frontiers in Science

TYPE Frontiers in Science Lead Article
PUBLISHED 09 April 2026
DOI 10.3389/fsci.2026.1609998

Nature Positive: halting and reversing biodiversity loss toward restoring Earth system stability

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RECEIVED 11 April 2025
REVISED 09 February 2026
ACCEPTED 12 March 2026
PUBLISHED 09 April 2026

CITATION
Locke H, Rockström J, Plowright RK, Laffoley D, Little Bear L, Peres CA, Wei F, Karanth KK, Zemke L, Seetal R and Hauer FR. Nature Positive: halting and reversing biodiversity loss toward restoring Earth system stability. *Front Sci* (2026) 4:1609998. doi: 10.3389/fsci.2026.1609998

Abstract

Human activities are driving a global decline in biodiversity and are interfering with the natural processes essential for human well-being. Achieving climate and development goals is impossible without keeping nature intact. In this article, we establish the urgent need for a paradigm shift toward a “Nature Positive” (NP) future, where the health and resilience of the Earth system are recognized as the fundamental basis for human prosperity. This requires that humanity acts to halt and reverse the loss of nature by 2030. The Kunming-Montreal Global Biodiversity Framework (GBF) provides a critical roadmap for this NP goal, and global policy increasingly recognizes that environmental targets can only be effective when integrated with global climate, ocean, and human development agreements. This requires a biodiversity conservation approach that accounts for both biotic and abiotic components of the Earth system. We assess the adequacy of GBF targets for stabilizing the Earth system and highlight key gaps. We employ the Three Global Conditions Framework (3Cs), which categorizes landscapes by human impact levels as a practical method for guiding appropriate NP actions, and we extend its application to the marine realm. We outline specific actions and metrics for patterns and processes across all scales needed to achieve biodiversity conservation in synergy with climate stabilization and securing freshwater systems. Our findings emphasize that preventing the loss of intact biomes, ecosystems, and species assemblages is the most critical strategy while acknowledging the urgency of extinction prevention and the need for restoration. Additionally, we highlight the importance of incorporating

Indigenous and local knowledge systems alongside scientific methods to achieve effective and equitable conservation outcomes. Finally, we discuss the need for economic transformation and the private sector's role in fostering an NP future.

KEYWORDS

biodiversity, climate change, Global Biodiversity Framework, Nature Positive, planetary boundaries, Sustainable Development Goals, Three Conditions Framework, indigenous and traditional knowledge

Key points

- Stabilizing the biophysical components of the Earth system requires a unified "Nature Positive" (NP) approach to global environmental goals and governance through greater integration of global agreements for human development, the climate, biodiversity, and the ocean.
- To achieve the NP goal by 2030, the top priority should be preventing the loss of intact biomes, ecosystems, natural processes, and species assemblages, as they are irreplaceable and cannot be quickly restored. At the same time, urgent efforts to prevent species extinction and restore nature remain essential.
- Three Global Conditions Framework (3Cs) serves as a strategic approach to halt and reverse the loss of both the processes (biotic and abiotic) and patterns (species distribution and assembly) of biodiversity, as these are integral components of the Earth system, and to ensure their sustainable use.
- Incorporating Indigenous or traditional knowledge and practices, which are rooted in responsibility to the living world and inherently include awareness of biotic and abiotic processes, is essential to achieving the NP goal.
- The NP shift requires transforming our economic system to work within the Earth system and equitably support human development.

Introduction

Human exploitation of nature driven by prevailing economic systems of production and consumption is causing a rapid and catastrophic decline in biodiversity (1) while simultaneously disrupting the climate system (2). These actions are actively destabilizing the Earth system upon which human health and development depend (3), and the trajectory of environmental degradation is accelerating, placing life as we know it at grave risk.

Biodiversity loss occurs at three interconnected scales—species, ecosystems, and natural processes—all of which affect Earth system stability. At the species scale, 48% of vertebrate and insect species are in decline, with only 49% remaining stable and 3% increasing (4). Within individual species, genetic diversity is also in decline (5): globally, 6% of species are losing genetic diversity, rising to 24% among island species (6). At the ecosystem scale, 54% of the world's ecoregions are severely degraded, with an additional 25% undergoing further degradation, leaving only a quarter largely intact (7, 8).

Natural processes, which encompass both biotic and abiotic interactions across ecosystem, biome, continental, and planetary scales, are also under threat. Migration, a key biotic process essential for maintaining ecosystem health and structure (9), is increasingly imperiled across terrestrial, freshwater, and marine environments. Alarmingly, 44% of species tracked by the Convention on Migratory Species (CMS) are in serious decline, with 97% of listed migratory fish species facing extinction (10). Similarly, biotic and abiotic interactions, also known as biophysical processes (11), are threatened. For example, running freshwater systems, such as springs, streams, and rivers, are critical biophysical processes that sustain the health of both terrestrial and aquatic ecosystems, yet only 30% of river systems worldwide remain free flowing (Box 1) (12). Excessive nutrient run-off from terrestrial sources has created anoxic "dead zones" in estuaries downstream from the world's most densely inhabited areas (13).

At the biome and continental scales, rainfall processes that involve moisture recycling in rainforests are also at risk, with potentially disastrous consequences for species, the climate, and food security (Box 2). At the planetary scale, ocean warming (14–18), acidification (19, 20), and deoxygenation (17, 21) are altering marine ecosystems. These changes are driving mass coral die-offs due to marine heat waves (22–24), weakening the shells of marine organisms due to acidification (25, 26), and threatening marine foundation species (23).

Human-caused species extinction, damaged and collapsed ecosystems, and disrupted natural processes are not only factors of an ecological crisis but also an ethical failure with profound consequences for human health. Biodiversity loss is linked to the emergence and spread of infectious diseases in humans, animals, and plants (27). Declines in species diversity can increase the number of zoonotic disease-carrying species (28), while ecosystem disruption, such as forest loss, degradation, and fragmentation (29), elevates the likelihood of pathogen spillover from stressed wildlife to humans directly (30) or to livestock and then on to humans, as happened with Hendra virus (31). Ecological disruptions have already contributed to outbreaks of deadly diseases, including Ebola, Marburg, and mpox (32, 33). Climate change further exacerbates these risks, intensifying 58% of the 375 known infectious diseases (34, 35).

Zoonotic disease spillover to humans is an ecological process and therefore an ecological problem (33). Despite mounting

BOX 1 Hydrological systems are critical to a Nature Positive future

Preserving and restoring freshwater hydrological systems and habitats is crucial for achieving the "Nature Positive" (NP) goal, the Sustainable Development Goals (SDGs), and climate change objectives.

River systems (especially in tropical and boreal environments) are rich in methane, a potent greenhouse gas, and account for a substantial portion of methane emissions. Disturbing river hydrology releases methane into the atmosphere, with 10% of all global freshwater methane emissions resulting from dams (36). Conversely, maintaining and restoring hydrological processes reduces methane emissions (37).

Another example is peatlands, vital carbon and water reservoirs that depend on intact hydrology. Tropical peatlands store more carbon than upland forests (38), while those in the Northern Hemisphere are spatially more extensive (39). Peatlands release carbon when drained, whether through peat mining or infrastructure projects such as roads, dams, and water diversions (40, 41). Protecting intact peatlands and their hydrological functions is crucial for maintaining their carbon storage capacity and preventing them from becoming carbon sources (42, 43). Rewatering degraded peatlands can serve as a climate mitigation strategy, although its benefits are better understood for northern than tropical peatlands (44). High-elevation peatlands in the Andes (páramos or bofedales) are also essential for water supply in Andean nations (45).

Generally, the deleterious effects of dams are well understood. The Columbia River Basin of North America, with over 40 hydroelectric dams, has seen the near collapse of enormous salmon populations, once numbering up to 100 million returns annually. Functional hydrology is also critical to estuary ecosystems. Mangrove conservation and restoration provide effective nature-based solutions to the climate crisis, as mangroves sequester significant amounts of carbon relative to their area and offer critical shoreline protection and food security (46–48). These ecosystems rely on sediment-bearing freshwater inputs, which are threatened by upstream dams. For example, mangroves in Mexico died off following the construction of dams upstream, whereas those in nearby free-flowing rivers thrived (49). Similarly, hydrological alterations in the Mississippi River delta have caused catastrophic mangrove loss (50, 51).

Therefore, hydroelectric dam removal is a powerful NP action. In the United States, the removal of two hydroelectric dams on the Elwha River has led to rapid ecological recovery, benefiting both marine and terrestrial species (52, 53). Likewise, the removal of four dams in the Klamath River system resulted in salmon returning within 2 weeks (54, 55). In an NP world, more dams would be removed, and new dam proposals would need to undergo a "nature veto", proving they would not harm ecological integrity.

BOX 2 Tropical rainforests—vital Nature Positive actions at the biome level

Maintaining and restoring tropical rainforests of the Amazon, Congo Basin, and Southeast Asia regions is critical to "Nature Positive" (NP) actions owing to their roles in carbon sequestration and storage and the enormous number of species they harbor. The first two also play a vital role in rain generation at the continental scale.

Amazonian rainforest generates a significant part of its own rainfall through moisture recycling (56), but estimates suggest this only occurs if the overall forest cover is 75–80% intact (57). The Amazon Basin is already about 17% deforested (58) and under pressure from global warming (59). Its irreversible transition into savannah-like vegetation would greatly affect rainfall patterns and persistence of the remaining forest and the species it supports (60), as well as the global climate (61).

Modeling indicates that losses of 23% forest cover would put these tropical forest biomes at risk of massive disruption, with potential disastrous effects on agriculture outside their basins (62–65). The Amazon provides rain to the La Plata Basin, the most productive agricultural area in South America (66), and as far away as Texas (67). Loss of this rainfall potentially threatens large-scale food security. Forest cover in the Congo Basin (65) also generates spring rains, with 80% of the atmospheric moisture coming from the transpiration of plants (68). This Central African rainforest is also a major source of rainfall to parts of East Africa (63). Moreover, the Congo is much drier than the Amazon and has larger peatlands—drying of Congo peatlands could the release of a vast amount of stored carbon into the atmosphere (69).

These are more than theoretical concerns. The much-degraded southeastern Amazon has already become a carbon source to the atmosphere (70), and at its southern edge, loss of 55% of the forest is causing nearby agricultural losses due to reduced rainfall (64). According to a recent assessment, human-caused changes in 40% of the Amazon rainforest have moved that part of the system to a bifurcation point where it could exist either as rainforest or savannah (71).

evidence that preserving and restoring nature is the most cost-effective and equitable means of preventing zoonotic spillover (72–74), current public health strategies prioritize biomedical interventions over ecological prevention measures (73). Additionally, the degradation of natural systems has serious mental health consequences, contributing to eco-anxiety among the general population (75, 76) and negatively impacting Indigenous communities whose cultural and spiritual well-being is deeply tied to their environments (77). Conversely, access to nature improves physiological, mental, and cognitive health (78). Recognizing these interconnections, over 200 medical journals jointly called on world leaders and health professionals to address climate change and biodiversity loss as a single, indivisible crisis that must be tackled together to preserve human health and avoid catastrophe (79).

The economic implications of environmental degradation are equally severe. The global economy is embedded in the biosphere (80) and fundamentally dependent on a stable Earth system, which, in turn, is sustained by a healthy biosphere (81). Half of global economic activity, including food production, relies directly on nature (82), and the continuing decline of biodiversity threatens financial stability worldwide (83). The most vulnerable communities suffer disproportionately when nature's ability to provide essential services deteriorates (84).

The very conditions that have made modern human civilizations possible are now unraveling. The Holocene Epoch—the stable, warm, interglacial period spanning the past 12,000 years—enabled the rise of sedentary societies and global development. However, since the mid-20th century, human exploitation of the environment has accelerated, ushering in the Anthropocene, an era in which humanity has become the dominant force driving planetary change (85). We are destabilizing critical components of the Earth system, particularly biodiversity and the climate (3, 86, 87). Our ongoing actions have the potential to push the planet into a new self-reinforcing "Hothouse Earth" state (88), rendering the Earth increasingly hostile to human life (88). Our impacts have placed humanity at such risk that the United Nations (UN) Secretary General has called our collective actions "suicidal" (89).

