

BIODIVERSITY

# A sustainable future requires holistic actions towards ambitious biodiversity goals

Insert Deck Here

By Sandra Díaz\*, Noelia Zafra-Calvo, Andy Purvis, Peter H. Verburg, David Obura, Paul Leadley, Rebecca Chaplin-Kramer, Luc De Meester, Ehsan Dulloo, Berta Martín-López, M. Rebecca Shaw, Piero Visconti, Wendy Broadgate, Michael Bruford, Neil D. Burgess, Jeannine Cavender-Bares, Fabrice DeClerck, José María Fernández-Palacios, Lucas A. Garibaldi, Samantha L.L. Hill, Forest Isbell, Colin K. Khoury, Cornelia B. Krug, Jianguo Liu, Martine Maron, Philip J.K. McGowan, Henrique M. Pereira, Victoria Reyes-García, Juan Rocha, Carlo Rondinini, Lynne Shannon, Yunne-Jai Shin, Paul V.R. Snelgrove, Eva M. Spehn, Bernardo Strassburg, Suneetha M. Subramanian, Joshua J. Tewksbury, James E.M. Watson, Amy E. Zanne.

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, out of the twenty Aichi Targets for biodiversity it set in 2010, none has been reached and only six have even been partially achieved (4). Against this backdrop, the CBD is now defining the next generation of global goals (see S1), due for release in mid-2021, which will frame actions of national governments and other social actors for decades to come. After a critical evaluation of scientific evidence relevant to the goals proposed in the draft global biodiversity framework made public by the CBD Parties (5), we urge the negotiators to consider three points that are critical for whether the agreed goals will be able to stabilize or reverse nature's decline. First, multiple goals for nature are required because of nature's complexity: not only does it have multiple facets – genes, populations, species, deep evolutionary history, ecosystems, each of **intrinsic value and each providing** different contributions to people – but these facets differ markedly in geographic distribution and respond differently to human drivers. Second, the interlinkages among these facets mean that the goals must be defined and developed holistically rather than in isolation. These interlinkages also highlight the potential value of actions that 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, as implied by the CBD's 2050 Vision of "Living in harmony with nature".

It is clear that such a good outcome will require prompt and concerted measures to address the causes of biodiversity loss (6), mean-

ing that implementation will be crucial. The new post-2020 Global Biodiversity Framework (5) has advanced conceptually relative to its predecessor by making outcome-oriented goals (what we want the state of nature to be) explicit as a concrete intermediate link between the aspirational – and necessarily vague – vision ("living in harmony with nature"; see S1) and the operational mission (what concrete actions need to be taken to get there, and how to measure progress). It is therefore more important than ever to make these outcome goals clear, sufficiently ambitious, and grounded in the best knowledge available.

Different 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 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). Our evaluation asked whether proposed goals encompass, are consistent with, or are opposed to each other; whether they are sufficiently ambitious that meeting them will indeed curb and reverse biodiversity trends; and whether they contain all the elements needed to make them difficult to 'game'.

## DISTINCT GOALS

The communication success of the 1.5° C target for climate warming established by the UN Paris Climate Agreement highlights the potential value of a single 'apex' goal as a shortcut to achieving most or all of the targets (e.g. (8)). However, whereas UNFCCC's mission focuses on one main outcome – keeping greenhouse gas concentrations in the atmosphere low enough to prevent dangerous climate change – 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 first component is itself

complex because biodiversity includes variation among living entities at all levels from genes to ecosystems. Recognizing this, the proposed formulation of the post-2020 Global Biodiversity Framework (5) (see S1) includes separate goals explicitly covering ecosystems, species, genetic diversity, and the contributions to people derived from them. Whether this structure is retained, or these facets are instead subsumed into more overarching goals, our analysis (see S2-S5) shows that all these facets need to be addressed explicitly, because of how they are connected. If the facets were nested neatly 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 (10, 11). As a result, there is no single goal based on any one facet that would, if realized, guarantee by itself that the other goals would be achieved (12, 13).

A second reason, more related with social and political factors, for having multiple goals: "Goodhart's Law": whenever a measure becomes a policy goal itself, it ceases to be a good measure of the goal, 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 (8, 14). If the CBD enshrined an 'apex' goal focusing on a single facet of nature, there is the danger for other facets to be relegated to the back seat. By incentivizing holistic actions, a framework with multiple goals reduces the risk that the goals could be achieved without also achieving the overarching vision they were intended to serve.

## HOLISTIC ACTIONS

If the state of ecosystems, species, genetic diversity and nature's contributions to people varied independently, then and actions to achieve each goal would have no effect on

\*Corresponding author: E-mail: [sandra.diaz@unc.edu.ar](mailto:sandra.diaz@unc.edu.ar)  
For a complete listing of affiliations, see supplementary material.

the others. However, the interdependence of these facets opens the door to the design of policies and actions that contribute to multiple goals simultaneously. This approach offers the potential for the establishment of mutually reinforcing goals, in which progress towards one goal also advances the others, even though each facet of nature will also require some targeted actions to address its specificities (see S2). For example, restoring ecosystems that are species-rich, have many endemics and store large amounts of carbon contributes towards all goals. The downside of this interdependence is that failure to achieve one goal will likely undermine others, in a negative mutually reinforcing cycle. Following the same example, continued loss of area and integrity of high-endemism, high-carbon ecosystems such as 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 S2 for references and more examples of positively and negatively mutually reinforcing goals).

