-frame that can meet the urgent need to reduce greenhouse gas emissions. About 23% of this irrecoverable carbon is found within PAs, with about half of it concentrated in just 3.3% of the planet's lands[14,15]. Globally, forests contain the most stored carbon, partly because of their widespread extent. Mangroves, salt marshes and seagrass beds contain more stored carbon on an area basis than most forests, although their limited geographic extent makes them less important on a global scale (Figure 1).

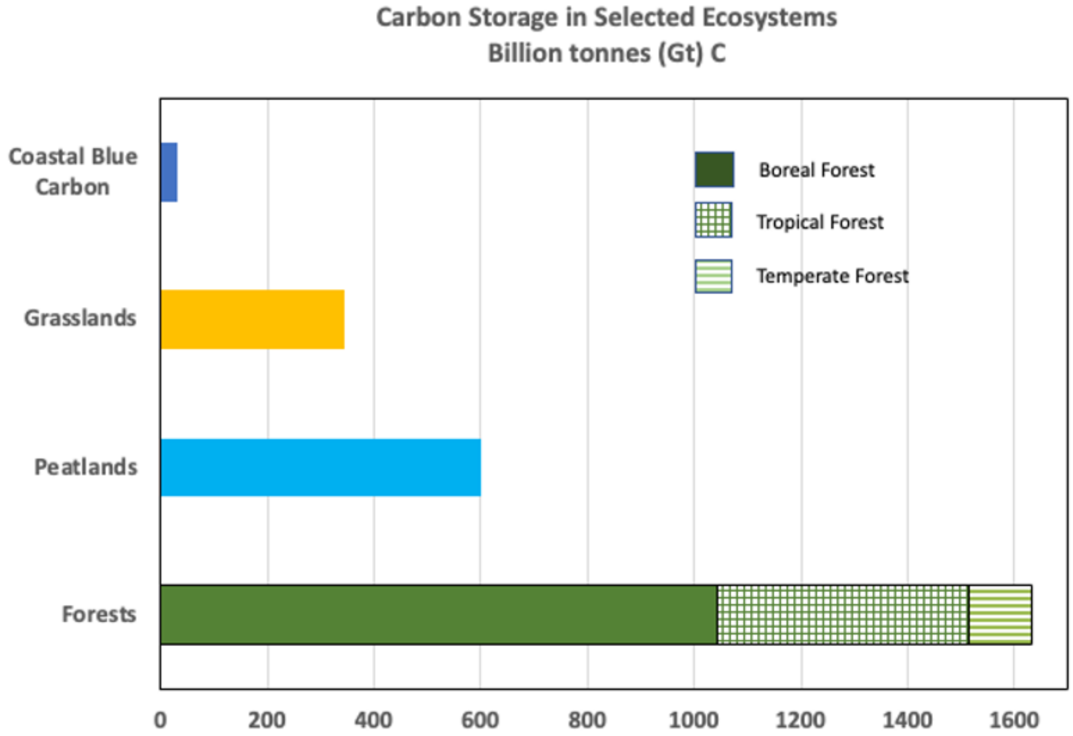

Figure 1: Estimates of global carbon storage in selected ecosystems. Sources for estimates are: Coastal blue carbon (mangroves, salt marshes and seagrass beds) (Macreadie et al 2021); Grasslands (Lorenz and Lal 2018); Peatlands (Strack et al. 2022); Forests (Woods Hole Climate Research Center et al 2020).

Areas rich in biodiversity and those high in carbon reserves do not always overlap. However, where they do, there is potential for expansion of protected areas to conserve biodiversity and achieve climate mitigation goals. In one global analysis, Soto-Navarro *et al* (2020) found an overlap of 38% between carbon richness and a biodiversity index that prioritizes areas of high biodiversity (measured as high species richness, range-size rarity), high local intactness and high habitat condition, with 12% of the overlap area falling within existing PAs. The same authors found only a 5% overlap between carbon richness and a biodiversity index that prioritizes high local biodiversity, low average habitat condition and high threats to biodiversity, but 21% of the overlap area fell within existing PAs[16] (Figure 2). There is potential for increasing protected areas where the overlap is high and protection is low.