To provide a coherent and hopeful response to the crisis, international environmental, non-governmental, and business organizations issued a call to the 2020 UN General Assembly to establish a "Nature Positive" (NP) global goal for nature (90). This goal was proposed for use by the Convention on Biological

Diversity (CBD) to complement the UN Framework Convention on Climate Change (UNFCCC) Paris Agreement's carbon-neutral "net-zero" target for climate change and the Sustainable Development Goals (SDGs). In April 2021, NP was formally defined as a goal to halt and reverse nature loss by 2030, relative to a 2020 baseline, to ensure full recovery of nature by 2050 (91). The G7 leaders subsequently endorsed NP as a core objective in their 2030 Nature Compact (92).

The Kunming-Montreal Global Biodiversity Framework (GBF) was adopted in December 2022, and it included the NP global goal of halting and reversing biodiversity loss by 2030 on the way to achieving the GBF's vision of restoring a healthy planet and achieving harmony with nature by 2050 (93). However, this, in isolation, is not enough. It is now widely acknowledged that nature conservation and restoration contribute to climate change mitigation and adaptation and that biodiversity and climate objectives must be addressed together (94–96). Notwithstanding the clear connection, international climate and biodiversity treaties have historically operated in isolation (97).

However, parties have now taken steps toward an integrative approach. The 2023 Global Stocktake agreed at the 28th Conference of the Parties (COP28) to the UNFCCC in Dubai (98) recognized the importance of conserving biodiversity in line with the GBF to achieve the Paris Agreement temperature target. Similarly, the GBF's lack of a clear commitment to support climate goals was substantially remedied by the CBD COP16 Cali decision on biodiversity and climate change in 2024 (99). It calls on CBD parties to maximize potential synergies between biodiversity and climate actions, including prioritization of the protection, restoration, and management of ecosystems and species important for the full carbon cycle. Although efforts to agree on a roadmap to halt global deforestation failed at COP30 in Belem (100), there was greater integration of nature at this climate COP than previously. These important developments are a recognition that both treaties operate in the context of the Earth system.

This article is the first to take an interdisciplinary, intercultural, and integrated approach to examining what is needed to achieve the NP goal on land and in freshwater, as well as in the ocean. Specifically, our analysis focuses on:

- Assessing how NP aligns with the SDGs, Paris Agreement, and GBF and discussing how these existing frameworks could contribute to Earth system stabilization.
- Proposing a holistic NP framework and global-scale metrics spanning all aspects of biodiversity (natural processes, ecosystems, and species) using the Three Global Conditions for biodiversity conservation and sustainable use framework and extending it into the marine realm.
- Recommending alignment of GBF, Paris Agreement, and SDG reporting mechanisms.
- Describing an economic transformation that integrates NP principles while ensuring equitable human development.
- Highlighting the importance of the ways of knowing (sometimes called traditional knowledge systems) of Indigenous peoples and local communities to achieving the NP goal.

Nature Positive and Earth system stability: Sustainable Development Goals, Global Biodiversity Framework, and planetary boundaries

Human development and climate goals cannot be met without a healthy, diverse, and resilient natural world. This section explores these interdependencies and clarifies how the NP global goal aligns with key international development and climate instruments, identifies gaps, and provides a foundation for a more integrated approach to achieve an equitable, nature-positive, and carbon-neutral world.

Nature Positive and the Sustainable Development Goals

The SDGs are a set of biophysical, social, and economic normative goals that seek to end poverty, protect the planet, and ensure peace and prosperity for all by 2030 (101). They have been described as universal, interconnected, and inseparable and are of equal importance, balancing the economic, social, and environmental dimensions of sustainable development (102). Thus, economic goals such as promoting inclusive and sustainable economic growth, employment, and decent work for all (SDG 8) and building resilient infrastructure, promoting sustainable industrialization, and fostering innovation (SDG 9) are placed on equal footing with fundamental human survival needs like food security (SDG 2) and access to clean water and sanitation (SDG 6) as well as environmental imperatives such as climate stability and maintaining life on land and in water (SDG 13, 14, and 15).

When social, economic, and environmental goals are expressed as equal and competing, the SDGs are viewed as seeking the "sweet spot" where they overlap and converge (Figure 1, left side). Fundamentally, this is a conceptual failure: the SDGs may be of equal importance politically, but they are not so in reality.

The Earth system existed for billions of years before humans emerged. Human life, and thus all human development goals, are wholly dependent on the Earth system operating in a way that is favorable to humanity. The various SDGs are simply not of equal importance: those that support the Earth system underpin all human activity (SDG 13, 14 and 15), and humans cannot exist without a conducive Earth system that creates food and water (SDG 2 and 6); the economy was invented by and cannot exist without humans—it cannot thrive unless human society has food, water, health, institutions, and skills sufficient enough to support it (103–105).

Therefore, a more accurate framework acknowledges a hierarchical relationship in which the environment forms the foundation for human society, and the economy exists as a subset of society that must serve human interests (106–108), as illustrated in Figure 1, right side. This perspective aligns with early sustainable development principles that recognized biodiversity, ecosystems, and natural processes as an indispensable prerequisite to sustainable development (103). Addressing the SDGs in that light is now more urgent than ever. The NP paradigm embodies this conceptual shift.

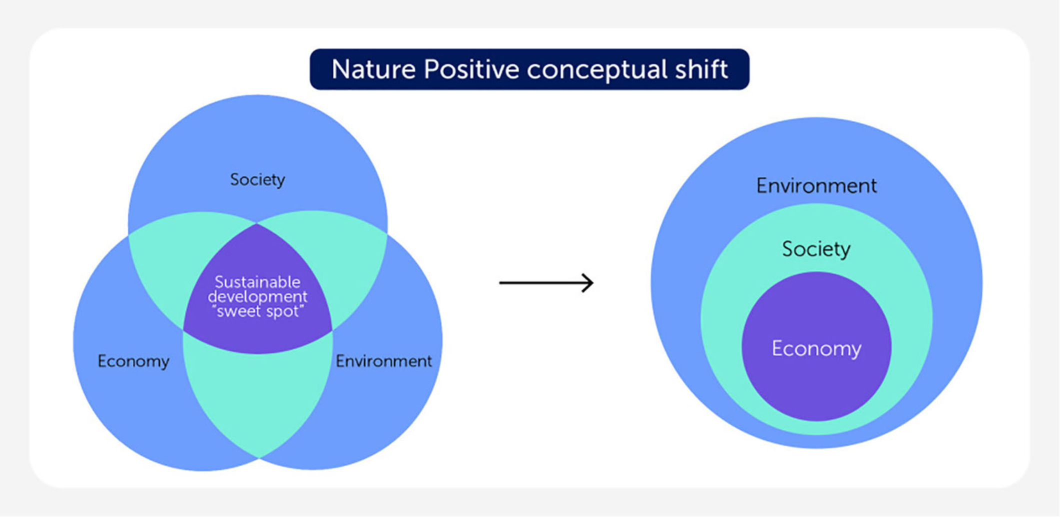

FIGURE 1
"Nature Positive" (NP) involves a conceptual shift from viewing the environment as a competing interest with society and the economy to recognizing it as the context for all human activity. This shift realigns the Sustainable Development Goals (SDGs), moving from the search for the "sweet spot" of overlap between the environment, society, and the economy (left side) to a hierarchical relationship in which the environment is recognized as the context for all aspects of human existence and the economy is understood as a subset of society, existing solely to serve human interests (right side).

Nature Positive and Earth system science

The Earth system comprises the atmosphere, hydrosphere (including the cryosphere), geosphere, and biosphere. The biosphere emerges from interactions among the other three spheres and, in turn, influences them. These feedback mechanisms regulate planetary resilience by buffering stress and shocks (i.e., solar radiative forcing and volcanic eruptions), thereby maintaining equilibrium. The most recent equilibrium state, the Holocene epoch, allowed sedentary civilizations to develop and large human populations to flourish (Figure 2A).

This stable state, however, is now threatened by global human pressures on the Earth system, ushering in the Anthropocene (109). We see more frequent and intensified extreme events (e.g., droughts, floods, heat waves, fires, and disease outbreaks), while we are gradually eroding the biosphere of its life-support capacity, pushing Earth system boundaries toward multiple tipping points (59). Sixteen biophysical and climate tipping points have been identified where self-reinforcing feedback loops threaten to drive irreversible state shifts, ultimately altering the state of the entire planet (Figure 2B) (59). Examples include the transformation of rainforests into savannah-like landscapes due to moisture loss (Box 2), the rapid melting of the Greenland Ice Sheet, and the collapse of tropical coral reef systems.

The Planetary Boundaries Framework emerged from understanding Anthropocene pressures, the risks of crossing tipping points, and the evidence that nature is a precondition for a stable Earth system (110, 111). Nine planetary boundaries that regulate the function and stability of the Earth system have been identified. Humanity's actions have now transgressed seven of them, namely the two core boundaries of biodiversity and climate, together with those for land system change, altered biogeochemical cycles for nitrogen and phosphorus, freshwater change, changes to both blue water (runoff water) and green water (soil moisture), novel entities [human-created chemical compounds, e.g. per- and poly-fluoroalkyl substances (PFAS), persistent organic pollutants (POPs), and microplastics] (3), and, most recently, ocean acidification (112). These crossed boundaries indicate that the Earth is losing resilience and is in a state of internal stress unprecedented in human history (113). In addition, control variables exist but have not yet been quantified for high-seas deoxygenation and ocean heat absorption, which are further exacerbating instability. The Planetary Boundaries Framework is a diagnostic tool providing a dashboard for a safe operating space for humanity on Earth; it does not, however, prescribe solutions or define normative goals (114). NP is the necessary normative goal and pathway derived from Earth systems science that provides a safe landing for humanity within the living biosphere. Combined with carbon emissions reductions, it seeks to return the Earth system to Holocene-like stability by halting the loss of intact nature and transforming nature-negative impacts into nature-positive feedbacks (Figure 2C).

Nature Positive and the Global Biodiversity Framework

The GBF is the primary global agreement that relates to nature and is broadly analogous to the Paris Agreement on climate, although it is not binding in its own right. Both agreements were reached under Rio Framework Conventions (CBD and UNFCCC). The GBF consists of an overarching 2050 vision, an actionable 2030 mission, and specific targets to be achieved by 2030. Its mission is to halt and reverse biodiversity loss by 2030 as a pathway to the 2050 vision of humanity living in harmony with nature, ensuring a healthy planet that provides benefits for all. The GBF promotes cohesiveness and

