

CONNECTIVITY CONSERVATION

SUSTAINING NETWORKS FOR ECOLOGY AND COMMUNITY

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Connectivity conservation: *The time is now*

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ABSTRACT

The theory and practice of connectivity conservation have matured, and we are now at the point where intentional, landscape-scale ecological networks are poised to play an indispensable role in the drive to protect and conserve at least 30% of the earth's lands and waters by 2030. Clearly, achieving the "30x30" goal is an urgent matter and a big step toward what nature needs. The stark conclusions of the latest

IPCC report leave no doubt that the 2020s will be a decisive decade for the planet, and there is broad scientific agreement that the biodiversity and climate change emergencies must be met in tandem. For conservationists, this means scaling up both our

Tanaya Creek tumbles into Yosemite Valley, Yosemite National Park, California, USA. GABRIEL OPPLER



Each decade over the past 40 years has been warmer than any prior decade dating back to 1850. JOHN MANKOWSKI

thinking and our ambitions. While formal protected areas and other effective area-based conservation measures (OECMs; also referred to as “conserved areas”) form the bedrock of conservation, equally important are the connections between and among these areas. The featured theme papers in this issue of *Parks Stewardship Forum* explain recent advances in connectivity conservation, spelling out what has to happen to hit the 30x30 target, exploring how science and policy are aligning to support the livelihoods of local communities and human rights while contributing to global environmental conservation goals, and providing concrete examples of where and how landscape-scale conservation can be applied to meet the challenges of our time.

A PLANET IN TROUBLE

Climate change and widespread biodiversity loss threaten the ecological health of our planet like never before. The recently released physical science component of the Intergovernmental Panel on Climate Change’s (IPCC’s) Sixth Assessment Report leaves no doubt that significant changes are needed now. The topline of the report are that current climate change is unequivocally caused by human activity, with surface temperatures rising until at

least 2050 no matter what we do. Climate-linked droughts, heat waves, extreme storms, sea-level rise—all of them are happening now and will increase in frequency and intensity unless immediate, drastic, worldwide action is taken to cut greenhouse gas emissions (IPCC 2021). Each of the last four decades has been successively warmer than any decade that preceded it since 1850. Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years (IPCC 2021).

Another new assessment, carried out jointly between the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and IPCC, finds that increasing energy consumption, overexploitation of natural resources, and unprecedented transformation of Earth’s lands and waters have helped create better material living standards for many but have also led to changes in climate and the accelerating decline of biological diversity worldwide. Underlining these broad points are a host of alarming statistics. Up to one million species are currently at risk of extinction (IPBES 2019). Over three-quarters of the earth’s land mass outside of Antarctica has been transformed by human activity, and of the intact wilderness that

does remain, 70% is confined to just five countries (Watson et al. 2018). The world's oceans fare no better, as 87% of marine biomes are experiencing overfishing, nutrient run-off, and the impacts of climate change (Jones et al. 2018).

Like the IPCC with respect to climate change, the Convention on Biological Diversity (CBD) is proposing a rapid scaling-up of action to save biodiversity, with the goal of effectively protecting and conserving at least 30% of the earth's land, sea, and freshwater ecosystems by 2030 ("30x30"). Even beyond scientific groups such as IPCC and IPBES, there is growing recognition that we need to act now to address the interrelated challenges of climate change and biodiversity loss. Agreement on this comes from human rights organizations—given that proponents of 30x30 acknowledge that it must be achieved in the context of the rights of Indigenous Peoples and local communities—and from forward-thinking business groups (IUCN-WCPA et al. 2021). There is also an intergovernmental High Ambition

Coalition for Nature and People backing 30x30, with over 60 countries as members to date (HACNP 2021).

Reaching the target requires conservationists to think very differently, and on much larger scales. This is where connectivity conservation is poised to make a major contribution to 30x30.

A FUNDAMENTAL SHIFT IN CONSERVATION PRACTICE

From urban, suburban, and rural landscapes to the deepest stretches of wilderness, conservation of critical habitat is increasingly important. For much of the past century, area-based conservation has succeeded in advancing protections for critical lands and waters. As of 2021, global terrestrial and marine protected and conserved areas coverage amounts to 16.65% and 7.74%, respectively (UNEP-WCMC and IUCN 2021). Nature conservation must remain committed to protecting more intact ecosystems. While formal protected areas (PAs) and other effective area-based conservation measures (OECMs), also referred to as "conserved areas,"

A highway shuttles park visitors through Lamar Valley, Yellowstone National Park, Wyoming/Montana/Idaho, USA. GABRIEL OPPLER



form the bedrock of conservation, 21st-century challenges require a more comprehensive approach (IUCN-WCPA 2019). PAs and OECMs are essential to conservation, but equally important are the connections between and among these areas.

