Biodiversity conservation in a changing environment beyond 2020

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The massive and ongoing loss of biodiversity comprises a social and environmental emergency that the world's governments must urgently address. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) global assessment has warned that biodiversity is declining faster than at any time in human history. To this end, the 15th Conference of Parties (COP 15) for Convention on Biological Diversity (CBD) in Kunming, China this October will focus on developing a post-2020 global biodiversity framework to replace the 2011–2020 Strategic Plan for Biodiversity (including the Aichi Biodiversity Targets). Given the failure to meet previous policy targets, how can the global scientific community provide strong science-based evidence to improve biodiversity conservation as well as address conflicts with the demands of an increasing human population?

In this special collection, leading conservation scientists identify grand challenges for biodiversity conservation, conflicts, and trade-offs between conservation and the exploitation of natural resources, and strategies for sustainable utilization and management of biodiversity at global, regional, or national scales. A solid science foundation can better inform recommendations for the development and implementation of the post-2020 Biodiversity Agenda. The special collection papers contribute to this grand aim, by providing insights into the following issues.

MULTIPLE STRESSORS DRIVE BIODIVERSITY LOSS

While the roles of individual threats to biodiversity, including climate change, habitat loss, and pollution, are well documented, much less is known about how these drivers interact and how their interactions vary across locations. Through analysis of the spatial-temporal distributions of threatened and declining species across China, Lu *et al.* (*1*) found that these "losing" species are affected by multiple stressors, with climate and human activities as the fundamental shaping forces. Expanding construction and intensifying pollution have led to habitat loss and degradation, threatening high proportions of amphibians, mammals, and reptiles. However, the distributions of species and stressors vary greatly across different climatic zones and geographical areas. This finding suggests that policy and target setting for biodiversity conservation at regional scales needs to account for local context and the most important drivers of loss in any specific setting.

ELEVATED TROPOSPHERIC OZONE IMPACTS BIODIVERSITY

Despite progress in understanding the physiological mechanisms of O_3 and other atmospheric pollutants on plants, we know little about the responses of communities and ecosystems to O_3. Agathokleous *et al.* (*2*) suggest that O_3 can affect (i) the composition and diversity of plant communities by affecting key physiological traits; (ii) foliar chemistry and the emission of volatiles, thereby affecting plant-plant competition, plant-insect interactions, and the composition of insect communities; and (iii) plant-soil-microbe interactions and the composition of soil communities by disrupting plant litterfall and altering soil processes. Consequently, O_3 changes the community composition of soil microbes, and their alpha diversity is often reduced, but the effects vary across different environments in time and space. These findings will stimulate further studies on the impacts of atmospheric pollutants on biodiversity, communities, and ecosystem functioning.

MONITORING PHYLOGENETIC DIVERSITY

Phylogenetic diversity reflects the evolutionary history of species and has been used in the selection of biodiversity conservation priority areas (*3*). However, the amounts and spatial patterns of genetic and phylogenetic diversity of wildlife at the regional scale remain largely unclear. Using a meta-analysis of phylogenetic diversity in Chinese terrestrial vertebrates, Hu *et al.* (*4*) found strong positive spatial correlations among mitochondrial DNA–based genetic diversity, phylogenetic diversity, and species richness. Climatic factors had notable positive effects, while altitude and human population density had negative impacts on the levels of mitochondrial DNA–based genetic diversity in most cases. These findings highlight the need for governments at both national and regional levels to set up genetic diversity conservation plans.

TRANSFORMATIVE CHANGE IN FOOD SYSTEMS

Food systems are one of the major stresses on biodiversity, accounting for approximately 60% of global terrestrial biodiversity loss and the overexploitation of 33% of commercial fish populations (*5*, *6*). With the overarching goal to sustainably provide sufficient food for people while conserving and restoring biodiversity, Delabre *et al.* (*7*) examine how, and under what conditions, the post-2020 global biodiversity framework can support leverage points for transformative change, with a specific focus on food production and consumption. It is important to set up specific targets and indicators that could effectively address sustainable food production and consumption and present the enabling conditions to achieve these targets.

GLOBAL EXPANSION OF PROTECTED AREAS

Crisis Ecoregions, Biodiversity Hotspots, Endemic Bird Areas, and Intact Forest Landscapes are a few types of protected areas (PAs) that should help prevent biodiversity loss. However, the current global PA network has not successfully mitigated the ongoing decline of biodiversity and ecosystem services, and there is overwhelming agreement that Aichi Target 11 has not adequately conserved biodiversity (*8*). Yang *et al.* (*9*) suggest focusing on the spatial planning of global terrestrial PAs by identifying cost-effective priorities and setting global and national coverage targets. This paper considers how to practically achieve a target of 43% of land protected, which reflects the "half-earth" target set as a threshold to achieve effective biodiversity conservation. With high-resolution spatial planning for effective PA expansion, the most cost-effective sites for PAs can be designated, in consideration of both national targets and different regional environmental and social conditions.

BIODIVERSITY CONSERVATION AND CARBON NEUTRALITY

Most countries set conservation priorities at a national or subnational scale, but national accounts rarely mention regional or global targets and indicators. However, it is vital to seek synergies across scales and identify overlaps and differences to enable effective decisions necessary for implementing the post-2020 global biodiversity framework. To avoid negative impacts on conservation outcomes, trade-offs and synergies with other priorities should be assessed. Zhu *et al.* (*10*) examine how to incorporate carbon targets into biodiversity conservation planning to maximize co-benefits. In this regard, CBD signatory countries should develop an actionable framework that sets synergistic priorities for biodiversity conservation, carbon capture, and emissions reduction and makes better use of effective instruments for the delivery of both climate and biodiversity goals.

It is important to note that large knowledge gaps hamper our understanding of biodiversity itself. Terrestrial biodiversity, both above and below ground, and ocean biodiversity are critical areas for further study. In particular, we must include less studied parts of the world. Failing this, it will be difficult to develop international commitments on sustaining biodiversity in the oceans and soils. Over the next few years, key activities should emphasize species discovery and the monitoring and mapping of biodiversity. We look forward to further international collaboration on biodiversity research and implementation of targets at different scales.

–Yonglong Lu and James M. Bullock

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