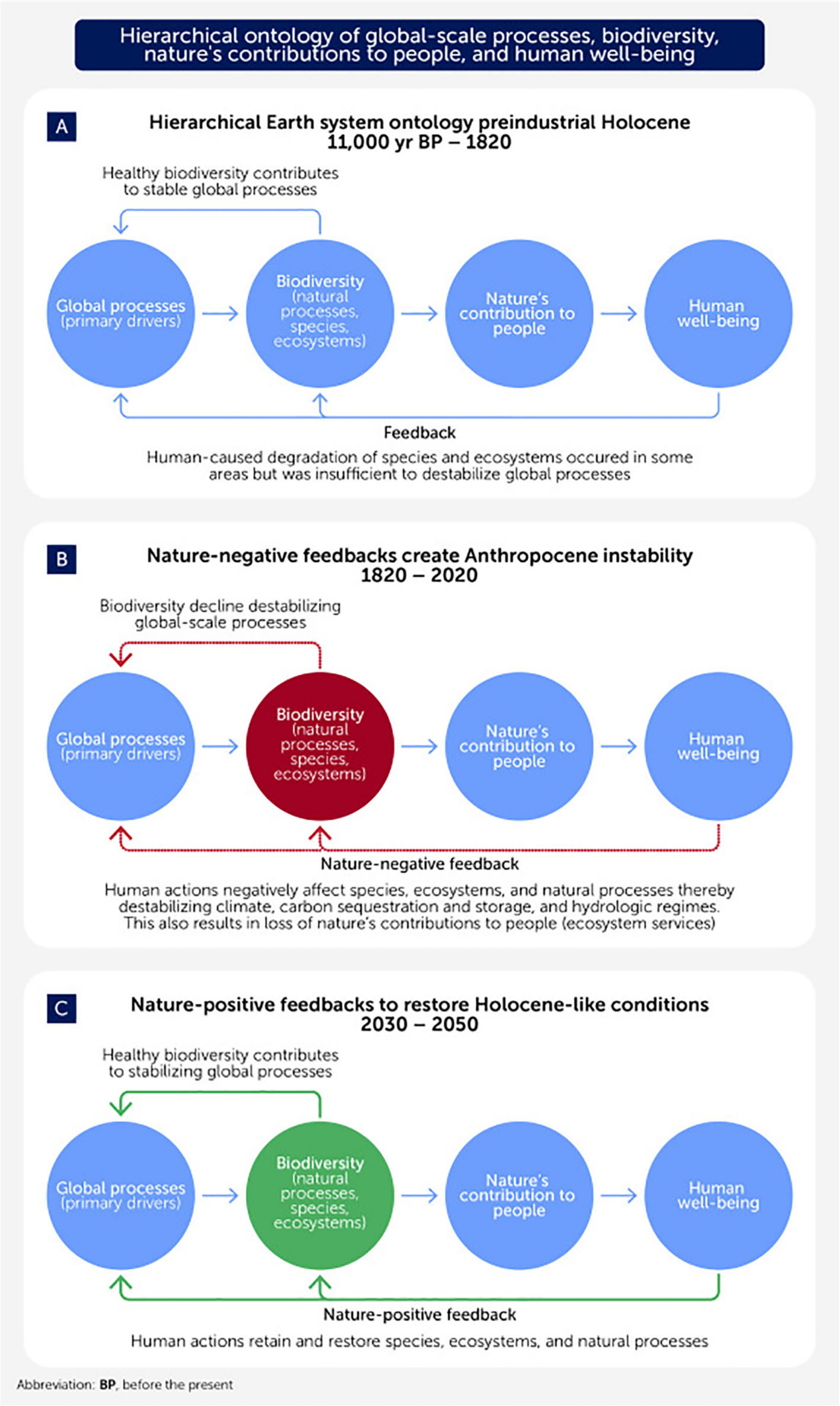

FIGURE 2
Hierarchical ontology of global-scale processes, biodiversity, nature's contributions to people, and human well-being. **(A)** Holocene conditions; **(B)** Anthropocene conditions, during which nature-negative human feedbacks destabilize the Earth system; **(C)** "Nature Positive" actions to halt and reverse biodiversity loss, combined with climate actions to reduce fossil fuel emissions, are needed to restore stable Holocene-like conditions.

complementarity among international agreements (93)[1] and integrates the Rio Declaration on Environment and Development (93),[2] which calls for a global partnership to protect and restore the health of the Earth's ecosystem (115). The GBF also calls for

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[1] Section B, Global Biodiversity Framework.

[2] Section C, Global Biodiversity Framework.

alignment with the SDGs (93) and the One Health approach, which recognizes the link between human, animal, and environmental health (116). To achieve the GBF's 2050 vision, Rio Principle 7, and One Health, we must stabilize the Earth system.

GBF implementation is based on a comprehensive framework that includes monitoring, financial resource mobilization, and an agreement on digital sequence information to support shared benefits from the use of genetic resources. While implementation occurs at the national level through the 196 country parties, the GBF also calls on subnational governments, civil society, business, as well as Indigenous and local communities to participate in a whole-of-society approach.

The GBF's mission of halting and reversing biodiversity loss by 2030 is the NP goal in all but name. Its 2050 goals reinforce this alignment: Goal A calls for the integrity, connectivity, and resilience of all ecosystems to be maintained, enhanced, or restored, thereby substantially increasing the area of natural habitat (93). Goal B calls for biodiversity to be sustainably used and ecosystem functions and services to be maintained and restored. Goals C and D address equitable distribution of benefits, increasing financing, and aligning financial flows with the GBF. While the GBF's goals effectively address many aspects of the 2030 mission, its targets are silent on key elements necessary to meet the GBF's mission, vision, and overarching objective of complementarity with other international agreements. The major shortcoming is a lack of attention to natural processes at all scales. Ameliorating this gap does not require amendment of the GBF, but complementary attention by all actors as discussed below.

Another area requiring focused attention is ocean governance, as there is disagreement over whether the GBF covers areas outside of national jurisdiction, which is almost two-thirds of the global ocean. The Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ) under the UN Convention on the Law of the Sea (UNCLOS) is a much-needed complement to the GBF. Its general objective is conservation and sustainable use of marine biodiversity, and it creates a framework for marine protected areas (117). Its specific objectives include building resilience to the adverse effects of climate change and ocean acidification and maintaining and restoring ecosystem integrity, including carbon cycling, in order to underpin the role of the ocean in the climate system. If implemented effectively—through measures such as protecting at least 30% of the ocean and ensuring sustainable fishery management—it could contribute significantly toward the development of an NP world (118). Recognizing this, at the Conference of the Parties (COP16) to the Convention on Biological Diversity (CBD), the Parties decided to "explore opportunities for addressing the ocean-climate-biodiversity nexus in an integrated manner". This integration is urgently required.

Implementing and measuring Nature Positive conservation

In this section, we outline a framework for implementing conservation actions for natural processes, ecosystems, and species, and we present metrics for measuring progress toward the NP global goal.

The scope of the NP global goal was originally described in 2021 as follows:

> *Nature-positive includes a focus on species distribution, abundance, functional traits, genetic diversity, and demographic trends as well as the intactness and integrity of ecosystems and biomes. It also includes the functioning of ecological and global processes such as hydrology, rainfall patterns and migration…. Together these provide a resilient planet able to cope with shocks and stresses without crossing destabilizing tipping points…. Connecting the nature-positive goal to equity and carbon neutrality recognizes the fundamental connection between human development and the health of nature and the deep connection between nature, climate and Earth system stability* (91).

Here, we explore actions and metrics that address the full scope of the 2021 NP global goal. We note a variety of papers published since 2021 that deal with aspects of NP, including an additional proposed metric focused on staying within nature's carrying capacity (119). Useful approaches to measuring biodiversity in terms of patterns and quantification of genes, species, and ecosystems have also been identified (120). However, both biotic and abiotic natural processes must also be addressed to fully conserve biodiversity and contribute to a stable Earth system. We begin with some general principles.

General principles for Nature Positive actions and metrics

To move toward stabilizing the Earth system, the protection of intact nature is our most urgent goal. By "intact" we mean areas free of significant human-induced degradation, which often occur within the territories of local traditional communities and Indigenous peoples (121), and all remnants of primary ecosystems, whether large or small (122–124). Nature restoration is important but secondary to retaining intact nature because any further losses cannot be restored in the critical time we have left. Although tree planting is widely discussed as a climate solution because trees absorb atmospheric carbon dioxide (125), at the global scale, preserving existing intact ecosystems is far more effective for achieving net-zero emissions by 2050 than large-scale afforestation efforts (126–128). This is because most natural systems, when disturbed, lose a substantial portion of their above- and below-ground carbon stores, requiring decades to centuries to recover, which takes us far beyond the 2050 net-zero target (129). Retaining intact nature also maximizes Earth's resilience, which is crucial because climate pressures are already weakening ecosystems' capacity to absorb carbon (130). Remaining intact natural biomes are also vital for retaining rainfall patterns (Box 2), and healthy ecosystems support more species in greater numbers than degraded ones, resist invasive species, reduce pandemic risk (33, 131), and provide greater ecosystem services, such as clean freshwater.

That said, restoration is a primary and urgent strategy in areas of significant ecological degradation, such as New Zealand/

Aotearoa, Western Europe, many Mediterranean-type ecosystems, and in tropical grasslands and dry forests worldwide (132). Reforestation in tropical areas where forest cover has been reduced can rapidly restore some aspects of ecological function (132, 133). Restoration of species composition can improve ecosystem function and help meet carbon-management goals (134); however, this often takes longer than biomass recovery (135). Importantly, reforestation and afforestation are not necessarily synonymous with ecological restoration (136). A singular focus on tree planting for climate mitigation instead of a thoughtful focus on restoring ecosystem composition and protecting native species risks failing both biodiversity and climate goals (137). In two cases, reducing just one human pressure can result in important improvements in species diversity and populations, ecosystem health, and natural processes: (1) discontinuing fishing in ocean areas with minimal human modification (118, 138, 139) and (2) reducing continuous grazing pressure from domestic animals on grasslands that have not yet undergone phase shifts (140).

Establishing baselines is essential for measuring progress (141). The NP global goal is a net improvement in ecological conditions from a 2020 baseline by 2030. The 2020 baseline was set because that is when the last set of conservation targets under the preceding CBD's Aichi Biodviersity Targets expired, and the new GBF was to be negotiated, before the process was delayed by the COVID-19 pandemic. Achieving the NP goal by 2030 does not require every natural process, ecosystem, or species to have improved by 2030. However, it does require that, in aggregate, human actions across the Three Global Conditions Framework (3Cs) have secured the existing intact nature and that substantial ecological restoration actions are underway, so that nature is in better condition in 2030 than it was a decade earlier.

Here, we apply the 3Cs as a practical approach to achieving both the GBF goals and targets and the necessary complementary NP actions that address natural processes.

The Three Global Conditions Framework for implementing the Global Biodiversity Framework and complementary Nature Positive actions

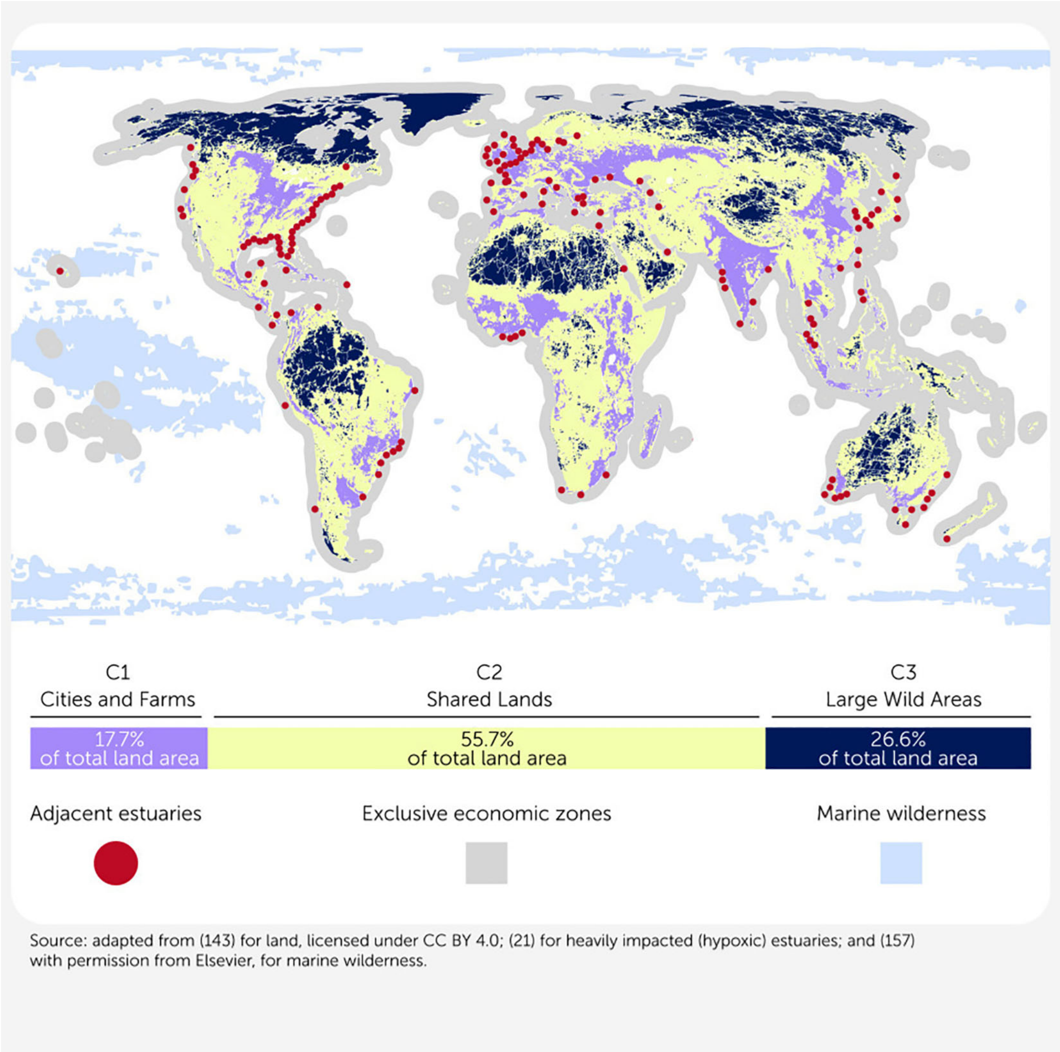
The GBF's targets for actions to protect, restore and sustainably use biodiversity are as follows: reduce loss of intact areas to near zero (T1); restore 30% of degraded areas (T2) and protect and conserve at least 30% of land, freshwater, and ocean in an interconnected way (T3); reduce species extinction risk and curtail unsustainable use (T4, 5, 6, and 9); reduce pollution (T7); address climate impacts on biodiversity (T8); improve sustainable practices for agriculture, aquaculture, wild fisheries, and forestry (T10); and maintain nature's functions and contributions to people or ecosystem services (T11). While the GBF sets global targets that each party will implement in accordance with its own national circumstances (93), it provides no guidance on which of the many required actions apply most effectively in the highly variable conditions that exist among and within countries. For example, while half the world has been transformed by human activity, this transformation is unevenly distributed (142).

