

## BIODIVERSITY

# Set ambitious goals for biodiversity and sustainability

Multiple, coordinated goals and holistic actions are critical

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Global biodiversity policy is at a crossroads. Recent global assessments of living nature (1, 2) and climate (3) show worsening trends and a rapidly narrowing window for action. The Convention on Biological Diversity (CBD) has recently announced that none of the 20 Aichi targets for biodiversity it set in 2010 has been reached and only six have been partially achieved (4). Against this backdrop, nations are now negotiating the next generation of the CBD's global goals [see supplementary materials (SM)], due for adoption in 2021, which will frame actions of governments and other actors for decades to come. In response to the goals proposed in the draft post-2020 Global Biodiversity Framework (GBF) made public by the CBD (5), we urge negotiators to consider three points that are critical if the agreed goals are to stabilize or reverse nature's decline. First, multiple goals are required because of nature's complexity, with different facets—genes, populations, species, deep evolutionary history, ecosystems, and their contributions to people—having markedly different geographic distributions and responses to human drivers. Second, interlinkages among these facets mean that goals must be defined and developed holistically rather than in isolation, with potential to advance multiple goals simultaneously and minimize trade-offs between them. Third, only the highest level of ambition in setting each goal, and implementing all goals in an integrated manner, will give a realistic chance of stopping—and beginning to reverse—biodiversity loss by 2050.

Achieving this will require prompt and concerted measures to address the causes of

biodiversity loss (6), meaning that implementation will be crucial. The draft GBF (5) has advanced conceptually relative to its predecessor by highlighting the importance of outcome-oriented goals (i.e., what we want the state of nature to be in 2050 in terms of, for example, species extinction rates or ecosystem area and integrity). These outcome goals link the broad aspirational vision (“living in harmony with nature”; see SM) to the concrete actions needed to achieve it. The outcome goals—operationalized by more specific targets and assessed using indicators—provide a compass for directing actions and a way of checking their results; for example, whether meeting a set of action-based targets (e.g., designating X% of Earth's surface as protected areas) delivers on a desired outcome (e.g., “no net loss in the area and integrity of natural ecosystems”) needed to realize the aspirational vision. It is more important than ever that the necessary outcomes are incorporated in the GBF and that they adequately cover the distinct facets of nature, are sufficiently ambitious, and are grounded in the best knowledge available.

Various proposals for the new CBD outcome goals have focused on individual facets of nature, such as ecosystems (7), species (8), or genetic diversity (9). What has been missing is a unified view on how these facets relate to each other in setting goals to achieve the CBD's 2050 vision. To address this gap, we surveyed, evaluated, and discussed published proposals of goals for ecosystems, species, genetic diversity, and nature's contributions to people (NCP) in relation to the empirical and theoretical knowledge in the scientific literature. Our evaluation addresses whether proposed goals encompass, are consistent with, or are opposed to each other; whether they are sufficiently ambitious such that meeting

them will indeed curb and reverse biodiversity trends; and whether they contain all the elements needed to make them difficult to “game” (i.e., avoid making substantial contributions by exploiting weaknesses in wording) (see SM for details on our analysis).

## DISTINCT GOALS

As the failure to achieve the CBD's single 2010 goal—to substantially reduce the rate of biodiversity loss—shows, having an “apex” goal does not guarantee success. Whereas the mission of the United Nations Framework Convention on Climate Change (UNFCCC) focuses on one main outcome—preventing dangerous climate change, for which one goal and indicator (well below 2°C) provide a reasonable proxy for the others—CBD's vision and mission have three components that are distinct, complementary, and often trade off with each other: conserving nature, using it sustainably, and (though we do not consider this component here) sharing its benefits equitably. The nature conservation component is itself complex because biodiversity includes variation in life at all levels, from genes to ecosystems. Recognizing this, the proposed formulation of the GBF (5) (see SM) started by proposing separate goals that explicitly covered ecosystems, species, genetic diversity, and the contributions to people derived from them. Whether this structure is retained, or the necessary outcomes for these facets are instead subsumed into more overarching goals, our analysis (see SM) shows that all these facets need to be addressed explicitly because of how they interrelate. If the facets were nested into one another like Russian dolls, or at least nearly so, then a single concise goal that specifies one number about the most encompassing facet could cover all of them. However, although the facets of nature are deeply interlinked, they are far from neatly nested and represent instead a “minimum set” (10, 11). As a result, there is no single goal based on any one facet that would, if realized, guarantee by itself that the necessary outcome for the other facets would be achieved (12, 13).