Ecological connectivity is the unimpeded movement of species and the flow of natural processes that sustain life on Earth (CMS 2019). Connectivity allows ecosystems to function at larger scales, and provides the “safety net” for biodiversity in times of changing climate (Foden and Young 2016; Gross et al. 2016). As anthropogenic forces continue to fragment the earth into smaller and smaller parcels of viable habitat, there is an increasing need to prioritize ecological connectivity conservation. To combat fragmentation, we now know that measures must be taken to maintain, enhance, and restore ecological connectivity. Policy and practice must be tailored to the specific context of each area of land, freshwater, and sea, but as a whole, can contribute to large-scale, long-lasting conservation.

GROWING MOMENTUM AND INCREASING COORDINATION

Ecological connectivity conservation is the collaboration and action of individuals, communities, and institutions to maintain, enhance, and restore ecological flows, species movement, and dynamic processes across intact and fragmented environments.

As the scientific basis for ecological connectivity conservation has solidified, a new movement has emerged. Momentum is growing around the world, with connectivity conservation expanding beyond science to influence policy, law, and management. Keeley et al. (2019) analyzed 263 terrestrial connectivity conservation plans (CCPs) from around the world and demonstrated an exponential growth in their total number in the past 30 years. The United States, Europe, and South Africa lead this expansion. The authors also studied the factors that contributed to successful implementation of CCPs, finding that partnerships and collaboration among stakeholders were key elements of success. It is clear that interest in, and demand for, effective connectivity conservation is increasing across sectors and around the globe. In many places, non-governmental organizations (NGOs) are leading this effort; in others, the public sector is more directly involved in promoting ecological connectivity. Some countries, in fact, have

passed legislation that mandates identification of, and protections for, ecological corridors. Nonetheless, there remains a general need for increased coordination and standardization in the field.

MOVING TOWARDS A GLOBAL APPROACH: IUCN’S GUIDELINES FOR CONSERVING CONNECTIVITY

In 2016, the World Commission on Protected Areas (WCPA), one of six commissions of the International Union for Conservation of Nature (IUCN), established the Connectivity Conservation Specialist Group (CCSG) to give greater structure to this growing community of practitioners. The CCSG is currently based at the Center for Large Landscape Conservation in Bozeman, Montana, USA. Since its inception, membership in the specialist group has grown to over 900 individuals spread across 85 countries, lending evidence that a deep wealth of knowledge and passion is available and ready to be further tapped. In 2020, CCSG published IUCN’s *Guidelines for Conserving Connectivity through Ecological Networks and Corridors*. This groundbreaking tool now serves as the leading resource for advancing best practices to protect the interconnectedness of protected and conserved areas, and restore degraded or fragmented ecosystems that are critical to the health of biodiversity.

These guidelines are the culmination of over two decades of effort by IUCN, and the result of contributions from more than 100 experts in 30 countries. Since the guidelines’ release, they have begun to provide managers, policymakers, and experts across the globe with best practices and recommendations for achieving more connected land, freshwater, and seascapes. Of note, the guidelines provide authoritative definitions for *ecological corridors* and *ecological networks for conservation*, the spatially defined areas that enable structural and functional ecological connectivity. The guidelines provide advice to governments and conservation practitioners on how to plan and implement ecological corridors, including considerations for their delineation, governance, tenure, management, and long-term monitoring, evaluation, and reporting. In addition, the guidelines detail the many ways in which ecological corridors and networks can provide communities with social and economic value. Twenty-five case studies complement the guidelines by illustrating projects from around the world.



Promoting connectivity at the landscape scale is a proven way to deliver conservation outcomes. JOHN MANKOWSKI

Connected ecosystems are more resilient: they support plants, animals, and processes to persist in an increasingly human-dominated world. However, more than half of the planet is now developed and this is threatening human health, accelerating species loss, and limiting nature's ability to withstand the impacts of climate change. Safeguarding ecological connectivity is a proven conservation measure, and the purpose of the guidelines is to bring together current knowledge and proven practices to lead a new global effort to combat habitat fragmentation and protect intact ecological networks for conservation.

CONNECTIVITY CONSERVATION IN THE POST-2020 ERA

The CCSG is working with private and public partners in several countries to coordinate efforts and advance connectivity conservation at all levels. This informal "connectivity coalition" is elevating the profile of ecological connectivity in international environmental bodies, such as IUCN and the United Nations Environment Programme, as well as in multilateral environmental agreements such as the Convention on Migratory Species, CBD, Ramsar Convention on Wetlands, and the World Heritage Convention.

Beyond policy negotiations, there are efforts being made to implement connectivity conservation on the

ground. By building partnerships among local and regional decisionmakers, landowners, scientists, and community members, projects are taking off around the world that integrate connectivity conservation into land- and sea-use plans, infrastructure development, and conservation frameworks. From Romania's Carpathian Mountains, to Kenya and Tanzania's "SokNot" landscape, to the Bolivian Chaco-Pantanal wetlands, NGOs, governments, and communities are increasingly working together to maintain, enhance, and restore ecological connectivity. With newly available and globally applicable guidelines from IUCN, greater effort can now be taken to replicate successes across all lands and seas, fending off biodiversity loss and increasing nature's resilience to climate change.