Nonetheless, the GBF targets and supplemental NP actions addressing natural processes can be implemented systematically by categorizing the world into three "conditions" of human impact: (1) "Large Wild Areas" with very low human impact (termed Condition 3 or C3, approximately 26% of the terrestrial world), (2) "Shared Lands" ranging from slightly to less than half transformed by human activity (termed C2, approximately 55%), and (3) "Cities and Farms" where land is more than half to entirely transformed (C1, approximately 18%) (Figure 3) (143).

The 3Cs framework has been recommended by multiple expert bodies and institutions, including by: the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and Intergovernmental Panel on Climate Change (IPCC) as an effective approach to integrating climate and nature actions (95, 144); experts engaged by the CBD as an effective approach to implementing GBF targets in an integrated way (145); African scientists as an effective way to integrate biodiversity targets from local to global levels (146); economists as the most cost-effective means of implementing the 30 × 30 protected and conserved areas under GBF T3 (147); the Dutch Central Bank as an efficient way of reconciling conservation, climate, and food security goals (148); and zoonotic disease experts as an effective way of sorting ecological countermeasures to prevent pandemics (30, 33). It has also been recognized as an approach to support governance that achieves co-benefits alongside social, biodiversity, and climate objectives (149).

For too long, the ocean, freshwater, and land have been treated as separate domains, which has resulted in a fragmented approach to an integrated challenge. For example, no discussion of mangrove conservation is complete without addressing freshwater hydrology and sediment transport (49). Similarly, no effort to remedy oxygen-depleted "dead zones" in marine estuaries is of any value unless it examines harmful terrestrial inputs into freshwater systems (13). Similarly, coral reefs can either be adversely affected by sediments and nutrients from anthropogenic causes or enhanced by background levels of natural nutrients from land (150). Further, the rapid changes in ocean temperature, chemistry, currents, ice cover, foundation species, and fish biomass are cause for alarm. We must therefore pay urgent attention to both reducing stressors and increasing conservation measures across the marine realm. In this article, we seek to remedy the artificial separation of ocean, freshwater, and land by extending the 3Cs approach across all three, allowing for a more holistic and integrated approach.

Human impact on the ocean differs from that on land; the 3Cs approach is not directly transferable except in the case of estuaries immediately adjacent to cities and farms, with C1-level physical impacts (151). However, fisheries-related impacts are analogous to habitat loss on land due to bottom trawling and severely reduced large-bodied fish populations (152–154), which have resulted in ecosystem-level impacts (153, 155, 156). Thus, in the marine context, C1 applies not only to estuaries but also to the 12 nautical mile (22.6 km) territorial waters of most countries, which have been extensively modified by human actions but still retain fragments of semi-intact nature. C2 can be applied to the remainder



Source: adapted from (143) for land, licensed under CC BY 4.0; (21) for heavily impacted (hypoxic) estuaries; and (157) with permission from Elsevier, for marine wilderness.

FIGURE 3
The Three Global Conditions Framework (3Cs) for simultaneous conservation and sustainable use strategies applied to land, freshwater, and ocean. Adapted from (143) for land, licensed under CC BY 4.0; (21) for heavily impacted (hypoxic) estuaries; and (157) with permission from Elsevier, for marine wilderness.

of the exclusive economic zones (200 nautical miles) and most of the high seas, where fishing that includes bottom trawling has depleted fish stocks and removed large-bodied fish (152, 155, 158) but where some high-biomass areas with low fishing pressure remain (159). Only the Arctic and Antarctic, which have been protected by large ice sheets, and only the most remote parts of the open ocean (approximately 13%) are “marine wilderness”, a condition analogous to C3 large wild areas on land (157).

The 3Cs framework provides a structured approach for implementing NP actions tailored to the human impacts and resulting ecological and biophysical characteristics of each condition (Figure 3). It is not a prioritization scheme but rather provides coherent points of departure for simultaneous conservation and sustainable-use actions appropriate for each condition, because nature matters everywhere.

Maps of the terrestrial 3Cs for every region and country are found at naturebeyond2020.com. We hope this initial integrative work might stimulate more thorough mapping of the 3Cs in the ocean.

Actions and metrics for natural processes, species, and ecosystems

There are well-known and effective strategies for biodiversity conservation, many of which are found in the GBF. Here, we discuss those actions and metrics necessary to measure progress toward the NP global goal and the GBF’s vision, goals, and targets across the 3Cs. We also identify gaps in the GBF (Table 1).

Large-scale natural processes

Large-scale natural processes relate to the dependence of ecosystems and species upon, and their interactions with, the abiotic component of the Earth system at scales that affect planetary health and functioning. NP actions targeted at species or specific ecosystem types alone are not sufficient to retain overall structure and function. For example, in large intact areas, GBF species and individual ecosystem targets could be met in isolation, but the entire biome could still collapse. This could result in not only the loss

TABLE 1 Global-scale “Nature Positive” (NP) actions and metrics, and their alignment with Global Biodiversity Framework (GBF) goals and targets, applied across the Three Global Conditions Framework (3Cs) using Conservation Imperatives (160), International Union for Conservation of Nature (IUCN) Red List of Threatened Species (161), IUCN STAR Metric (162), IUCN Green Status (163), and Mitigation Hierarchy (123).

	Actions	Metrics	Goals and targets
C1 – Cities and Farms	**Species level**		
	Conservation Imperative sites are secured	All identified *Alliance for Zero* extinction sites/ Conservation Imperative sites are under effective management to secure the target species	Goal B; Target 3, 6
	All species at risk are in the recovery process	Species moves in a positive direction along the Red List continuum: Species Threat Abatement and Restoration (STAR) metric	Goal A; Target 4
	Connectivity is retained or restored	Some structural connectivity is in place in streams and among terrestrial habitat patches	Goal A; Target 12
	Ecosystem level		
	Retain all patches of native vegetation (land and estuaries)	All patches are inventoried and secured 20% of native vegetation is restored with particular attention to pollinator habitats	Goals A, B; Targets 10, 11
	Superabundant species and exotic species are managed	Exotic and superabundant species are controlled to reduce ecosystem harm and disease risk. New exotic species are controlled quickly	Goals A, B; Targets 6, 12
	Agricultural waste and chemicals (nutrients and pesticides) are kept out of freshwater, streams, and wetlands	No nutrients, herbicides, or pesticides are detectable in freshwater systems	Goal A; Target 7
	There is good urban planning to prevent sprawl and keep the best farmland in production	The best farmlands are retained; there is no increase in area under cultivation	No Goal; Target 10
	Provide people with access to nature for mental and physical health	Equitably distributed, convenient access to green and blue spaces is realized	Goal B; Target 12
	Natural processes		
	There is safe travel for migratory birds and marine life and secure migratory stopovers and nesting sites	All migratory stopover and nesting sites are inventoried and secured Safe travel for birds is increased by reducing collision risk (turning off unnecessary lights in buildings) and controlling domesticated cats Fishing nets are managed to avoid interfering with migratory marine species	Goals A, B; No target
	Hydrological processes are retained and improved; restoration of all four dimensions of freshwater connectivity is carried out as much as feasible	Development on floodplains is halted and reversed where feasible No new dams appear and/or dams are removed where appropriate Seasonal sediment transports return to natural patterns	Goals A, B; No target
	To secure carbon sequestration and storage, all mangroves, seagrasses, and wetlands are retained and restored, and patches of native vegetation are retained (see ecosystem-level actions)	Areas of mangroves, seagrasses, and wetlands increased with good hydrological connectivity	No goal; no target
C2 – Shared Landscapes	**Species level**		
	All species at risk are in the recovery process	Species at risk increased to a minimum population size of 500	Goal A; Target 4
	Missing keystone species are reintroduced	Missing keystone species are assessed and the reintroduction process has begun	Goal A; No target
	Harvest levels do not diminish current patterns of abundance or distribution	A species’ status does not fall below its current Red List status or Green Status	Goal B; Target 4 Red List; No target; Green Status
	Ecosystem level		
		Species levels are assessed for Green Status function and secured; harvest levels are consistent with goals	Goals A, B; Target 9 (partial)

(Continued)

TABLE 1 Continued

	Actions	Metrics	Goals and targets
	All native species currently performing ecological functions remain at current levels of abundance or increased if needed		
	Retain all native vegetation (land and estuaries)	No new areas are cultivated All primary ecosystems are retained	Goal A, B; Targets 1, 3, 8
	Industrial resource extraction (mining, logging, oil, and gas) discharges no sediments out of season or pollutants into watercourses	Water quality, sediment load, and timing are adhered to	Goal A; Target 7 (partial)
	Exotic species are eliminated or controlled Superabundant species are reduced	Exotic species are eliminated to reduce ecosystem harm Superabundant species caused by loss of predation are reduced in number to reduce ecosystem harm New exotic species are controlled quickly	Goals A, B; Targets 6, 12
	Further cultivation is prevented	There is no increase in area under cultivation	Goal A; Target 10
	Ecosystem connectivity and core habitats are secured through an ecologically representative and interconnected system of protected and conserved areas covering at least 30% Protected and conserved areas are managed effectively and governed equitably	Key biodiversity areas are identified Protected or conserved areas, as well as functional connectivity, are present for all species Indigenous and local communities are properly engaged At least 30% of land, freshwater, and ocean is effectively protected or conserved to achieve equivalent outcomes to protected areas, with effective management and equitable governance	Goal A, B; Targets 3, 8
	Gaps in ecosystem connectivity are mitigated	Wildlife crossings are built to mitigate infrastructure (trains, roads, and dams), so functional connectivity is restored There is no isolation of minimum viable populations (500 individuals) from their meta population	Goal A, B; Targets 2, 3, 4
	Domestic animal grazing levels are managed appropriately	There are appropriate stocking rates to maintain good range conditions Domestic animals are kept out of streams and wetlands	Goal A; Target 2
	Natural processes level		
	All migratory breeding and wintering sites, migration patterns within the ecosystem, and continental stopovers are secured	All migratory patterns, stopovers, breeding, and wintering sites are inventoried and secured	Goals A, B; No target
	Large-scale hydrological processes are retained and improved There is retention and restoration of all four dimensions of freshwater connectivity	There are no new dams and there are dam removals Seasonal sediment transport is kept at or returned to natural patterns	Goal A, No target (except Target 2 restoration)
	There is efficient carbon sequestration and storage All primary ecosystems are retained and secured	There is no old-growth logging There is no new cultivation	No goal; no target
	There is sustainable resource extraction	Existing disturbance footprint is the primary focus of operations but where new impacts are unavoidable, the Mitigation Hierarchy framework should be followed and overall landscape context improved	Goal A; Target 10
	Water flow is retained with enough energy and volume to drive ecosystem structure	A minimum of 80% natural water flow is retained or restored	Goal A; No target (except Target 2 restoration)
	Sediment flows follow normal seasonal variability	There is no discharge of sediment from roads, railways, or industrial resource-extraction sites outside of natural seasonality	Goal A; No target

(Continued)

TABLE 1 Continued

	Actions	Metrics	Goals and targets
C3 – Large Wild Areas	**Species level**		
	All abundant species are retained and perform ecological functions	Harvesting rates are consistent with abundance All species are managed to Green Status 3 levels	Goal A; No target
	Species at risk are secured	All species at risk are identified with an action plan toward protection and conservation	Goal A; Target 4
	Ecosystem level		
	All species are able to move in existing natural patterns	There is no new fragmenting infrastructure (new dams, roads, and railways)	Goal A, B; Target 1 (accelerated)
	Ecosystems remain intact	There is no new resource extraction industry (logging, mining, oil, and gas)	Goal A, B; Target 1 (accelerated)
	Natural processes level		
	Biome function is secure	There is 80% tropical forest cover Migrations within biomes and across biomes are possible	Goals A, B; No target
	Hydrological processes are maintained in a wild state	No dams or roads are impacting wetlands or peatlands directly or indirectly There are no water diversions All four dimensions of connectivity are intact There are natural patterns of sediment transport and flooding	Goals A, B; No target

of the species and ecosystems that were intended to be conserved but also of hydrological and biome functions critical to humanity (Box 3).