Another reason for having multiple goals is “Goodhart's law”: Whenever a measure becomes a policy goal itself, it ceases to be a good measure of the true state of the system because it can be “gamed” (14). For example, incentives would favor actions to enhance the targeted metric irrespective of effects on the rest of nature. Given nature's multidimensionality, this approach would cause inefficient use of resources at best and possibly promote perverse outcomes (14). If the CBD enshrined an “apex” goal focusing on a single facet of nature, other facets may be relegated to the back seat. By incentivizing holistic actions, a framework with multiple

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## Sustainability at the crossroads

Columns show different facets of nature and their contributions to people (NCP). Each cell shows a potential goal (in bold) at a particular level of ambition in attaining it and some consequences of reaching it, including effects on the other facets of nature and NCP. Only the scenario in green would contribute substantially to “bending the curve” of biodiversity loss. See supplementary materials for further details.

GOALS				
ECOSYSTEMS	SPECIES	GENES	NATURE'S CONTRIBUTIONS TO PEOPLE	
<b>LOW AMBITION – DECLINE</b>				
<p><b>Lax “no net loss”</b></p> <ul style="list-style-type: none"> <li>• Critical ecosystems lost</li> <li>• “Natural” ecosystems lose integrity and function</li> <li>• Unchecked extinction and loss of genetic diversity</li> <li>• Ecosystems less able to provide resilient flows of NCP</li> </ul>	<p><b>Stabilize extinction rate and average abundance</b></p> <ul style="list-style-type: none"> <li>• Continued rapid extinction of species and populations</li> <li>• Many ecosystems altered by, e.g., loss of megafauna</li> <li>• Threatened species lose adaptability</li> </ul>	<p><b>50% conserved</b></p> <ul style="list-style-type: none"> <li>• Critical ecosystems cannot adjust to climate change</li> <li>• Many species can no longer adapt and die out</li> <li>• Crops and livestock more vulnerable to pests and diseases, causing famines</li> </ul>	<p><b>Few NCP secured</b></p> <ul style="list-style-type: none"> <li>• Critical ecosystems cannot adjust to climate change</li> <li>• Many species can no longer adapt and die out</li> <li>• Crops and livestock more vulnerable to pests and diseases, causing famines</li> </ul>	
<b>MEDIUM AMBITION – UNCERTAIN FUTURE</b>				
<p><b>Strict “no net loss”</b></p> <ul style="list-style-type: none"> <li>• “Natural” and “managed” ecosystems keep functioning and delivering NCP</li> <li>• Critical ecosystems stabilized</li> <li>• Species currently with too little habitat will go extinct</li> </ul>	<p><b>Reduce extinction rate and stop rare species declines</b></p> <ul style="list-style-type: none"> <li>• Many species saved</li> <li>• Large or specialist species may still go extinct</li> <li>• Many ecosystems lose functions delivered by particular groups of species</li> </ul>	<p><b>75% conserved</b></p> <ul style="list-style-type: none"> <li>• Most species can adapt</li> <li>• Ecosystem adaptability safeguards many NCP, but others are diminished</li> <li>• Many species at risk from reduced adaptability to climate change</li> </ul>	<p><b>Some NCP secured</b></p> <ul style="list-style-type: none"> <li>• Some NCP secured but critical shortfalls in many</li> <li>• Ongoing deterioration of “natural” and “managed” ecosystems and species that deliver NCP</li> <li>• Climate risks remain</li> </ul>	
<b>HIGH AMBITION – ROAD TO RECOVERY</b>				
<p><b>Strict “no net loss” and targeted protection and restoration</b></p> <ul style="list-style-type: none"> <li>• Net increase in “natural” ecosystem area and integrity</li> <li>• Large numbers of species and much genetic diversity saved</li> <li>• NCP flow from “natural” and “managed” ecosystems secured</li> </ul>	<p><b>Minimal loss of species and populations</b></p> <ul style="list-style-type: none"> <li>• Stabilizes species abundance, including particular groups delivering ecosystem functions and NCP</li> <li>• Safeguards the “tree of life”</li> <li>• Saves culturally important species</li> </ul>	<p><b>90% conserved</b></p> <ul style="list-style-type: none"> <li>• Resilient ecosystems</li> <li>• Safeguards adaptability of most of rare species</li> <li>• Crops, livestock, and their wild relatives can adapt to pests, diseases, and climate change</li> </ul>	<p><b>Broad range of NCP secured</b></p> <ul style="list-style-type: none"> <li>• Food, water, health, and climate security for the most vulnerable people</li> <li>• More resilient “natural” and “managed” ecosystems</li> <li>• Nature-based solutions reduce climate risk</li> </ul>	