While the scientific and management communities have been long aware of interactions among biodiversity goals and targets, this has 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 and derived targets, indicators and actions.

In addition to addressing different facets, goals need to be set across the whole gradient from "natural" to "managed" ecosystems, attending to the specificities and value of these different landscapes (see S3).

#### NEED TO AIM HIGH

If the goals that encompass the major facets of nature are designed holistically, would they be sufficient to achieve the 2050 Vision? We posit that goals on ecosystems, species, genetic diversity and NCP are necessary; whether they are sufficient will depend on the level of ambition these goals reflect. We argue that the best implementation can hardly 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 species loss will bend (high ambition) or merely flatten (low), and whether the goal aims for 2030 (high) or only 2050 (low); or whether no net loss of ecosystems is specified with a lax (low) or strict (high) criterion for replaceability (see S4 for different levels of ambition and S5 for rationale and literature behind them). The interdependence among facets of nature means that

underachieving a goal related to one facet leads to a shortfall on goals related to other facets, whereas achieving each goal at sufficient ambition level can contribute to reaching the others. Our synthesis of the evidence (distilled in figure 1 and based on rationale and literature in S2- S5) shows that the 2050 Vision is feasible only by aiming high with each of the goals. Lower levels of ambition are sure to deliver inadequate outcomes, including loss of ecosystems, more global extinctions, reduced abundance and productivity of many important species, loss of genetic diversity, and reduced benefits from nature to people. This would not only compromise the objectives of the CBD, but also progress toward most of the United Nations Sustainable Development Goals and the Paris Climate Agreement (1).

#### MULTIPLE GOALS: ONE VISION

Our arguments for having multiple goals do not mean they should not converge under the umbrella of a compelling and unifying vision. The lesson from collective action over more than a century is clear: to gain political traction, any unifying vision needs to be a rallying cry – broad, normative, inspirational and aspirational. In the CBD process, such broad vision has already been set – “Living in harmony with nature”. The goals underpinning the vision, in contrast, need to be unambiguous, descriptive, and strongly based on the best available knowledge, to make it possible to derive SMART operational targets (15) from them.

In sum, one compelling overarching vision, buttressed by facet-specific goals that are mutually reinforcing, scientifically tractable, 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.

#### COP 15 AND BEYOND

Ultimately, the main challenge ahead is not in the number of goals, but rather in making them happen. Governments at the 15<sup>th</sup> Conference of the Parties (COP15) of the CBD in 2021 will decide far more than the number of goals in the post-2020 Global Biodiversity Framework: The specific wording of those goals and the supporting framework of targets and monitoring indicators will be equally influential on global policy. We provide a summary of critical elements that we hope delegates will consider when establishing the Framework, intended to help maximize positive impacts of each goal and

minimize perverse interpretations (see 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. 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 in nature, 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 this 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 be holistic, tackling the indirect socioeconomic drivers 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 afterwards, to transition to a better and fairer future for all life on Earth.

#### REFERENCE

Comentario [q1]:

Comentario [q2]: Please do not do ANYTHING in this blank bit. It is a blinded formatted bibliographpy that we will fix at the very end. Look at the bottom if you want to see the bib cited.

#### ACKNOWLEDGEMENTS

This article was initiated at a meeting organized by the Earth Commission in close collaboration with the Convention on Biological Diversity and Future Earth, which took place on 28 February – 2 March 2020 in Davos, Switzerland, with the participation of 63 scientists from 26 countries. Financial support for the meeting was provided by Oak Foundation and Porticus. S. Dobrota, H. Moersberger and the whole of the Earth Commission Secretariat provided support in the meeting organization. We thank the following contributors to the Report to the CBD Synthesizing the Scientific Evidence to Inform the Development of the Post-2020 Global Framework on Biodiversity, on which this article builds: J. Bascompte, J. Carriño, N. Castañeda-Alvarez, M. Azeredo de Dornelas, S. Hoban, S. Jones, P. Jordano, L. Laikre, G. M. Mace, N. Maxted, P. Miloslavich, D. Moreno-Mateos, R. Ogden, G. Segelbacher, J.-C. Svenning and members of the Future Earth GRP EvolveS (formerly bioGENESIS) M. Bellon, L. Colli, F. Forest, M. Johnson, R. Kasen, C. Souffreau and E. Vázquez-Domínguez. We also thank D. Cooper for useful discussions and for advice in the design of the meeting.