These large-scale Earth system processes are essential to meeting the GBF's vision of a healthy planet and are implied in Goal B. They are also recognized in the "ecosystem approach" (164), which the GBF states should guide its implementation. However, large-scale natural processes are largely absent from the GBF's targets and indicators. They can be broken down into three categories:

- Abiotic hydrological processes: These are major drivers of ecosystem structure and carbon storage, influenced by biotic feedbacks.
- Intact biome functions: These drive global processes, such as rainfall, through the integrity of biotic and abiotic processes.
- Biotic migrations: These occur at the biome and global scales, are essential for maintaining ecological integrity, and have some abiotic effects.

BOX 3 Action at multiple biodiversity scales: example of the harpy eagle and Amazon Basin

All three interacting scales of biodiversity—natural processes, ecosystems, and species—need to be measured and addressed in a nature-positive manner. The harpy eagle (*Harpia harpyja*) in Amazonian forests illustrates this point.

The harpy eagle is a large apex carnivore of the tropical forest that preys on large arboreal mammals and nests on emergent trees. At the species level, we can assess its presence or absence and estimate whether its population is large enough for viability (minimum 500 breeding individuals). However, this alone is insufficient. As a top-down regulator, the eagle's presence and function are vital for maintaining forest health. It must be widely distributed across the forest to regulate herbivore populations and contribute to ecosystem stability (165). Therefore, both presence and ecological function must be measured, along with human-induced mortality rates (166).

Even if the eagle population appears viable based on individual counts, it cannot persist if its forest habitat or prey species are lost. For example, a 50% loss of forest habitat leads to reproductive failure (167). Moreover, the removal of tall canopy trees, essential for nesting, also reduces population viability, even if forest cover remains above 50% (168). But measuring ecosystem extent alone via remote sensing is insufficient; a species-level assessment is needed to determine whether harpy eagles and their prey are actually present.

Further, if we focus only on species and ecosystem assessments, we overlook key dimensions of natural processes. The Amazon rainforest spans multiple ecosystem types, and its hydrological processes are vital for forest survival. Two forest types, *várzea* and *igapó*, are floodplain forests covering 750,000 sq km and rely on seasonal flooding. Changes to hydrology caused by river channeling, damming, and water diversion threaten their structure, composition, and function (169). Heavily used by harpies, these ecosystems depend not only on local fluvial processes but also on hydrological connections upstream, as far as the Andes (Box 1).

Biome function is also critical to consider for harpy eagle survival. Moisture influx from the Atlantic Ocean initiates rainfall in the eastern Amazon, but forest evapotranspiration generates a significant portion of inland precipitation from there all the way to the Andean mountains (56). The forest recycled water is critical for maintaining upland forests, wet peatlands, as well as rivers and floodplains (170), which in turn support the rainforest ecosystem and frugivorous freshwater fish essential for forest regeneration. If more than 20% of the forest cover is lost, the rainforest could transition into a savannah-like state (57), resulting in the extinction of species like the harpy eagle and the collapse of many "tele-connected" ecosystems (171). This would not only devastate biodiversity but also disrupt agriculture, as the Amazon contributes to precipitation patterns across the Western Hemisphere, and would release vast amounts of carbon into the atmosphere (Box 2).

Hydrological processes

The GBF does not address hydrology. This is a major omission because freshwater regimes, unimpeded riverine connectivity, and unpolluted water are of such significance that maintaining or restoring hydrological processes, water quality, and associated floodplain and delta habitats is the most important NP action for a disproportionately wide variety of terrestrial, freshwater, and marine organisms (137, 172, 173).

Healthy running water ecosystems depend on the condition of their terrestrial watersheds (113) and vice versa. Big river systems, such as the Mississippi in the United States or the Brahmaputra, Tsangpo, Yarlung Zangbo, Jamuna, and Ganges system in South Asia, traverse substantially different biomes, making ecosystem-scale metrics inadequate for monitoring continental-scale structure or function. Rivers and streams embody the key elements of ecological connectivity, providing both unimpeded movement of species and flow of natural processes (174–176). Hydrologic connectivity at the ecosystem scale is particularly important to freshwater vertebrates, whose populations have declined by an average of 83% (177). Large-scale connectivity is also critical for a wide range of terrestrial and avian species that interact with river floodplains (178), and it directly influences water quality (179), sediment flows (180), and fish migrations (181).

Intact hydrological regimes are also essential to maintaining the vast carbon storage capacity of peatlands (42) and mangroves (46, 49) and retaining methane (37). However, river systems throughout the world have been significantly modified by dam construction (49, 182). Ostensibly built to supply low-carbon “green energy”, high-head hydroelectric dams are highly nature negative (Box 1).

Freshwater hydrological processes are not limited to water in rivers, lakes, and groundwater (blue water) but also include soil moisture (green water) (183). An essential part of the water cycle, soil moisture transforms into evapotranspiration (vapor flows) in all photosynthesizing terrestrial ecosystems. Green water stocks consist of the soil moisture that feeds all biomass growth. Green water flows are the total flux of vapor, including evaporation and transpiration, as well as interception. Accounting for 60–65% of annual global hydrological flows, they are key to ecosystem functioning and services, supporting food production, biomass on land, and carbon sequestration.

The function of intact forests in green water flows and the climate system is particularly important (121). Stomata (pores in leaves) regulate both water vapor and carbon dioxide (CO_2) exchange between a tree’s intercellular space and the atmosphere (184, 185), affecting both precipitation and carbon sequestration. Forests everywhere have a local cooling effect that is lost whenever they are removed (186). Tropical forests and mid-latitude forests to about 40° North also cool the global climate through evapotranspiration. Climate change also causes variations in green water outside normal seasonal cycles, which in turn leads to major reductions in the land carbon sink. (187).

Water vapor from forests is important to rain generation (188, 189). Extensive forest loss can disrupt precipitation patterns across continents (65, 113), heightening the risk of large-scale food insecurity and financial losses (64), especially in the tropics. Tropical forest losses are caused by forest clearing for commercial and subsistence agriculture, logging, charcoal production, and livestock grazing and by uncontrolled fire (190), dams, mining, overhunting (191), roads, and other linear clearings (67). Elimination of seed dispersers due to habitat loss and overhunting impairs forest regeneration (192) and causes declines in carbon storage (193). Deforestation (responsible for 75% of rainfall reduction) and global warming (25% of the reduction) have combined to reduce precipitation in the Amazon Basin by 16 mm per dry season while in areas with heavy deforestation (>28.5% cleared) the rainfall reduction is three times greater due to the added localized increase in temperature and drying (194).

At the global level, assessments of green water reveal dramatic, detrimental changes to the Earth’s water cycle (113), resulting in critically important structural and functional losses of species, ecosystems, and natural processes.

Hydrological actions and metrics

There are four dimensions of hydrologic connectivity to be addressed and measured for NP (12, 195):

i) Longitudinal connectivity: connectivity between upstream and downstream (river continuum concept) (196)
ii) Lateral connectivity: connectivity between channel, floodplain, and riparian areas (flood pulse concept) (197)
iii) Vertical connectivity: connectivity between groundwater and surface water (function of hyporheic zone) (198)
iv) Temporal connectivity: hydrogeomorphic change through short and long time periods (shifting habitat mosaic concept) (199).

Actions to halt and reverse the loss of connectivity in the world’s rivers align well with the 3Cs:

- C1 (heavily modified landscapes): All four dimensions are likely to be impacted, and restoration is NP.
- C2 (shared landscapes): Retaining existing and repairing impaired longitudinal, lateral, and seasonal connectivity is essential.
- C3 (intact landscapes): Keeping rivers wild and free-flowing is key (200).

An Earth system boundary metric suitable for NP has been developed for natural flows (201), with specific objectives for each of the 3Cs:

- C1: Retain and restore natural flows across landscapes and adjacent marine areas, reduce storm flash flows, and maximize green water retention to mitigate flood risk.
- C2: Aim for a minimum of 80% natural flow retention and restoration.
- C3: Preserve all natural flows in an unimpaired state.

Guidance on maintaining and measuring sediment flows is already available (202). Importantly, while continuing and restoring sediment transport is vital for healthy freshwater and estuarine systems (203, 204), human-induced sediment flux into freshwater systems can be harmful, especially outside normal cyclical seasonal flushes (205, 206).

A global green water planetary boundary metric indicates that no more than 10% of Earth's land area should deviate (in dry or wet direction) from its natural green water variability during the late Holocene (3, 113, 185). Today, 18% of Earth's terrestrial land area exceeds this boundary (3). We discuss this further under the sections *Biome function* and *Biome intactness actions and metrics.*

Biome function

A biome is a large-scale aggregation of related ecosystems (207) characterized by areas of vegetation of the same life form (208), and it is the largest biotic unit after the biosphere. Biome function, tied to intactness, affects continental- to global-scale processes. Despite the absence of biome-specific targets in the GBF, they are needed to achieve both the NP global goal and the GBF's vision.

Biome condition affects rainfall, with widespread effects on carbon storage, ecosystem health, and agricultural productivity, as discussed above and illustrated by Amazon and Congo Basin rainforests (Box 2). Maintaining and restoring forest cover at the biome scale is therefore a priority NP action. Forests are not the only areas where land-use changes affect precipitation. In Western Australia, the clearance of 13 million hectares of dry bush for agriculture using non-native species has directly reduced cloud cover and rainfall relative to areas with native vegetation (209).

The GBF lacks explicit targets or indicators for biome intactness, which should be an explicit conservation objective (210). Indirectly, T1 calls for land-use planning to stop the loss of areas of high biodiversity importance (including ecosystems of high ecological integrity) by 2030. However, action by 2030 is not sufficient. Some tropical forests are on the path toward a tipping point beyond which they may transition into savannah-like vegetation (Box 2). Given recent rates of tropical forest logging, 2030 is too late. Halting tropical forest cover loss and degradation everywhere must be an immediate top priority if these efforts are to protect these biomes, sustain their species and ecosystems, and ensure rainfall throughout the tropics and downwind agricultural regions.

Biome intactness actions and metrics

The best available metric for sustaining rainfall production in tropical forests is to maintain biome-scale forest cover, limiting losses to ≤20% of original primary forest extent (57) and ideally restoring losses to achieve 90% cover to increase resilience to climate change (211). However, some researchers are unwilling to identify any threshold of acceptable forest cover loss (194). For restoration, fast-growing species (including non-natives) aid initial rainforest recovery; the long-term NP goal is to use native slow-growing hardwood species (136, 212). More research is needed to establish a metric for dryland vegetation change.

Migrations

Migration is a specific kind of animal movement where species move between different habitat regions at different times of the year, usually driven by season (213). It has become an urgent conservation problem because not only are migratory populations in decline, but 58% of sites monitored by the CMS are under unsustainable pressure, and 399 endangered migratory species are not even listed for CMS protection (10). In North America, 419 native migratory bird species have experienced a net loss of 2.5 billion individuals since 1970 (214). These losses occur extensively in C1 areas caused by free-ranging domestic cats (mostly unowned) preying on migratory birds (215) and by migratory birds striking illuminated buildings at night (216).