goals reduces the risk that the goals could be achieved without also achieving the overarching vision that they were intended to serve.

### HOLISTIC ACTIONS

The interdependence of ecosystems, species, genetic diversity, and NCP offers the opportunity to design policies and actions that contribute to multiple goals simultaneously. This offers the possibility for mutually reinforcing goals, in which progress toward one goal also advances the others, even though each facet of nature will also require targeted actions to address its specificities (see SM). For example, restoring ecosystems that are species-rich, have many endemics, and store large amounts of carbon, such as tropical peatlands, contributes toward all goals. The downside of this interdependence is that failure to achieve one goal will likely undermine others in a negative mutually reinforcing cycle: Ongoing loss of area and integrity of tropical peatlands leads to global extinctions and reduces options for climate mitigation; climate change then causes further loss of ecosystems, species, populations, genetic diversity, and NCP (see SM).

Although the scientific and management communities have been long aware of interactions among biodiversity goals and targets,

these linkages have not been sufficiently operationalized (11). We highlight the need for the connectedness, partial dependence, and imperfect nesting of nature’s facets to be built right from the start in the design of outcome goals, targets, indicators, and actions. In addition to addressing different facets of nature, goals must be set across the whole gradient from “natural” to “managed” ecosystems, attending to the specificities of these different landscapes (see SM).

### NEED TO AIM HIGH

Holistically designed goals on ecosystems, species, genetic diversity, and NCP are necessary to achieve the 2050 vision; whether they are sufficient will depend on the level of ambition that these goals reflect. Even perfect implementation cannot make up for outcome goals set too low or too narrowly at the start. Different levels of ambition are, for example, whether the curve of biodiversity loss will bend (high ambition) or merely flatten (low), or whether no net loss of ecosystems is specified with a lax (low) or strict (high) criterion for replaceability (see SM). The interdependence among facets of nature means that missing a goal for one facet risks also missing goals related to other facets, whereas achieving each goal at a sufficient ambition

level can contribute to reaching the others. Our synthesis of the evidence (see the figure, and SM) illustrates that the CBD’s 2050 vision is feasible only by aiming high with each of the goals. Lower levels of ambition will deliver inadequate outcomes, including loss in area and integrity of ecosystems, more global extinctions, reduced abundance and performance of many important species, loss of genetic diversity, and reduced benefits to people. This would not only compromise the objectives of the CBD but also undermine progress toward most of the United Nations Sustainable Development Goals and the Paris Climate Agreement (1). The stakes are high.

### MULTIPLE GOALS, ONE VISION

Our arguments for setting multiple goals do not mean that there is no place for a compelling and unifying overarching vision. Collective action over more than a century offers a clear lesson: To gain political traction, any unifying vision needs to be a rallying cry—broad, normative, inspirational, and aspirational. The CBD process has already set such clear vision: “living in harmony with nature.” The goals underpinning the vision, by contrast, need to be unambiguous and strongly based on the best available knowledge to make it possible to derive SMART (specific,

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measurable, assignable, realistic, time-related) operational targets (15) from them.

