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Key steps toward expanding protected areas to conserve global biodiversity

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A Viewpoint on the Frontiers in Science Lead Article

Conservation Imperatives: securing the last unprotected terrestrial sites harboring irreplaceable biodiversity

Key points

- The current number of protected areas is inadequate to preserve all biodiversity; a significant global expansion of protected areas is urgently required to meet ambitious goals to protect 30% of the planet by 2030.
- Major advances in protecting areas to prevent irreversible biodiversity loss is more financially feasible than previously thought, with costs estimated at US$169 billon, which is insignificant in comparison to the $44 trillion of the world's GDP that is potentially at risk as a result of biodiversity loss and the erosion of ecosystem conditions.
- Identifying and protecting areas for conservation is not enough: reserves need resources to properly manage and rigorously monitor biodiversity.

It has long been recognized that protected areas of ecological importance are critical for biodiversity conservation, with greater populations of plant and animal species inside reserves compared to the biodiversity observed in unprotected areas. For example, protected areas are believed to have prevented the extinction of approximately one-quarter of the world's birds (1). There are also "spill-over" effects from protected areas, whereby locations adjacent to reserves support larger populations and greater species richness than unprotected areas further from reserves (2). Therefore, reserves have significant benefits for biodiversity that extend well beyond their borders.

As important as reserves are, it is clear that current reserve networks are inadequate to preserve all biodiversity, and a significant global expansion of protected areas is urgently required (3). In 2021, the International Union for Conservation of Nature (IUCN) World Conservation Congress in Marseille implored governments around the world to set ambitious targets to protect at least 30% of the planet by 2030. The expansion of the network of protected

areas forms an integral part of Target 3 of the post-2020 Global Biodiversity Framework, in which at least 30% of areas of particular importance for biodiversity are included in representative and well-connected systems of protected areas. This target is supported by the High Ambition Coalition for Nature and People, an initiative bringing together 119 nations to implement this global goal.

While it is crucial that there is a major expansion in the extent of protected areas globally, it is also clear that not all parts of the world are equally rich in biodiversity. It has long been known that there are hotspots of species richness, species endemism, and other areas of high conservation value that are important targets for protection. In a recent study, Dinerstein et al. identified key areas for conservation on a global scale (4). Importantly, the authors also determined the costs of expanding the current network of protected areas, which would entail an investment of US$169 billion in 2024 dollars. While this sounds like a lot of money, it is insignificant in comparison to the $44 trillion of economic value generation that the World Economic Forum estimates is potentially at risk as a result of biodiversity loss and the erosion of ecosystem conditions. It is also dwarfed by the US$12 trillion (in 2019 dollars) estimated to be required to restore the planet's degraded landscapes (5), which cover billions of hectares. Others have estimated that less than 0.01% of the world's GDP would be sufficient to virtually halt species extinctions (6).

While the global focus is a key strength of the study by Dinerstein et al. (4), the relatively coarse scale of the analysis is also a potential weakness. I believe there is a need for complementary work on reserve selection at smaller spatial scales, utilizing data on and analysis of factors such as past disturbance regimes. In the Australian state of Victoria, for example, efforts were made to rapidly expand the protected area network to limit the impacts of logging on forest biodiversity. Yet a careful analysis of purported high conservation value forests in Victoria found that many so-called Immediate Protection Areas had recently been logged, burnt (often repeatedly), and sometimes both, with their habitat value for threatened forest-dependent biota severely impaired (7). This highlights the critical need for finer-scaled ground-truthing of global datasets, as reserve acquisition cannot be based on models alone.

A key factor preventing the much-needed expansion of protected areas is the strong competition for land important for conservation. Many of the most biodiverse parts of landscapes are also in high demand for other uses, such as forestry and agriculture. These areas are often poorly protected but can contain significant biodiversity. This can create what is sometimes termed the "worthless land hypothesis". That is, land is protected that no-one else wants but at the same time has limited conservation value. For example, a global analysis of the world's non-Antarctic protected areas revealed that, although 400,000 new reserves were created between 2004 and 2014, many were not places with high numbers of threatened vertebrate species (8). The authors found that high conservation value areas were often not protected because they were in demand for agriculture (8). Similarly, in Australia, high conservation value areas that support many threatened forest-dependent taxa are also those most often targeted for native forest logging (7). These (and many other) examples highlight both the high levels of conflict in land uses and the challenges involved in the tenure changes needed to move productive agricultural and forestry land into the formal protected area system. Indeed, agriculturalists and foresters (and the powerful lobby groups that advocate on their behalf) will often strongly oppose the expansion of areas for enhanced conservation. Of course, conservation efforts need to go beyond conserving only areas with threatened species and also include habitats where non-threatened taxa occur.