Migration affects species health and diversity (217), ecosystem function and structure (9), and carbon storage in ecosystems (134). Migratory movements range from short seasonal shifts between small habitat patches to transcontinental intergenerational migrations, as seen in monarch butterflies (217). Therefore, conservation strategies focused solely on resident species are insufficient to protect migratory populations (9). Migration is also different from animal movements within a home range to establish a new home range or to find mates in a metapopulation. These all require connectivity but are not migrations (213). Similarly, the need for species to move their range in response to climate change requires connectivity (218), but is not migration *per se* (219), although climate change could lead to migratory range shifts (220).

Migration is not mentioned in the GBF except by implication through ecological and landscape connectivity, which are to be addressed at the country level (GBF T2 and T3) (175). While protecting ecological connectivity across a species' migratory range is essential for migration (10), species movements often transcend national boundaries. The lack of attention to migration is a material deficiency in the GBF because it applies to the CMS as well as to many countries that are not signatories to the CMS.

Migration actions and metrics

For many migrating species, there are well-established approaches to protecting habitats essential for critical life-history events, including wintering and stopover resting habitats, as well as breeding areas (10, 221). These conservation actions require species-specific assessments for NP actions to ensure that habitat patches and their connectivity enable safe breeding, rearing, and travel across a species' full migratory range (222). For sea turtles, for example, a structured conservation framework has been developed to secure their movements across terrestrial, nearshore, and high-seas environments, which could be adapted for other migratory marine animals (223).

Major losses of migratory birds through cat depredation could be substantially reduced by controlling cats in C1 areas (224), and mortality due to building strikes could be greatly reduced by turning off unnecessary lights at night (225). Regarding terrestrial connectivity, metrics to guide conservation efforts are available as outlined by Keeley et al. (226), while conserving hydrologic connectivity is of utmost importance due to its critical role in supporting both freshwater and terrestrial migratory species.

Ecosystem level

The CBD defines ecosystems as a dynamic complex of biotic (plant, animal, and microorganism) communities interacting with their abiotic environment (geophysical, climatic, and chemical processes) (227). Four elements define an ecosystem type: (1) characteristic native species, (2) abiotic environment, (3) key ecological processes and interactions, and (4) spatial distribution (228). While many mechanisms influencing species' vulnerability also apply at the ecosystem level, ecosystems embody natural processes that are not adequately captured through species-by-species conservation efforts (228). This underscores the importance of ecosystem-level actions in biodiversity conservation.

The ecosystem equivalent to species extinction is ecosystem collapse, which occurs when an ecosystem's inherent resilience is overwhelmed, resulting in a phase shift to a different and often novel ecosystem state (229, 230). An ecosystem collapses when one or more key defining variables are functionally impaired, including geomorphological features, species composition, nutrient cycling, disturbance regimes, ecological connectivity, and other biotic and abiotic processes. Vulnerability thresholds have been identified: ecosystems are considered at risk when 30% of their structure is degraded, functionally impaired at 50% degradation, and approaching collapse at 80% degradation (228).

Recently, there has been a discussion of the potential conservation value of novel ecosystems (231). New species assemblages, some of which may be exotic, could create new self-organizing ecosystems that have value for biodiversity conservation or ecosystem function. These emerging systems may warrant conservation attention, but a great deal of research remains to be done on them (232). The primary focus of NP conservation is retaining and restoring the composition and function of native ecosystems.

Some vertebrate species perform processes disproportionately vital to ecosystem function. These species act as ecosystem engineers or keystone species, regulating trophic cascades (e.g., wolves and sea otters), shaping vegetation structure (e.g., elephants and bison), or influencing hydrology and wetland formation (e.g., beavers) (166). Foundational species in nearshore marine environments (e.g., kelp and corals) play critical roles in preserving ecosystem structure (23). Fortunately, small and abundant species that are also vital to ecosystem function benefit from conservation actions that are aimed at suites of larger species through an "umbrella" effect (233), but attention should be paid to their demographic robustness as well (234). Conversely, invasive species can degrade ecosystems by displacing native species and disrupting natural processes.

Ecosystem actions and metrics

NP ecosystem goals will vary according to the 3Cs. C1 areas contain ecosystems that have already collapsed and can be described as crisis ecoregions (235). These landscapes support most of the human population and produce most of the world's food calories, so other important values are at play (143). While ecosystem restoration to full function is impractical under C1 conditions, all remaining fragments of primary ecosystems should be secured, and at least 20% native vegetation cover should be restored to support ecosystem services (236). This includes urban re-greening for multiple ecological and human benefits (237, 238), which is well covered in GBF T12. Agricultural chemicals are most common in C1 areas, which require practices that keep excess runoff out of waterbodies. Safeguarding areas of high agricultural productivity through prevention of urban sprawl serves as an indirect NP practice, preventing further degradation of C2 lands for marginal agriculture and contributing to the SDGs. Combined with improved agricultural practices, dietary adjustments, reduction of food waste, and better global fisheries management, the current cultivated land could feed a global population of up to 10 billion people (239, 240). Such a food systems shift can be done in a just, equitable, and NP manner that halts the loss of intact areas and includes restoration of marginally producing areas to forest cover (241).

NP actions in ecosystems that are less than 50% impaired (C2 areas) should prioritize retaining or restoring overall ecosystem integrity to well above 50%. This requires halting habitat degradation and fragmentation, preserving all remaining intact areas, and retaining and restoring natural abiotic processes, such as fire regimes and hydrology (242). GBF Target 3, which mandates interconnected conservation of at least 30% of land, sea, and freshwater, is particularly well-suited to C2 areas, and such networks will also support climate adaptation efforts (218). Large intact ecosystems (C3 areas) are often aggregated in biomes and should be maintained intact, which requires accelerated action under GBF Target 1.

Across the 3Cs, actions to protect and restore keystone, top-down regulating, and foundational species contribute to NP at the ecosystem level (166, 243). These species also provide positive feedback to the climate system by preventing carbon release and enhancing carbon sequestration (96, 134). Large carnivore and large grazer restoration efforts are best suited to C2 and C3 landscapes. Removals of invasive species can have positive effects across ecosystems (150) and improve green and blue water availability (244). Removing exotic species constitutes an NP action unless they have become part of a novel ecosystem that supports endangered species (245, 246); such exceptions will typically be restricted to C1 areas. Ecosystems also benefit from reducing populations of native generalist species that have become overabundant owing to their adaptability to human-dominated landscapes, the absence of predators, or confined ranges (247), which also aids in zoonotic disease prevention (28).

Species level

Native species are integral to the Earth system, and healthy populations with reliable access to food supplies are less likely to shed pathogens that cause disease in humans (33). The NP goal for species is to increase their distribution, abundance, functionality, and resilience, maintaining genetic diversity and preventing extinctions (91). In contrast, the GBF target for species only focuses on the latter two (T4) (248).

Worldwide, species are in decline due to habitat loss (the primary driver of species loss on land) and overharvesting (the primary driver of loss in the ocean). Other important drivers include industrial production processes, such as deforestation, mining, chemical pollution, cereal crops, and palm oil plantations, the expansion of marginal agriculture, deliberate and inadvertent introduction of invasive species (249), as well as global warming, which alters thermal conditions for species and habitat niches in ecosystems (250).

Species status varies significantly across the 3Cs. At-risk species exist in all three (251), but most are found in C1 areas (143). Moreover, species loss for C1 exceeds detectable presence as many large-bodied species have already been lost from these heavily transformed landscapes (86, 252, 253). In contrast, some largely intact C2 landscapes show remarkably complete faunal assemblages with robust genetic diversity still performing natural processes, such as migration (e.g., Serengeti-Mara). However, while C2 areas often have complete or near-to-complete faunal assemblages, they also suffer from species at risk, extirpations of some populations, declines within populations, and reduced genetic diversity (e.g., large mammals tend to decline first) (86). In addition, their aquatic integrity is often compromised by river damming. C3 areas, being the least disturbed, have few at-risk species, with the primary threat being overexploitation or climate change impacts. However, their sheer size, intactness, and inherent connectivity make them the most resilient of the 3Cs to climate change and least vulnerable to overexploitation (254).

Species actions and metrics

The NP goal to increase the distribution, abundance, function, diversity, and resilience of native species requires halting loss by maintaining intact species assemblages, increasing populations toward ecological functionality, and reducing extinction risk across the 3Cs (Figure 4).

This includes addressing overexploitation of species through enforced regulations or long-standing customary practices, preventing hyper-abundance of species that degrade ecosystems, implementing anti-poaching programs, and promoting active human–wildlife coexistence efforts everywhere.

Maintaining intact species assemblages

Healthy ecosystems that retain the full array of native species interacting with intact natural processes are of the greatest value to the Earth system. They also serve as a barrier against the spillover of potential pandemic-causing pathogens into human populations (131). Despite advances in ecological restoration and species recovery, there is no substitute for preserving original, intact systems. The NP goal of halting nature loss prioritizes the protection of all remaining intact ecosystems and species assemblages wherever they occur—whether in C3 areas, intact parts of C2 landscapes, or in remnant patches within C1 regions. While GBF T4 is silent on maintaining intact species assemblages and abundance, Targets 1 and 3 (spatial conservation) and Target 9 (preventing overexploitation) are aligned with this NP objective.

Restoring functional species populations

Achieving the NP goal of reversing nature loss by 2030 and fully recovering nature by 2050 requires thriving populations. Moreover, NP requires a focus on ecological processes, not just patterns of persistence. The common threshold of an effective population size of at least 500 (Indicator 4 for GBF T4) indicates reduced extinction risk but tells us nothing about whether the species is abundant enough to perform ecological processes at a scale that contributes to Earth system stability (9, 255). Similarly, counting species diversity as a metric of success is insufficient. High diversity of small-bodied species does not compensate for the loss of large vertebrates that perform keystone and regulatory functions such as predation, herbivory, and seed dispersal (243, 255).

The International Union for Conservation of Nature (IUCN) Green Status Framework (163) provides guidance for three NP metrics designed to ensure that species populations are large enough to sustain ecological function across landscapes and maintain resilience:

- Green Status 1 (GS1): The species exists in multiple interconnected populations, each with at least 500 individuals.
- Green Status 2 (GS2): The species is fulfilling its ecological role, with missing species reintroduced where feasible.
- Green Status 3 (GS3): The species exists in a representative set of ecosystems and communities throughout its historical range.

Progressively moving species along this Green Status continuum, from GS1 toward GS3, and maintaining them in a higher status is a contribution to NP (Figure 4). Some C2 systems are close to hosting intact large vertebrate assemblages, often missing only one to three species in the less impacted C2 regions. In such cases, reintroduction is relatively simple and could help move these ecosystems toward GS3 (256). Where species already exist in GS3 status (in many C3 areas), maintaining this state is essential to achieving the NP goal of halting biodiversity loss.

Reducing extinction risk (threatened species)

Preventing extinction is an urgent conservation priority, as the natural background species extinction rate has been greatly exceeded in the Anthropocene (257). Recovery of an extinct species is not yet possible and may never be. Conservation goals should therefore focus on reducing the extinction rate attributable to human activity, which exceeds the natural background rate (258). GBF T4 calls for halting human-induced extinctions of known threatened species and for their recovery and conservation, significantly reducing extinction risk. A key indicator for T4 is the widely used minimum viable population threshold of 500 individuals.

