Workshop Report
A synthesis of available scientific input to inform the development of the post-2020 global biodiversity framework

Summary

This report draws on discussions held during a workshop convened at Clare College, Cambridge, UK, from 20-24 of May 2019. The workshop brought together key experts from the scientific community and policy makers involved in supporting the development of the post-2020 global biodiversity framework. This report has been developed to support government negotiators, national focal points of the Convention on Biological Diversity, and observer organisations in the development, and subsequent implementation, of the post-2020 global biodiversity framework. Particular focus is placed on:

- Unpacking and outlining various options for operationalising the 2050 Vision for Biodiversity;
- Outlining scientific proposals for the post-2020 global biodiversity framework, including:
  - Proposals from the scientific community for the overall approach to the post 2020 global biodiversity framework;
  - Proposals for an overall biodiversity state index (including biodiversity benefits to people), or set of indexes or indicators that could be useful to measure progress towards 2030 milestones;
  - Proposals to better connect biodiversity with the climate change and land degradation agendas;
  - Proposed action-oriented targets within Driver, State, Pressure, Response, Benefits categories;
- Summarising the scientific status of potential indicators and their underlying data to measure progress towards 2030 milestones;
- Summarising the scientific status of spatial and temporal data that can assist countries and other stakeholders to plan ways to implement the post-2020 global biodiversity framework;
- Summarising the scientific status of web-based platforms that can support countries and others to implement the post-2020 global biodiversity framework.

These inputs are based on work conducted by biodiversity experts over recent years and the subsequent discussions that took place during the workshop in Cambridge.

---

1 The workshop was convened by UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), together with partners from National Geographic Society (NGS), Luc Hoffmann Institute (LHI), the NatureMap consortium, and the biodiversity hub of the Science-Based Targets Network.
Background

In 2020, at the UN Biodiversity Conference in Kunming, Parties to the Convention on Biological Diversity and its Protocols will review achievements towards the Strategic Plan for Biodiversity 2011-2020 and its Aichi Biodiversity Targets. It is anticipated that a new global framework (post-2020 framework) for biodiversity will also be adopted at that time, in the context of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals.

Guiding the post-2020 framework is the Vision of “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 for all people”. The framework is intended to provide a pathway with milestones (2030 Mission) towards the 2050 Vision. To measure progress towards this, the Parties to the CBD called for the consideration of “ambitious, realistic and measurable, time-bound targets and corresponding indicators, reporting and monitoring frameworks and baselines to be developed in a coherent way”. This call was made in the context of insufficient progress towards the existing Aichi Targets as noted in the IPBES Global Assessment, which also reviewed future trends, and recent papers that have shown the most successful Aichi Targets are those that are measurable. This finding emphasises the importance of SMART targets.

Parties to the Convention on Biological Diversity decided at the 14th Conference (COP 14) in Sharm El-Sheikh, Egypt: "that the post-2020 global biodiversity framework should be accompanied by an inspirational and motivating 2030 mission as a stepping stone towards the 2050 Vision ‘Living in Harmony with Nature’, which will be supported by a coherent, comprehensive and innovative communication strategy". The IPBES Global Assessment Report on Biodiversity and Ecosystem Services suggests that the development of the post-2020 global biodiversity framework would benefit from considering the indirect and direct drivers of biodiversity loss, and the consequences of biodiversity loss for humanity. The IPBES global assessment has also identified key areas of response that can help reverse the loss of biodiversity; this can be useful for further consideration in selecting action-oriented targets.

Workshop Aims

The overall aim of the workshop was to identify how spatial and temporal biodiversity information can collectively inform global priorities and support national level decision-making. Specifically, this is in the context of developing and implementing the post-2020 global biodiversity framework. The workshop also aimed to identify and support collaboration among participating organizations and affiliated projects/initiatives. It sought to identify opportunities for making joint technical advances, enhancing synergies between ongoing and future work, communicating the outputs and outcomes of various initiatives, and avoiding potentially conflicting messages or duplication of efforts.