In cases where there is strong competition for land between conservation and commodity production, there may be ways to enhance outcomes for biodiversity by creating economic and employment opportunities from conservation initiatives (e.g., through well-managed ecotourism) and garnering community support for changes in land use to protected areas. This could help catalyze a transition to a nature-based economy. Such transitions can be enhanced when economic benefits associated with conservation can be quantified, like through the United Nations System of Environmental and Economic Accounting (SEEA) framework (9). An example comes from Botswana, where accounting was used to assess financial competition for water between cattle and elephants—that is, between agriculture and conservation (9). The analysis clearly showed that wildlife tourism generated significantly more revenue (more than six times the amount) for the country than agriculture and was the largest income earner, outstripping the mining, business, and finance sectors (9). Environmental accounting assessments can identify where there are clear employment opportunities for people working within reserves, such as in the protection of wildlife from poaching, the control of invasive plant and animal species, and facilitation of vegetation restoration.

In other situations where conflicts between conservation and commodity production cannot be resolved by a tenure change, off-reserve conservation strategies might be required. These strategies encompass biodiversity-friendly farming approaches, such as rotational livestock grazing and native revegetation of wildlife strips between farm paddocks in agricultural landscapes (10) and reduced intensity or variable retention harvesting and long rotation silviculture in commercial forestry settings. However, these kinds of off-reserve strategies have limitations and can be ineffective for disturbance-sensitive species that require large tracts of intact habitat (e.g., primary forest or old growth forest).

Of course, the identification and subsequent establishment of reserves is just the first stage in enhanced biodiversity conservation. Reserves must also be well managed and involve the control of exotic species, controls on hunting, the management of disturbances such as fire, and the regulation of visitor impacts. Management is critical because, even after areas have been protected, they can still be subject to substantial pressure from human activities like livestock grazing, agriculture, road building, and the construction of urban settlements (11), all of which can have marked impacts on biodiversity. These problems are widespread with Jones et al. (11), for example, showing that almost one-third of protected terrestrial land globally was subject to intense pressure from human activities within its boundaries, with the effects particularly pronounced in smaller reserves.

Key processes that threaten biodiversity, such as the impacts of invasive species and altered fire regimes, will need special management, as their impacts span both on-reserve and off-reserve areas. For example, the pervasive effects of invasive species transcend reserves and neighboring areas in many parts of the world, with severe negative implications for already threatened biodiversity. However, encouragingly, when management interventions are undertaken to properly address these and other key threatening processes, there can be improved outcomes for biodiversity, or at least slower rates of decline than would have occurred in the absence of conservation action (12).

Effective management of protected areas demands appropriate levels of resourcing. This can be especially important in smaller reserves subject to major and often intense human pressure [see (11)]. However, conservation efforts are chronically underfunded, and biodiversity loss is elevated in the absence of appropriate environmental financing (13). This includes major deficiencies in the resources needed to properly mitigate threatening processes within reserves and, in turn, effectively conserve the biodiversity that protected areas are designed to maintain [e.g., (13)].

A lack of resources for conservation and protected area management often includes limited or no funding for adequate monitoring to determine if reserves are doing what they are supposed to do [see Langhammer et al. (12), for an analysis of positive conservation actions]. Sadly, there is a long history of a lack of funding for effective monitoring. Monitoring programs are often the last item funded in budget commitments and the first one cut when finances are under pressure. In the cases where monitoring is carried out, it is often of poor quality, both within and outside reserves.

Finally, while current global targets call for 30% of the planet to be protected by 2030, this may not be enough to conserve biodiversity in the face of rapid climate change. Climate change is not only directly reshaping species distribution patterns but also indirectly affects biodiversity by altering key ecological processes within reserves (e.g., fire regimes). These challenges underpin the "Nature Needs Half" movement, calling for 50% of the planet to be protected by 2030, not only to secure biodiversity but also to restore and/or maintain the fundamental ecological processes upon which life depends. Even with half the Earth reserved and well-managed, this alone will not be sufficient to conserve all biodiversity. We therefore will also need to ensure appropriate off-reserve conservation, not only in agricultural landscapes and wood production forests but in all other environments.

The much-needed urgent and global expansion of protected areas comes with major challenges. These include competition for productive land, past land uses having eroded the condition of areas being recruited to reserve systems, the need for effective management once areas are reserves, the allocation of adequate resources to support that management, and funding of robust monitoring programs to quantify (and report on) the effectiveness of conservation actions. Despite these challenges, the excellent contribution from Dinerstein et al. shows that the first step in establishing an expanded reserve system as called for by key global organizations, including the IUCN and the Convention on Biological Diversity, is financially tractable and should be achievable (4). Not only does the world's biodiversity depend on an expansion of protected areas, but so too does the world's prosperity.

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