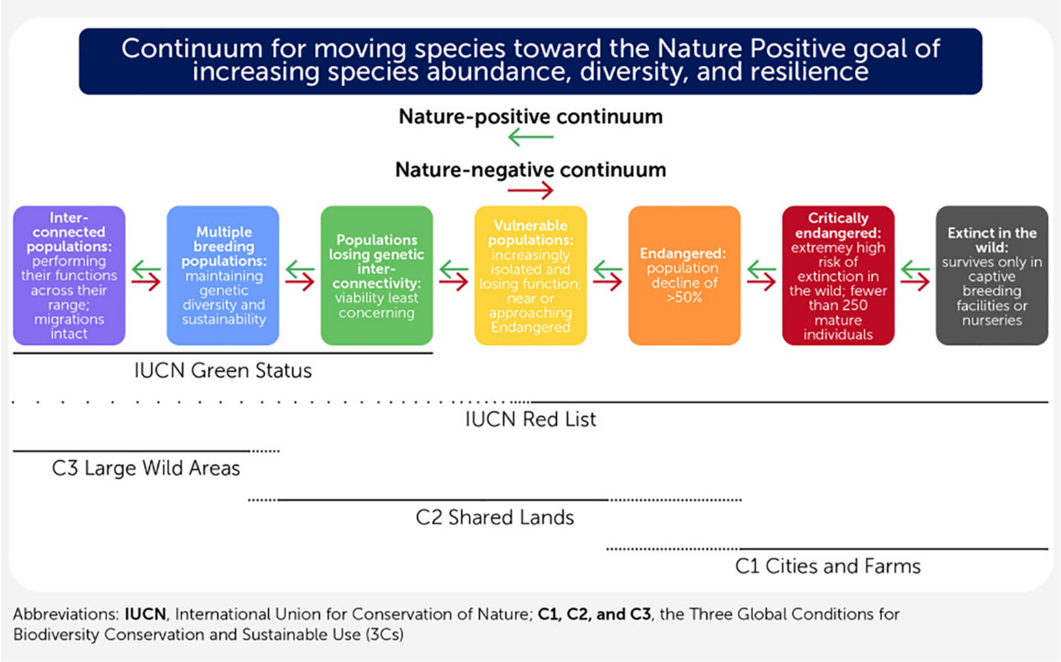


FIGURE 4
Continuum for moving species toward the "Nature Positive" (NP) goal of increasing distribution, abundance, function, diversity, and resilience of species and avoiding extinction. The present trend is either nature negative (i.e., moving species toward the right side of the continuum) or neutral (i.e., static on the continuum). Species on the far left-hand side are already contributing to NP, and their distribution, abundance, and function should be retained to halt biodiversity loss. Actions to reverse species loss and increase their distribution, abundance, function, diversity, and resilience will progressively move species toward the left. At the bottom, the likely location in the Three Global Conditions Framework (3Cs) of species relative to their status along this continuum is indicated. Controlling species exploitation levels is essential across all 3Cs.

The IUCN Red List remains the most comprehensive assessment tool for identifying and categorizing threatened species along a continuum from least concern to global extinction (161). NP-aligned actions for threatened species aim to progressively improve their status along this continuum. Moving each species up one category or more, in a ratchet-like manner, contributes to NP (Figure 4). A "Reverse the Red" campaign actively promotes this approach, emphasizing targeted conservation actions to improve a species' status (259).

A tool for measuring the progress of species toward nature positivity along the extinction risk continuum is the IUCN's Species Threat Abatement and Restoration (STAR) metric (162). Unlike the IUCN Green Status, which focuses on the functional distribution across a species' range, STAR emphasizes reducing extinction risk at specific sites and highlights opportunities for interventions to reduce extinction risk where they are greatest. The STAR system is particularly useful in C1 areas and in the more fragmented parts of C2. For an actor seeking to contribute to NP at the species level, STAR provides a multi-step assessment process that leads to an appropriate threat reduction strategy. The IUCN has published guidance on using the STAR metric to contribute to NP outcomes (260).

Protecting areas to avoid imminent extinction of rare, narrow-range, endemic, and threatened species is an important action under GBF T3, particularly in C1 areas. The Conservation Imperatives approach provides a guide for identifying such priority sites across all 3Cs (160).

Genetic diversity

Genetic diversity is essential for maintaining healthy populations of any size. It is inherently supported by many of the above actions. However, care must be taken to ensure that large populations of recovered species are genetically robust enough to retain resilience, which may require reintroducing genetic diversity (261).

Enabling social and economic conditions for a Nature Positive shift

We now move from conservation actions and metrics to enabling social and economic conditions necessary to achieve the NP global goal. We begin with diverse cultural perspectives, governance, and equity between the Global North and Global South.

Engaging diverse cultural perspectives in Nature Positive

Arising from contemporary empirical science, the NP approach incorporates a holistic understanding of life and a responsibility to act for the health of the planet. It positions human development as being embedded in nature rather than as a competing interest with it (Figure 1) and emphasizes the importance of considering the flow of natural processes over time at varying scales. But not all cultures are driven by empirical science.

Humans interacted with nature throughout the Holocene (262). Many ethnocultural traditions from South Asia, China, Africa, and Indigenous peoples worldwide converge in viewing humans as embedded ecological participants with relational responsibilities to live in balance and harmony with a dynamic natural world, rather than as having rights to exploit static natural resources (263–265). The NP approach is aligned with those cultural perspectives that provide a basis for a shared vision for humanity to live well while respecting nature's biological patterns and natural processes, as discussed further in *Nature Positive Society*, a companion paper to this article (266). Engagement on an equal footing with other cultures' relational and intrinsic values (267) will increase support for NP goals.

Other knowledge systems could also give rise to NP conservation approaches and metrics complementary to those we have outlined. For example, Indigenous and local communities often possess deep knowledge of the sustainability of their ecological contexts based on long-term observation and interactions. This can be embraced alongside empirical science through mutual respectful engagement in "ethical space", where the goal is reconciliation of knowledge systems to achieve NP (268).

Nature Positive governance reform

Meeting biodiversity, climate, and social goals contemporaneously will require greater integration of governance to carefully identify co-benefits, trade-offs, and co-detriments (149, 269) and is urgently necessary to avoid tipping points (270). Yet we lack strong global governance for sustainability. The CBD and UNFCCC/Paris Agreement are structured to place primary responsibility for implementation on state parties, although an International Court of Justice (271) advisory opinion has created the possibility for Global South countries that suffer adverse effects of climate change to sue for damages where a Global North country's failure to meet its commitments has led to direct harm.

In many countries, nature is usually the purview of an environment department rather than fully integrated into high-level decision-making processes, which is necessary if we are to meet global goals (92). Through systemic national-level integration, Costa Rica successfully halted and reversed biodiversity loss from 1990 levels (272). It is common in federal systems for provinces to control land use and, in some countries, for municipalities to govern large areas. Integration of national and sub-national governance, policies, and actions is essential and will be the focus of a global Nature Positive Summit in Japan (273).

Indigenous peoples' territories often have significant biodiversity, but frequently they have been marginalized from governance of those areas, contrary to the UN Declaration of the Rights of Indigenous Peoples (274). Power imbalances and lack of capacity can be addressed effectively and equitably (269) in a bio-cultural approach (275) that moves beyond consultation or financial compensation into design, governance, and financial participation (276). NP governance innovations that embed nature in all aspects of decision-making have emerged from Indigenous peoples themselves—e.g., the Buffalo Treaty among First Nations and Tribes of North America (277) and Māori people initiating personhood for rivers in New Zealand/ Aotearoa (278).

Nature Positive shift and finance

Funding is required to implement conservation measures. Informed by the Paulson Report (279), GBF T19's funding target to implement national biodiversity strategies and action plans is at least US$200 billion from all sources. This includes overseas development assistance (ODA) from rich nations of at least US $20 billion annually by 2025 and US$30 billion annually by 2030, which we discuss next in the context of equitable sharing of responsibilities between the Global North and Global South.

Equitable sharing of responsibilities between the Global North and South

In the developed North, advanced economies must conserve remaining intact nature, restore degraded natural systems, and decarbonize at their own expense. This transition requires strong political will, which could be driven by self-interest: continued environmental degradation will destabilize economies (80), threaten capital stocks (83), and intensify political instability through increased climate-related displacement and refugee crises (280).

In the Global South, similar actions are required. While degradation of nature occurs in both wealthy and poorer nations, the consumptive footprints of the Global North and newly industrialized nations are major drivers of biodiversity loss in developing regions. Similarly, climate change—primarily caused by emissions from wealthy industrialized countries and, more recently, by rapidly developing economies (281) —disproportionately affects poorer nations (282). Financial transfers from developed to developing nations are therefore equitable (283–286).

Both the CBD and UNFCCC have agreed on financial commitments. GBF Target 19 calls for overseas development assistance from rich nations of at least US$20 billion annually by 2025 and US$30 billion annually by 2030. A multilateral mechanism for the fair and equitable sharing of benefits from the use of digital sequence information on genetic resources, including a global fund, has also been agreed (99). The UNFCCC has an agreed US$300 billion annual resource mobilization goal from North to South by 2035. It also operationalized a Loss and Damage Fund, with US$730 million in initial pledges (287). Fulfilling these commitments is critical for achieving shared environmental goals equitably.

Many Global South countries struggle with national debt burdens, which restrict the financial resources available to them for both human development and NP implementation. Debt for nature swaps (DNS) started as an international public finance incentive to protect nature, involving debt forgiveness in exchange for conservation commitments (288). More recently, DNS have involved a reduction in the cost of borrowing for a developing country in return for NP actions (289, 290). Concessional finance from multilateral development banks (MDBs) or guarantees from rich countries improve the investment grade of developing countries' debt, which reduces interest rates. Such debt cost reduction projects have been implemented in several countries with NP conservation outcomes (291, 292).

Nature Positive transformation of the dominant economic system

The NP shift also requires a transformation of the dominant economic system, which is recognized in the GBF. We discuss how this can be enabled by valuing nature in public accounting standards, and through ODA, MDBs, innovations in financial markets, and changes in business operations. We begin with valuing nature.

Valuing nature

T14 calls for changes in national accounting and fully integrating the values of biodiversity. Many people attach non-economic value to nature (293, 294), but the world's dominant economic system does not. There are critiques of attaching financial value to nature because it undervalues or ignores values reflective of human–nature relationships (267) and could result in privatization of public goods (295) or economic imperialism (296). However, achieving the NP shift will require alignment of the dominant financial system, which is currently driving the loss of biodiversity (80, 297). We focus first on public sector mechanisms to attach economic value to nature in national accounts.

Public sector finance and Nature Positive

The global financial system treats "natural assets" as free for the taking with the only cost being the expense of extraction or harvesting (80). The result is private enterprise capturing the value at the expense of the common biosphere (298). Private enrichment with externalized costs is counted as a positive number in standard national accounts and Gross Domestic Product (GDP) (299). Thus, nature-negative actions are counted as positive economic outputs in government finances. For the world to become NP, governments must address this systemic problem through standards, regulations, and the creation of market mechanisms (80).

The externalized cost of economic activity can be viewed as depreciating the "natural capital" that underpins the economy and human well-being, but without accounting for that loss of value to society (80) (Figure 1). Valuing natural capital and ecosystem services is an effective way to correct this by measuring and counting the value to society alongside the extracted value realized by an individual or corporation (80, 300). Natural capital (also known as tangible natural assets or stocks of nature) produces flows of ecosystem services that can be measured through a "shadow" price. In 2012, the UN System of Environmental-Economic Accounting (SEEA) created a statistical Central Framework (CF) that enables countries to measure their natural capital and understand the contributions of nature to national prosperity and the importance of protecting it. Building on the CF, the UN also developed SEEA Ecosystem Accounting (SEEA EA), which provides a more in-depth view of the health of natural capital in each jurisdiction (301, 302). So far, over 90 countries compile accounts using SEEA CF, while over 50 countries also use the more detailed SEEA EA. However, these statistical frameworks are satellite standards to the System of National Accounts (SNA) and therefore have limited influence on how GDP is calculated by countries. To make an NP change, governments must meaningfully integrate SEEA EA into their system of national accounts and use this information to inform public sector decision-making.

Another avenue for integrating the value of natural capital into mainstream financial markets is to address barriers that limit the value of nature from being accounted for in public sector accounting standards. Currently, intact nature is left out of international accounting frameworks, and its economic value is not counted until it is exploited, purchased, or sold. Even formal area-based conservation actions by the state are viewed as an expense rather than an investment, and the resulting conservation areas are not viewed as assets in public accounting. However, in January 2026, the International Public Sector Accounting Standards Board (IPSASB) released IPSAS 51, Tangible Natural Resources Held for Conservation, which will allow governments to count conservation areas as tangible natural assets (303, 304). Getting countries to adopt this new accounting standard will be an important NP action (305).

Private sector investment in conservation

T19 seeks to increase private investment as part of the US$200 billion for conservation measures, but it provides no pathways for it. In market terms, nature is worth more dead than alive. New markets for the "social value" of nature are needed (80), whether through regulatory support or capital market evolution.