In sum, one compelling overarching vision, buttressed by facet-specific goals that are mutually reinforcing, scientifically traceable, and individually traceable, will deliver the overarching vision more reliably than any single-facet goal. Using a single-facet goal as the only flagship of global biodiversity policy is analogous to using blood pressure or body mass index as the sole surrogate for the vision of “vibrant health”: simple but risky.

## COP15 AND BEYOND

The main challenge ahead lies not in the number of goals but rather in making them happen. However many goals are in the GBF, their specific wording and the supporting framework of targets and indicators will be equally influential on global policy. This wording will be decided by the governments

at the 15th Conference of the Parties (COP15) of the CBD in 2021. We summarize critical elements emerging from our analysis that we hope delegates will consider when establishing the GBF, intended to help maximize positive impacts of each goal and minimize perverse interpretations (see the box).

We have deliberately focused on how the different facets of nature and their contributions to people should look in 2030 and 2050 to achieve the CBD 2050 vision (with 2030 seen as reflecting crucial “stepping stones” in the right direction toward 2050). We have not evaluated the economic and political consequences of the proposed goals nor the governance and distributional challenges of their implementation. In the case of NCP, we focused on their generation rather than on how they are accessed to meet actual needs and therefore result (or not) in people’s good quality of life. Implementing

actions to achieve these outcomes without considering social and political issues would be a recipe for further failure. We thus provide just one piece of the formidable puzzle that must be resolved. But it is an essential piece: what could be effective from the biological perspective, provided that the right actions are implemented and all relevant actors are involved in pursuing them. Actions to implement these goals will need to tackle the indirect socioeconomic drivers (and underlying value systems) at the root of nature’s decline as well as the direct proximal drivers on which conservation has mostly focused to date (1). Only then will the 2050 vision have a chance. We exhort the parties to be ambitious in setting their goals, and holistic in their actions afterward, to transition to a better and fairer future for all life on Earth. ■

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## SUPPLEMENTARY MATERIALS

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## Key considerations for 2050 biodiversity goals

The following key elements are essential for the new post-2020 Convention on Biological Diversity goals. If not fully expressed in the actual goals, they should structure the action targets and indicator framework. To clarify their ambition and enable tracking of legitimate progress, all goals need to have clear reference years (e.g., 2020). For detailed explanations and supporting references, see supplementary materials.

### The ecosystems goal should:

- Include clear ambition to halt the (net) loss of “natural” ecosystem area and integrity.
- Expand ecosystem restoration to support no net loss by 2030 relative to 2020, and net gain of 20% of area and integrity of “natural” ecosystems and 20% gain of integrity of “managed” ecosystems by 2050.
- Require strict conditions and limits to compensation, including “like-for-like” (substitution by the same or similar ecosystem as that lost) and no loss of “critical” ecosystems that are rare, vulnerable, or essential for planetary function, or which cannot be restored.
- Recognize that improving the integrity of “managed” ecosystems is key to the continued provision of many of nature’s contributions to people.
- Recognize that outcomes of conservation and restoration activities strongly depend on location and that spatial targeting is essential to achieve synergies with other goals.

### The species goal should:

- Have clear ambitions to reduce extinction risk and extinction rate across both threatened and nonthreatened species by 2050, with a focus on threatened species in the short term.
- Focus on retaining and restoring local population abundances and the natural geographical extent of ecological and functional groups that have been depleted, and on conserving evolutionary lineages across the entire “tree of life.”

### The genetic diversity goal should:

- Include maintenance of genetic diversity—the raw material for evolutionary processes that support survival and adaptation; population size is not an adequate proxy for this.
- Be set at the highest ambition level (e.g., above 90% of genetic diversity maintained).
- Focus on populations and their adaptive capacity and include wild species and domesticated species and their wild relatives.

### The nature’s contributions to people (NCP) goal should:

- Be addressed directly in a goal that recognizes NCP (e.g., food, medicines, clean water, and climate regulation) and avoids conflation with a good quality of life (e.g., food security or access to safe drinking water), which results from other factors as well as from NCP.
- Encompass spatial and other distributional aspects, such as provision from both “natural” and “managed” ecosystems, and inter- and intragenerational equity to ensure benefits to all.

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