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Biodiversity Conservation Targets: How to Allocate Resources

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https://doi.org/10.1016/j.oneear.2020.05.003

In this issue of *One Earth*, Chauvenet et al. identify strategies for the near-term allocation of protected areas on an ecoregion basis. However, the biodiversity challenge extends beyond ecoregions. More resources are needed to maximize the potential co-benefits between conservation, climate-change mitigation, indigenous communities, and sustainable land-management practices.

There are multiple reasons for conservation. Scenic beauty was an early one and drove, for example, the protection of Yellowstone, Yosemite, and the Grand Canyon in the United States. Today, among the most important reasons for the conservation of biological diversity is to avoid looming waves of extinction. But avoiding extinction also depends on an equally large agenda of conservation in support of the global carbon cycle, continental climate systems, and the sustainable management of terrestrial and marine ecosystems.

Funding that agenda is challenging. It will require more robust economics in how we account for biodiversity benefits and losses,[1] as well as efficient expenditure of funds available for conservation. In this issue of *One Earth*, Chauvenet et al.[2] make an important contribution toward the latter.

A central and long-standing question has been how conservation efforts should allocate their limited resources. An important historical point in the United States occurred in the early 1970s when the Nature Conservancy initiated its Natural Heritage Program, a state-level biodiversity database that oriented the conservation targets away from just natural beauty (e.g., hemlock hardwood forests) and toward the protection of threatened and endangered species.

An important next step was the recognition of biodiversity hotspots, regions with high concentrations of endemic plant species and high percentages of habitat destruction (e.g., Madagascar and the Atlantic forest of Brazil[3]). Not long after that came the United Nations Earth Summit of 1992 in Rio de Janeiro, which launched the Convention on Biological Diversity (CBD) as well as conventions addressing climate change and land degradation.

The CBD was very slow in creating its own scientific body, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, which released its first global assessment report of the state of the planet's biodiversity in 2019.[4] The findings of the report were dire; for example, it reported that one million species currently face the threat of extinction, many within decades. The race is on to conserve global biodiversity. The CBD has negotiated and introduced a series of Aichi Biodiversity Targets, which include percentages of national area in formal conservation areas. The current set includes 17% for terrestrial areas and another 10% for marine areas globally by 2020. At the next Conference of the Parties (which has now been postponed until 2021) there will be an effort to raise them to 30%.

Area-based protected-area targets are not necessarily biologically or ecologically meaningful. In some regions, such a target could, for example, include a lot of rock and snow (e.g., in high-altitude regions of Nepal). It would be more ecologically representative if targeted protected-area percentages were to be applied to the 846 terrestrial ecoregions[5] because they are in fact each defined by their own characteristic biological diversity. (By contrast, biomes, e.g., tropical rainforests or deserts, are hopeless to have much actionable biodiversity significance.)

Chauvenet et al. consider this more biologically meaningful set of ecoregion targets in their paper on terrestrial conservation planning. The study assesses strategies for the expansion of protected areas and concludes that more ecoregions can reach the Aichi Target 11 percentage area required by 2030 if funds are concentrated on those ecoregions where land is cheap and "quick wins" (in which ecoregions closest to the protection target are prioritized for new protected-area acquisition) are possible. The flip side, of course, is that concentrating on those areas neglects those with biodiversity under greater pressure. Personally, I would use the results to argue for greater resources overall.

Without question, the ecoregion framework provides both a more global-scale and finer-resolution analysis of conservation priorities than do biomes, and it therefore makes complete sense for ecoregions to be at the core of setting global conservation priorities. Yet, in no sense are ecoregions uniform in species composition throughout their individual geographic extent any more than biomes are. Many species with small geographic distributions[6] would otherwise be left out of the conservation calculus. These analyses are defined by vertebrates; the extent to which invertebrates (other than butterflies) and plants would follow a similar pattern is not known. Clearly, adjustments should be made in conservation planning for these details, which are at a finer scale than ecoregions.

Indigenous areas already make a meaningful contribution to global biodiversity conservation and, in tropical rain forests, can have very high levels of biological diversity. Such areas are overlooked in the usual calculations and not counted as official conservation areas *de* *jure* as opposed to *de facto*. Conservation should seek substantive partnerships with indigenous peoples. Those will be successful only if they are approached within the larger context of the aspirations of the individual indigenous groups.

In addition, there are biologically driven ecosystem and planetary functions that need to be considered for the ecoregion approach to succeed. There is no better example than the biodiversity-rich Amazon. Although already close to 25% is in conservation areas and an additional 25% is in demarcated indigenous lands, the Amazon needs more than 80% forest cover to maintain the hydrological cycle, which approaches the continental scale. Driven by forest structure and major plant transpiration, the rain generated nurtures the highly diverse rain forest and its other ecosystems and provides moisture to every South American nation except Chile.[7]

Biodiversity conservation must also contend with the ongoing impact of climate change.[8] Climate-change policy is only in its initial phases of integrating biodiversity into its decision making. The Paris Agreement target of limiting climate change to 1.5°C above pre-industrial levels was largely arrived at because of small island nations and sea-level rise. That target is equally important in terms of biodiversity conservation.

Ecosystems do not move as a unit in response to climate change. Rather, the individual organisms and species each move at their own rate and in their own independent direction. Consequently, beyond 1.5°C, ecosystems as we know them will disassemble, and the surviving species will assemble into new ecosystems that will be difficult to envision in advance. We are already witnessing ecosystems coming apart. This includes the bleaching tropical coral reefs as the relationship between coral animals and algae breaks down and the widespread dieback in North America's western coniferous forests, where climate change has tipped the balance in favor of native bark beetles.

Climate change needs to be limited to no more than 1.5°C for there to be a biologically manageable planet. The current levels of CO_2 in the atmosphere will send us way beyond that unless we reduce the atmospheric CO_2 load. It should give us hope that twice in the geologic history of the planet natural systems were able to lower atmospheric concentrations to levels equivalent to pre-industrial levels.[9]

The amount of carbon in the atmosphere from destruction and degradation of terrestrial ecosystems (450–500 gigatons) is roughly equivalent to what remains in extant terrestrial ecosystems.[10] Ecosystem restoration sufficient to recapture one-third of the atmospheric carbon contributed by destroyed terrestrial ecosystems can reduce atmospheric carbon from 415 to 350 ppm, providing a climate soft landing at 1.5°C (2.2 gigatons of carbon sequestered equals a 1.0 ppm reduction). Forests, especially tropical rain forests, come to mind first because they are so carbon dense, but the restoration of all kinds of terrestrial ecosystems has the potential to contribute—and all provide valuable ecosystem services.

Conserving the amazing biological diversity of the planet is an integral and central part of any agenda for a sustainable future not only for humanity but also for life on Earth. The time is quite short, and the challenge is quite large. The kinds of analyses exemplified by Chauvenet et al. identify useful efficiencies for conservation under current constraints, but they clearly show that current conservation resources are far from sufficient.

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