2 Bold elements were the focus of discussions during the meeting.
5 https://www.ipbes.net/news/ipbes-global-assessment-preview
6 Key partners and organizations who were not able to attend the meeting in person have been engaged in discussions remotely and involved in the preparation of this document.
As well as drawing on many different initiatives, workshops, scientific papers, and existing partnerships, the meeting built upon the results of two previous meetings convened by UNEP-WCMC:

- **Scoping workshop, 6 June 2017**: UNEP-WCMC and the Luc Hoffmann Institute, with support from the Leonardo DiCaprio Foundation, convened a workshop to advance the scientific underpinning for scaling up area-based conservation. The workshop focussed on approaches for combining and disseminating knowledge that can best support the area-based conservation elements of a post-2020 global biodiversity framework. This included options for bringing together existing data on biodiversity, protected areas and other area-based conservation measures to help determine the highest priorities for new protected and conserved areas.\(^7\)

- **Expert meeting, April 2018**: An expert meeting was convened through the Cambridge Conservation Initiative (CCI), which includes UNEP-WCMC and other NGO and University Department members, to consider the effective use of knowledge in developing the post-2020 global biodiversity framework. Outputs from this meeting have been made available to inform the Convention’s governance and advisory processes.\(^8\)

This 2019 workshop, held at Clare College, Cambridge, 20-24 May, 2019, drew on these earlier meetings, scientific literature, but also the ongoing international inputs to discussion papers that are available as part of the process for developing the post-2020 global biodiversity framework.\(^9\)\(^10\)

\(^7\) See workshop report for more details:

\(^8\) See meeting report for more details:
[https://www.cbd.int/doc/c/a243/1d4d/667748f0fd8a2a7ff805267e/sbstta-22-inf-31-en.pdf](https://www.cbd.int/doc/c/a243/1d4d/667748f0fd8a2a7ff805267e/sbstta-22-inf-31-en.pdf)

\(^9\) As part of the process of developing the post-2020 global biodiversity framework established in [decision 14/34 of the Conference of the Parties to the Convention on Biological Diversity](https://www.cbd.int/doc/c/a243/1d4d/667748f0fd8a2a7ff805267e/sbstta-22-inf-31-en.pdf), a discussion paper has been developed summarizing and analysing the **initial views of Parties and observers**. The discussion paper has been considered in regional consultations and Parties and observers have submitted their written inputs to the CBD Secretariat and an Open-ended Working Group comprised of Parties to the CBD, against an April 15 2019 deadline. Taking into account the contributions received, the Secretariat will develop a new document with potential elements of the structure and scope of the post-2020 global biodiversity framework, which will be considered at the first meeting of the Open-ended Working Group on the Post-2020 Global Biodiversity Framework in August 2019. This document is an input to those discussions in August and may be updated during the year to be a further update to other meetings later in 2019 and early 2020.

\(^10\) To help all stakeholders navigate the process of meetings and other opportunities relevant to the post-2020 discussion over the next two years, UNEP-WCMC has worked with the CBD Secretariat to create “**The post-2020 Biodiversity Strategic Planning Timeline**”
Key Discussion Points

Key discussion points from the 2019 Cambridge workshop fall within the following categories, further elaborated in the sections below which are hyperlinked for ease of navigation:

1) Unpacking and outlining options for operationalising the 2050 Vision for Biodiversity;
2) Outlining proposed approaches for the post-2020 global biodiversity framework;
3) Outlining scientific proposals for an overall biodiversity state index (including biodiversity benefits to people), or set of indicators that could be useful to measure progress to 2030;
4) Exploring approaches to better connect biodiversity with climate change and land degradation agendas;
5) Progress towards the development of action-oriented targets;
6) Summarising the scientific status of potential indicators to measure progress towards 2030;
7) Summarising the scientific status of spatial data that can assist countries and other stakeholders to plan ways to implement the post-2020 global biodiversity framework;
8) Summarising the scientific status of web-based platforms that can support countries and others who will implement the post-2020 global biodiversity framework.

