Need for a new ecosystem target within the Strategic Plan for Biodiversity 2050

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Summary: An ecosystem target, that is equivalent to Aichi Target 12 on species extinctions, is an essential addition to the post-2020 framework. We propose a new target:

> ***By 2030, for all ecosystems, halt net declines in area, integrity and function, and prevent increases in risk of collapse, towards net gains by 2050, through recovery, restoration, and retention of intact areas.***

Background

The Vision of the Strategic Plan for Biodiversity is *"Living in Harmony with Nature" where "By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people."*

Ecosystems are a core part of the definition of biodiversity. Sustaining ecosystems is essential for safeguarding species, ecosystem processes, and the natural capital and ecosystem services people rely on. We propose that a new target that specifically addresses ecosystems is required in the Post-2020 Agenda. This target should be based in ecosystem science, encompass all ecosystems, and build on rapidly expanding data and potential metrics of change. The new target should complement and be directly comparable with other targets on the status of species and genetic diversity, under Strategic Goal C (*improve the status of biodiversity by safeguarding ecosystems, species, and genetic diversity*[1]).

Currently there is no explicit Aichi target on the status of ecosystems. Target 5 calls for a reduction in '*the rate of loss of all natural habitats, including forests'* and their degradation and fragmentation, while Target 15 calls for restoration of degraded ecosystems. Target 5 relates however to reducing pressures (under goal) rather than improving the status of biodiversity (Goal C). The new ecosystem target should encompass all ecosystems; currently some ecosystem types are mentioned in various targets (e.g. forests in Target 5, coral reefs in Target 10, and other marine ecosystems in Target 6), with no cohesive aspiration for safeguarding them and the biodiversity they support. The new target and associated indicators should be able to be disaggregated to countries or regions, and to specific ecosystems; we can foresee specific ecosystem or biome targets being generated that aligns with the new target. Finally, the new target should include actions needed to address ecosystem loss: retaining intact ecosystems and restoring degraded ecosystems, recognising the UN Decade of Restoration.

Proposed elements of an ecosystem target, and potential target language

We recommend expanding the proposed IUCN target for ecosystems ("*Halt further net loss of ecosystems by 2030, towards restoration and recovery of ecosystems by 2050*") into a SMART target that must be met to achieve a global goal of no net loss[2] of biodiversity, to bend the curve towards net gains, and address the mission of the CBD and improving the status of biodiversity specifically. We propose a new status target that reflects symptoms of change (ecosystem area, integrity and function, and collapse), and actions needed for target achievement, over two timeframes:

> *By 2030, for all ecosystems, halt net declines in area, integrity and function, and prevent increases in risk of collapse, towards net gains by 2050, through recovery, restoration, and retention of intact areas.*

Justification of target elements:

1. *Ecosystem area*: Larger ecosystems can support more biodiversity and ecosystem services, and are more resilient to environmental change than smaller ecosystems. Declines in ecosystem area reduce capacity to support biodiversity and ecological processes that underpin ecosystem services[3].
2. *Ecosystem function, intactness, integrity and degradation*: These terms are closely related and used somewhat interchangeably. Declines in integrity reduce habitat quality for native biota, disrupt ecological processes and functions, and diminish ecosystem resilience and capacity to sustain species

and ecosystem services[3]. More intact ecosystems support higher biodiversity and reduce extinction; conversely, more degraded ecosystems support lower biodiversity and have higher extinction risk[4,5].

3. *Risk of ecosystem collapse*: A collapsed ecosystem has lost its defining features (species, assemblages, processes and functions) and is replaced by a different ecosystem type. Measuring changes in collapse risk can reveal whether ecosystems are still imperilled, or whether management actions have reduced risk. Ecosystem collapse risk provides a complementary measure to species extinction risk.
4. *Retention of intact areas*: Retaining remaining intact areas is essential because they buffer against loss of species, ecosystem function and services globally[4,5]. Retention of intact areas is more cost-effective and less uncertain than recovery and restoration.
5. *Recovery and restoration:* Actions for recovery and restoration provide the only pathway for degraded ecosystems, particularly those that are most threatened. Thus they are an essential part of ensuring no net loss. However, restoration and recovery are riskier and more expensive than retaining more intact areas, due to uncertain outcomes and low success rates.
6. *Net loss and net gains:* Measuring net change acknowledges that some losses are inevitable as a result of anthropogenic pressures, but can be potenially off-set by actions that lead to no net loss and ideally net gains[2]. The challenge is to ensure that such actions result in meaningful positive outcomes, rather than sanctioned further loss with uncertain future benefits[6]. We highlight that avoiding declines should be prioritized over restoration or creation of offsets wherever possible.