THE PAPERS IN THIS ISSUE OF PARKS STEWARDSHIP FORUM

The featured theme papers in this issue of *Parks Stewardship Forum* aim to give readers a sense of some of the most important recent advances in connectivity conservation theory and practice. Stephen Woodley, Jonathan Jarvis, and Andrew Rhodes—from Canada, the US, and Mexico, respectively—offer a broad North American perspective on the urgent need for action in "Ensuring area-based conservation meets the twin challenges of biodiversity loss and climate change." They clearly

articulate the need to tackle the biodiversity and climate change crises together, and that the stakes couldn't be higher: "nature is rapidly disappearing, and the climate is changing, bringing into question the very survival of humanity." Yet theirs is not a counsel of despair. Instead, they "provide a diagnosis and a blueprint for what transformative change looks like for the world of protected and conserved areas," and lay out eight specific conservation solutions that are within our grasp.

In "Ecological networks and corridors in the context of global initiatives," Jodi A. Hilty and Aaron T. Laur summarize the key tools—conceptual in nature, but leading directly to on-the-ground conservation practices—that are central to the maturing science of connectivity conservation. These tools are *ecological connectivity*, *ecological corridors*, *conserved areas*, and *ecological networks for conservation*. Hilty and Laur review the evidence supporting the need for large-scale conservation and review the landmark IUCN guidelines for carrying it out, which, as noted above, were published last year.

The ocean environment has its own singular challenges for conservationists working at large scales.

"Advancing marine conservation through ecological connectivity: Building better connections for better protection," by Zachary J. Cannizzo, Barbara Lausche, and Lauren Wenzel, provides an honest appraisal of the state of play. In short, marine connectivity conservation currently lags somewhat behind its terrestrial counterpart, but theory and practice are beginning to catch up and the field is wide-open for innovative projects. The authors pay special attention to the distinction between *passive (oceanographic) connectivity* and *active (migratory) connectivity*, which are related to overall *seascape connectivity*—which is, as one might guess, unique to the ocean. They offer helpful rules of thumb for designing connectivity into marine protected area networks.

The endorsement of 30x30 by the current leaders of Canada and the US has kindled a palpable sense of excitement among conservationists in both countries, with the feeling that we have a historic (but potentially short-lived) window of opportunity before us to make much-needed progress across boundaries. This spirit animates the contribution by Karen F. Beazley, Gabriel Oppler, Leanna R. Heffner, Jessica Levine, Aaron Poe, and Gary Tabor, titled "Emerging policy opportunities for United States–

Seascape connectivity distinguishes between the passive and active movements of organisms. GREGOIRE DUBOIS



Canada transboundary connectivity conservation.” Reporting on two recent workshops held by Canadian and American colleagues, the authors present a broad strategy for increasing the effectiveness of conservation initiatives along the world’s longest undefended national border. Among other salient workshop outcomes, they convey the particular importance of prioritizing opportunities to support and promote Indigenous leadership in conservation.

This same window of opportunity applies to the potential revival of Landscape Conservation Cooperatives (LCCs) in the US. “Build back a better national landscape conservation network,” by John Mankowski, Greg Wathen, Aaron Poe, Rua Mordecai, and Anna Wearn, originated as a combination policy brief and call to action to US policymakers and is republished here with permission. The paper provides an overview of the LCC Network, which served as a national conservation framework from 2010–2017. There were 22 regional self-directed LCCs covering the entire country, each one designed to understand the threats and develop collaborative strategies to conserve natural and cultural resources important to the partners operating within their geographic scope. Connectivity was a major focus for most LCCs. The establishment of the LCC program was not without some controversy, but a 2015 congressionally mandated independent review of its scientific merits reached a positive conclusion. Nevertheless, funding for LCCs was ended in 2017 and most were disbanded. The authors explain the need to increase US federal support for landscape-scale, collaborative conservation, and build back a better, more durable network to meet this century’s conservation challenges.

CONNECTIVITY CONSERVATION’S MOMENT HAS ARRIVED

The papers presented here demonstrate that the theory and practice of connectivity conservation have matured to the point where intentional, landscape-scale efforts are poised to play an indispensable role in the drive to protect and conserve at least 30% of Earth’s lands and waters by 2030. The planetary emergency we now face is the most daunting humanity has ever known. We are out of time and out of excuses to further delay taking bold action. Creating a comprehensive global system of well-managed protected and conserved areas—connected together in ecological networks for conservation—is an essential part of what must be done.

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On the cover of this issue

A glacial river on Kodiak Island, Alaska, meets the North Pacific Ocean. Coastal deltas represent the critical interface between terrestrial, freshwater, and marine connectivity. | **STEVE HILLEBRAND / USFWS**