10.1126/science.abe1530

**Sustainability at the crossroads.** Ambitious and mutually reinforcing goals for different facets of nature are the only ones that will not fall short of achieving the 2050 Vision. The columns show different facets of nature and its contributions to people (NCP), whereas rows show goals of different levels of ambition (low in the top row; high in the bottom row). Each cell shows a potential goal (in bold) and some of the consequences of reaching it. These consequences include effects on the other facets of nature and NCP. Only the scenario in green would contribute significantly to “bending the curve” of biodiversity loss. The cells in red highlight how an inadequate level of ambition or attainment in any one goal undermines objectives in other facets of nature. See S4 for feasibility, risks and alignment with 2050 Vision associated with each level of ambition for each of the goals. Goals need to be set across ecosystems spanning the whole gradient of human influence, from wilderness to agricultural land or heavily fished areas, attending to the specificities and value of these different landscapes. See S3 for definitions of “natural” and “managed” ecosystems, and S5 for definitions of lax and strict “no net loss” policies.

#### Key considerations for 2050 Biodiversity Goals

We propose the following key elements that should be captured under each of the new post-2020 CBD Goals. If unable to be expressed in the final wording of the CBD Goals themselves due to their concise nature, these elements should provide the primary structure for the action targets that sit under the Goals, their implementation and monitoring. In order 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 S5.

The **ecosystems** goal should:

- Include a clear ambition to halt the (net) loss of both area and integrity of “natural” ecosystems.
- Expand ecosystem restoration to support no net loss by 2030, 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 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 NCP.
- Recognize that outcomes of conservation and restoration activities strongly depend on location, and spatial targeting is essential to achieve synergies with the other goals.

The **species** goal should:

- Have clear ambitions to reduce extinction risk and extinction rate across both threatened and non-threatened species by 2050, with a focus on threatened species in the short term.
- Focus on retaining and restoring local population abundances and 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 the evolutionary processes that support species survival and adaptation in the face of change; 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 species populations and their adaptive capacity, and include wild species, and domesticated species and their wild relatives.

The **Nature’s Contributions to People** 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.

#### @unformatted ref. list, just for info:

2. S. Díaz *et al.* *Pervasive human-driven decline of life on Earth points to the need for transformative change.* *Science* **366**, eaax3100 (2019).

7. J. E. M. Watson *et al.* *Protect the last of the wild.* *Nature*, (2018).
8. M. D. A. Rounsevell *et al.* *A biodiversity target based on species extinctions.* *Science* **368**, 1193 (2020).
9. L. Laikre *et al.* *Post-2020 goals overlook genetic diversity.* *Science* **367**, 1083 (2020).
10. H. M. Pereira *et al.* *Global Biodiversity Change: The Bad, the Good, and the Unknown.* *Annual Review of Environment and Resources*, (2012).
11. A. Marques *et al.* *A framework to identify enabling and urgent actions for the 2020 Aichi Targets.* *Basic and Applied Ecology* **15**, 633 (2014).
12. G. M. Mace *et al.* *Approaches to defining a planetary boundary for biodiversity.* *Global Environmental Change* **28**, 289 (2014).
13. A. Purvis. *A single apex target for biodiversity would be bad news for both nature and people.* *Nature Ecology & Evolution* **4**, 768 (2020).
14. A. C. Newton. *Implications of Goodhart’s Law for monitoring global biodiversity loss.* *Conservation Letters* **4**, 264 (2011).
15. E. J. Green *et al.* *Relating characteristics of global biodiversity targets to reported progress.* *Conservation Biology* **33**, 1360 (2019).

#### Uncategorized References

1. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), *Summary for Policymakers of the Global Assessment Report of the Intergovernmental Science-Policy Platform on*

**Comentario [q4]:** @Peter, @Martine: Edito wants 2 words on what this means. Reader can look it up in the supplements, but he wants reader to have a super-quick idea of what it is about.

**Comentario [q5]:** @Ehsan, @Luc: in the extended checklist you say just “populations”(not species populations). Which one is correct?

**Comentario [BW3]:** Echoing some earlier comments, these considerations all seem sensible. It’s not clear to what degree any of these considerations are unique as we move forward post-2020, or whether, for example, any/many of these recommendations may have been made in the past for the Aichi targets. In other words, are you just reminding us of things that we’ve been reminded of in the past, yet we didn’t really do enough to make this happen?

- 
- Biodiversity and Ecosystem Services*. S. Díaz, J. Settele, E. S. Brondizio E.S., H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. Brauman. (IPBES secretariat, Bonn, Germany, 2019), pp. 56.
3. Intergovernmental Panel on Climate Change (IPCC), *Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*. A. Arneth, et al., (Eds.) (2019).
  4. D. C. Convention on Biological, "Global Biodiversity Outlook 5," (Montreal, 2020).
  5. Convention on Biological Diversity (CBD), "Zero draft of the post-2020 global biodiversity framework. version 6 January 2020 (<https://www.cbd.int/doc/c/3064/749a/0f65ac7f9def86707f4eafa/post2020-prep-02-01-en.pdf>) updated 17 August 2020 (<https://www.cbd.int/doc/c/3064/749a/0f65ac7f9def86707f4eafa/post2020-prep-02-01-en.pdf>)," (2020).
  6. D. Leclère et al. (2018), pp. 1.