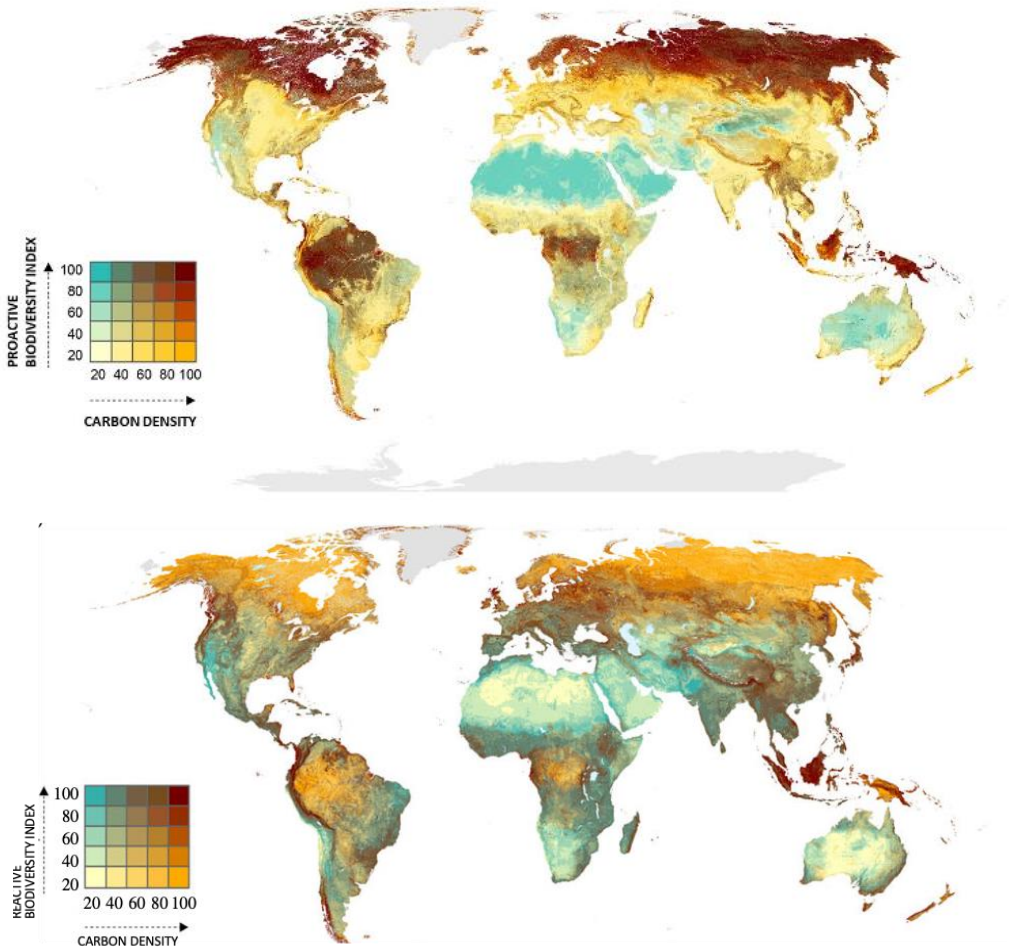

Figure 2. The top map depicts the area of overlap between areas of high local biodiversity (high species richness, range-size rarity), high local intactness and high average habitat condition with carbon-richness. The bottom map depicts the area of overlap between areas of high local biodiversity, low average habitat condition and high threats with carbon richness. The dark brown areas depict the areas of highest overlap. Reprinted with permission. [16]

Protected areas have been estimated to store about 15.2% of terrestrial carbon stocks and to sequester about 20% of the carbon sequestered by all land ecosystems[17]. A similar analysis has not been made for Marine Protected Areas (MPAs).

Analyses at the regional or national level provide the detail important for planning PAs that can provide biodiversity protection and serve as 'carbon stabilization areas'. A study by Graham *et al (*2021), in southeast Asia, demonstrated that carbon emissions in PAs are 2.5 times lower than outside PAs. Biodiversity hotspots (measured as species richness) overlapped with carbon-rich hotspots in 38% of the mapped area[18]. Similarly, the 364 refuges in the U.S. National Wildlife Refuge System store 16.6 Gt of carbon, with higher carbon per unit area inside refuges than outside[19].

Protected and Conserved Areas, as well as the conservation corridors that connect them[20]: i) provide the ecosystem integrity on which the long-term persistence of ecosystems depends; ii) enhance the resilience of natural ecosystems to change, and especially the disturbances resulting from climate change; and iii) reduce the vulnerability of ecosystems to multiple pressures across a landscape, including providing a buffer against global tipping points.

Nationally Determined Contributions (NDCs) to the Paris Agreement and Protected Areas

In the first iteration of Nationally Determined Contributions (NDCs) to the Paris Agreement, 67 countries (37% of the NDCs examined) explicitly mentioned terrestrial protected areas or other conserved areas as part of their contribution to reduce greenhouse gas emissions, although few offered specific numbers on how much GHG reduction would be achieved by PAs [21]. A similar analysis on the updated NDCs remains to be done, but the role of nature in GHG emissions is receiving increasing prominence in discussions at UNFCCC, so we can presume that PAs will also be more prominent in updated NDCs.

Unlike in the terrestrial realm, few countries included MPAs in their NDCs to the Paris Agreement, although the potential for MPAs to provide both mitigation and adaptation benefits is well-documented. Oceans play a significant role in buffering climate change - by absorbing more than 90 percent of the temperature increases caused by global warming and 50 percent of all the carbon emissions since the Industrial Revolution[22,23]. However, this is not sustainable given the cost to marine ecosystems such as deoxygenation[24], ocean acidification and ocean temperature increases[25] [26]. It has been estimated that between 0.02 to 0.65 billion tonnes (Gt) of CO_2e/year of GHG emissions could be sequestered and stored by increasing the protection and restoration of coastal ecosystems (mangroves, salt marshes and seagrasses)[25]. MPAs created and managed using climate information can enhance marine ecosystem resilience by:

- Enhancing connectivity between populations, species and ecosystems, including protecting species that migrate or travel over large distances;
- Providing climate refugia or safe havens for vulnerable species and ecosystems, and protecting populations of species important for food security;
- Improving the adaptive capacity of species, given the evidence that species and genetic diversity are often greater in marine reserves compared to harvested areas;
- Recognizing and supporting Other Effective Area-based Conservation Measures (OECMS) to protect key habitats, provide connectivity and enhance the resilience of coastal and marine ecosystem.

WHAT IS ECOSYSTEM INTEGRITY?

Ecosystem integrity refers to the ability of ecosystems to maintain key ecological processes, recover from disturbance and adapt to new conditions[1].

Ecosystem integrity can be measured as a continuum, from high to low integrity.

Ecosystems with high integrity have their full complement of species, high genetic variability within populations, and maintain the processes that keep all of the components, biotic and abiotic, working.

Ecosystems with high integrity are more resilient to disturbances, including those caused by climate change. They can persist over long periods.

Ecosystem integrity and resilience are supported by properties such as biological diversity, connectivity and intactness (i.e. having the minimal impact from human activities).

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