Potential indicators to support an ecosystem target

Mace et al. (2018)[7] identified three fundamental metrics or headline indicators for measuring change in species biodiversity: extinction risk, abundance and biotic health. Comparable ***headline indicators for ecosystems*** would address, respectively, collapse risk, ecosystem area, and ecosystem function. For each headline indicator, we suggest potential metrics with a brief summary of their suitability.

Risk of ecosystem collapse

1. *Red List Index (RLI) for Ecosystems[8]*: direct measure of ecosystem collapse risk, using risk status from the database of the IUCN Red List of Ecosystems, the global standard for ecosystem risk assessment; analogous to the Red List Index of Species Survival; currently available for a subset of countries/regions, with plans to complete all terrestrial ecosystems by 2023; applicable to all ecosystems types; scalable from single ecosystem to national and global.
2. *Number of collapsed ecosystems*: direct count of ecosystems listed as Collapsed in the IUCN Red List of Ecosystems; currently available for a subset of countries/regions, plans to complete all terrestrial ecosystems by 2023; applicable to all ecosystem types; scalable from national to global.
3. *Number of ecosystems that have improved in risk status*: direct count of ecosystems that were downlisted in the IUCN Red List of Ecosystems between assessments due to genuine recovery; available for a subset of countries; applicable to all ecosystem types; scalable from national to global.

Ecosystem area

1. Ecosystem Area Index[8]: uses IUCN Red List of Ecosystems data to measure changes in ecosystem area over standardised timeframes; currently available for a subset of countries/regions, all terrestrial ecosystems to be included by 2023; scalable from single ecosystem, to national to global; applicable to all ecosystem types.
2. In the interim, available datasets for a subset of ecosystem types include: *Forest cover[9],* global gains/losses in forest extent (2000-2018) at 30m resolution; *Wetland Extent Trends Index[10]*, change in wetland area (1970-2015), for a subset of natural and anthropogenic wetlands; *Mangrove watch*, global mangrove extent (1996-2010) at 30m resolution.

Ecosystem function, degradation, integrity and intactness

(note that metrics 3-5 model average assemblage/ecosystem responses to pressures, and 6-7 measure pressures, rather than directly measuring ecosystem status)

1. *Ecosystem Health Index[8]*: direct measure of ecosystem change using ecosystem-specific normalised variables over standardised timeframes, based on IUCN Red List of Ecosystems data; currently available

for a subset of countries/regions, all terrestrial ecosystems to be completed by 2023; scalable from single ecosystem, to national to global; applicable to all ecosystem types.

2. *Living Planet Index*[11]: relative change in abundance of vertebrate species from terrestrial, freshwater and marine realms (1970-2018), based on opportunistic time-series data of variable length for >20,000 populations of >4,200 species; biased towards Europe and North America; disaggregation at fine scales challenging (similarly *Wild Bird Index*[12] in Europe and North America, and database *Biotime*[13]).
3. *Mean Species Abundance*[14]: change in mean local abundance of species relative to undisturbed levels in response to *pressures*, modelled using GLOBIO3; scales from individual cell to global.
4. *Biodiversity Intactness Index*[15]*:* change in local mean species richness or abundance relative to undisturbed levels in response to land use; modelled response to *pressures*, broken down into plants, vertebrates and invertebrates based on global averages; scales from individual cell to global.
5. *Forest Health Index* (unpublished): forest only; integrates maps of forest configuration and connectivity using data on damaging human pressures and modelled asssments of edge effects and hunting, to provide a globally consistent, continuous scale index of contemporary forest degradation (300m resolution).
6. *Human Footprint Index*[16]: globally standardized measure of the cumulative human footprint on the terrestrial environment at 1 km^2 resolution (1993, 2009, 2013) based on eight major human pressures; thresholds have been identified for species extinction[17] to map intactness; recently combined with ecosystem area and connectivity maps at 1 km resolution.
7. *Marine Cumulative Human Impact indices*[18]: Marine only; vulnerability-weighted pressures (fishing, climate change, ocean- and land-based) on biodiversity.

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