Nature markets began with "no net loss" biodiversity harm mitigation laws, such as the United States Clean Water Act (306) and the United Kingdom's biodiversity net gain requirement under the Environment Act 2021 (307). Since these markets are inherently about mitigating loss, they can lead to further degradation of an intact area "offset" through restoration of a degraded area. This can help the world move toward less loss on the road to nature positivity (91, 308), but more than an offsets market is required to engage private investment to halt and reverse nature loss.

The European Union is evaluating a voluntary nature credits system (309). It builds on earlier private and government efforts to create biodiversity credits to sell to the private sector (310). Biodiversity credits require additionality, which means some improvement in the conditions of the underlying nature asset. Additionality is good for reversing loss through restoration (310). The International Advisory Panel on Biodiversity Credits (IAPBC) also includes improved governance and protection as an additionality. This may include Indigenous stewardship agreements or legal designations that did not previously exist (310). Biodiversity credits are of interest to buyers motivated by charitable or social license considerations but not to investors who seek a financial return on investment.

Unlocking large amounts of private capital for intact nature will require financial innovations (311) that provide a return on investment or reduce risk to capital. Governments can stimulate the creation of market mechanisms through concessional finance. This approach underpins the innovative Tropical Forest Forever Facility (TFFF), intended to attract private investment to halt the loss of tropical forests. Led by Brazil, TFFF was launched at UNFCCC COP30 in Belem. Its goal is to raise an initial US$25 billion from MDBs, ODA, and philanthropies to invest and also improve the investment grade of US$100 billion of debt to be sold to private investors. The resulting US$125 billion fund would then be invested to generate returns above the cost of borrowing, which is expected to net US$4 billion a year. This would be paid to governments of tropical forest countries to halt deforestation, with a specific percentage of the funds earmarked for Indigenous and local communities (312). In the month it was launched, there were over US$6 billion in pledges toward the initial US$25 billion (313).

Heightened awareness of nature risk and interest in investing to reduce it (314) could create a market for halting the loss of nature. Large investors are "universal owners" of climate and nature risks because they are widely invested in the global economy (315). Thus, ensuring the stability of the Earth system represented by natural capital is in their business interest, and they could invest in it. There is an existing natural capital protocol for business (316, 317) that is consistent with SEEA (318, 319). Initiatives to "put nature on the balance sheet" have identified the limitations in accounting standards and frameworks that prevent the inclusion of non-purchased natural assets in financial statements and provided a road map for addressing the problem (319).

The International Organization for Standardization (ISO) released the world's first international biodiversity standard in October 2025. ISO 17298 "Biodiversity — Considering biodiversity in the strategy and operations of organizations — Requirements and guidelines" provides companies, investors, and public institutions with a globally agreed rulebook for how to measure, manage, and report their relationship with natural capital (320). For the private sector, this defines how biodiversity risk enters credit rating, audit trails, and shareholder expectations.

Meanwhile, natural asset companies create an asset class for nature, enabling direct investment in protected natural capital (321). Similarly, insurance arrangements focused on avoiding loss of natural capital, in which part of the premiums received are invested in nature to reduce the likelihood of loss of ecosystem services vital to a particular economic sector, could be created. To stimulate the market and create a level investment environment, governments could regulate financial institutions and businesses to hold some percentage of their assets as natural capital (this could also create a market for biodiversity credits).

Local and Indigenous communities should be involved in the design, returns, and governance of nature and climate investments that affect their areas to ensure both equitable outcomes and security of title. Including traditional knowledge systems will also likely enhance the performance of the underlying nature asset (269).

Private sector operations and subsidies

The NP shift requires economic transformation beyond government finances and private markets. Economic factors and consumption patterns are major drivers of both biodiversity loss and climate change and must be fundamentally transformed if we are to achieve the NP global goal (322). Here, we focus on realigning business operations.

Business interests have been involved in NP efforts since its inception, including in co-authoring the foundational NP paper (91) and successfully supporting the inclusion of targets in the GBF that encourage businesses to make an NP shift (317). The aims are as follows:

- All sectors should align their activities with the GBF (T14).
- Corporations should reduce their impact on nature and report their dependencies on nature (T15).
- Governments should eliminate US$500 billion in nature-negative subsidies to business by 2030 (T18).
- Corporate and financial sectors should participate in GBF financing (T19, discussed above).

T14 and 15 have attracted significant interest from both operating companies and the financial sector (323), and there was substantial private sector participation at the Global Nature Positive Summit hosted by Australia and the state of New South Wales (324). In 2025, the World Economic Forum reported growing consensus around business alignment with the NP goal (325).

To transform operations, businesses will need to embed NP approaches across all business decisions (317). Alignment methods include both internal decision-making tools (such as the Natural Capital Protocol) and disclosure-related tools. The Task Force on Nature-related Financial Disclosures has developed voluntary guidance (adopted by hundreds of companies and financial institutions) to help businesses integrate nature into decision-making and shift financial flows away from nature-negative outcomes and toward nature-positive outcomes. (326). The Nature Positive Initiative is developing voluntary corporate NP metrics for businesses to make meaningful and reportable contributions to the global NP goal (327). Science Based Targets for Nature is developing a drivers-oriented framework to help companies align their activities with NP (328).

Measures like these will be mandatory in the European Union, which has passed rules scheduled to come into force in 2027 that will require companies to report on "sustainability matters" (environmental, social and human rights, and governance factors), including their supply chains and actions to prevent or mitigate adverse impacts (329).

Many of the world's largest mining companies have collectively endorsed NP, asserting that "nature positive must be both an objective to be achieved, as well as an embedded approach to doing business" (330). Industry-specific NP approaches have now been proposed for the mining sector (331), the agricultural sector

(239), and wind farming (332). The Nature Positive Universities Initiative involves 500 private and public higher education institutions across the world committed to promoting nature on their campuses, in their supply chains, and within their cities and communities (333). There is also a well-developed mitigation hierarchy available for businesses to reduce inevitable impacts as part of the transition to NP (334). Rigorous attention to achieving assured NP outcomes will be required to avoid "greenwashing" (335, 336).

T18 materially understates the flow of public subsidies to private activities that must be changed: there is an annual net US$7 trillion in nature-negative financial flows, US$5 trillion of which are private (337). This requires public policy shifts in incentives (279), which will be more likely to happen with business support.

An NP world will only be achieved if there is a transformed, enabling economic environment. This requires alignment of financial incentives, business operations, innovation to make intact nature investable, public and private investments in conservation, and integration of government actions across the treaties.

Integration through co-reporting progress toward Nature Positive, climate goals, and the Sustainable Development Goals

We have demonstrated that achieving the SDGs and global climate goals is intrinsically linked to the NP goal. An explicit overarching objective for all three should be the integrated pursuit of an equitable, nature-positive, and carbon-neutral world (91).

Now that there is recognition of the nature–climate nexus from the parties to the CBD and UNFCCC and also the International High Court, national governments should align their reporting of Nationally Determined Contributions (NDCs) under the Paris Agreement and National Biodiversity Strategic Action Plans (NBSAPs) under the GBF. At CBD COP16, an initial step toward this integration was made by "urging … parties to consider integrating into their NBSAPS … approaches … to climate change adaptation and mitigation" (99).

NBSAPS could immediately include carbon sequestration and storage indicators under GBF Targets 1–3 and 11. Similarly, the SDGs should explicitly acknowledge the GBF in SDG 14 and 15, as they currently recognize the Paris Agreement in SDG 13. Integrating NBSAPs and NDCs could be facilitated through the existing architecture under provision 4.19 of the Paris Agreement, which calls for long-term low-emission development strategies (338). Joint reporting across the Paris Agreement and CBD/GBF could also serve to track progress on SDGs 13, 14, and 15, while incorporating shifts in production and consumption patterns and the transformation of subsidies, aligning with SDG 12.

Both the GBF and Paris Agreement emphasize equitable outcomes, which are also a focus of SDGs 1–7, 16, and 17. Joint reporting on equity across these global agreements would mark a major advance as it would foster integrated thinking, improve efficient deployment of financial resources, address underlying drivers in a coordinated manner, and achieve positive outcomes for both people and the Earth system. All of this joint reporting across the GBF, UNFCCC/Paris Agreement, and the SDGs should start immediately. As a further step, the integration of planetary boundaries and equitable objectives has been proposed through the concept of safe and just Earth system boundaries (104), for which Rockström et al. (201) provided Earth system boundary metrics. They should be widened to include the species, ecosystems, and natural processes discussed above. These global metrics could then be used by governments to assess progress toward living within all nine planetary boundaries.

Conclusion

The Earth system is rapidly unraveling. Protecting intact nature and restoring damaged ecosystems must be prioritized in global policy to the same extent as climate action under the Paris Agreement and the SDGs for human development. Realizing the GBF's NP mission, goals, and targets, with heightened attention to natural processes and feedbacks, would be an essential stabilizing action. However, actions under the GBF alone are insufficient. We are at or near the critical threshold of 1.5°C of climate warming (339–341), beyond which the Earth system could cross tipping points (59).

Concerted, aligned, and monitored efforts across the CBD, UNFCCC, SDGs, and all of society are needed to create an NP future that is equitable and carbon neutral. To achieve this requires conservation action and an enabling social and economic environment that includes money to pay for it, reorientation of financial flows, a shift in production and consumption practices away from nature-negative activities toward positive outcomes, new financial mechanisms, and stronger coordinated governance that is equitable and people positive.

It is a grim irony that just as the need for integrated action at all scales has become both apparent and urgent, the UN system and multilateralism in general are under enormous pressure (309). Time has shown, however, that what is urgent eventually becomes apparent to even the most reluctant. There remain many actors who are both deeply concerned about the state of the world and highly committed to improving it, including a broadly based Nature Positive Initiative (342).

Achieving the NP goal of halting and reversing nature loss, with a net improvement by 2030 from a 2020 baseline, is essential for the well-being of humanity and the rest of life. It is the only pathway to ensuring that the 21st century progresses toward peace, prosperity, stability, better health, and natural beauty, rather than descending into a future marked by large-scale human displacement, violent conflict, fires, floods, disease, food and freshwater shortages, inhospitable climates, and ecosystem collapse.

It is time for us to recognize that nature is the foundation of all human affairs. Unless we act swiftly to make the world NP by 2030, our lives are likely to become very difficult in a destabilized Anthropocene.

Statements

Author contributions

HL: Writing – original draft, Conceptualization, Writing – review & editing, Visualization.

JR: Writing – original draft, Conceptualization, Writing – review & editing.

RP: Writing – original draft, Writing – review & editing.

DL: Writing – original draft, Writing – review & editing.

LL: Writing – original draft, Writing – review & editing.

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FW: Writing – original draft, Writing – review & editing.

KK: Writing – review & editing, Writing – original draft.

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RS: Writing – review & editing.

FR: Conceptualization, Writing – original draft, Writing – review & editing, Visualization.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

Funding

The authors declared that financial support was received for this work and/or its publication.

HL's company Harvey Locke Conservation Inc. received funding from the Yellowstone to Yukon Conservation Initiative which was funded through a Gordon and Betty Moore Foundation grant, no. GBMF7544.01.

LZ was funded by Harvey Locke Conservation Inc. pursuant to that funding.

RKP was funded by the United States National Science Foundation (no. DEB-1716698, no. EF2133763).

CP is supported by a Frontiers Planet Prize awarded by the Frontiers Foundation.

FRH was supported in part by the United States Army Corps of Engineers Contracts W912DYP0003 and W912DY24C0017.

None of the funders listed above were involved in the study design, collection, analysis, interpretation of data, the writing of this article or the decision to submit it for publication.

Conflict of interest

HL is president of Harvey Locke Conservation Inc., a for-profit consultancy that received the funding disclosed above. LZ is a consultant. She received support for this work from Harvey Locke Conservation Inc., pursuant to the funding disclosed above.

The remaining authors declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

HL is President of Harvey Locke Conservation Inc which was involved in the work's design, collection, analysis, interpretation of data, writing of this article and the decision to submit it for publication.

Generative AI statement

The authors declared that no generative AI was used in the creation of this manuscript.

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Publisher's note

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