Detailed notes of the workshop discussions are available upon request from UNEP-WCMC: Neil.Burgess@unep-wcmc.org

1. Unpacking and outlining options for operationalising the 2050 Vision for Biodiversity

Workshop participants discussed the anticipated outcomes of the 2050 Vision for Biodiversity:

A world of “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.

The post-2020 global biodiversity framework would, therefore, need to establish a clear pathway to 2050, via milestones in 2030 and 2040. The main points from the discussion, and how they can inform a potential target-setting process for the post-2020 global biodiversity framework, are outlined below under each of the four key components of the 2050 Vision:

a. Living in Harmony with Nature
   ● ‘Living in harmony with nature’ can be seen as both an outcome of the other components of the Vision and as a criterion for the design of relevant actions.
   ● ‘Living in harmony with nature’ does not imply simply maintaining unmodified natural areas. It also implies a sustainable approach to farming, forestry, fishing and other ways of harvesting and using nature.
   ● It would be valuable to develop a wider and flexible understanding of ‘living in harmony with nature’ that can be adapted to different contexts (e.g. countries, cultures) - for example ‘our lifestyles and economies maintain the diversity and functioning of nature’. Science-based criteria could then be linked to maintaining diversity, and the functioning of ecosystem processes.
b. **Biodiversity is valued, conserved, restored and wisely used**
   - This component of the Vision could be seen as both an outcome to achieve by 2050 and as a means for achieving the Vision.
   The actions of valuing, conserving, restoring and wise use of biodiversity could be seen as complementary ways to achieve desired targets for the state and functioning of biodiversity and for sustainable development.


c. **Sustaining a healthy planet**
   - It may be helpful to define the key properties of a 'healthy planet'. This can support the development of suitable goals or targets.
   - Maximum thresholds for the state and functioning of nature for a ‘healthy planet’ could be outlined, for example, building on the concept of a ‘safe operating space’.


d. **Maintaining ecosystem services and delivering benefits essential for all**
   - This element of the Vision implies that actions are needed to ensure that the supply of ecosystem services / nature’s contributions to people is maintained for all people.
   Consequently, targets could be agreed for essential ecosystem services delivered at the national and local scale. The IPBES global assessment has reviewed the available literature and local and indigenous knowledge to assess trends in some global ecosystem services / nature’s contributions to people that might be informative in terms of setting possible targets and defining potential indicators.
   - Targets may also consider societal needs under expected human population growth to 2050. For example, global population projections indicate different consequences for nature’s ecosystem provisions and capacities.
   - It may also be useful for ecosystem services targets to consider the biophysical trade-offs in the supply of different services. For example, there are different ecosystem conditions to maximise the services of food production, carbon capture and biodiversity values. The decision of which ecosystem services are prioritised, and for which beneficiaries, is ultimately a societal choice. This choice can be informed by information on ecosystem condition and scenarios of change, and may vary according to whether the analysis is done globally, regionally, or nationally. Many scientists consider that ecosystem services / nature’s contributions to people are necessarily an issue for national and sub-national prioritisation. They are demand-based and culturally and contextually determined.

2. **Outlining proposed approaches for the post-2020 global biodiversity framework**

Workshop participants considered a number of approaches to identifying transformational actions as the basis of the post-2020 global biodiversity framework. These approaches can be grouped into four broad conceptual categories:

I. **Approaches that focus on protecting, conserving, restoring and retaining natural areas of land and sea.** There are various proposed spatial approaches that identify areas of biodiversity importance at different scales and using different criteria, with some of these approaches proposed as the overarching frame for the post-2020 global biodiversity framework.
Examples of these ideas include representative samples of ecoregions, wilderness areas, intact ecosystems, Nature Needs Half, Half Earth, Three Conditions retention targets and Key Biodiversity Areas (KBAs). These ideas have been supported by various global mapping exercises to identify the locations of key biodiversity “state” attributes globally, for example in recent papers and ongoing mapping and priority setting projects, with examples being Naturemap, Map of Life, the ‘global safety net’. The Chinese concept of Ecological Red Lining, although currently only operationalized at national scale, is an area-based planning approach that shares similarities with ideas developed elsewhere using systematic conservation planning approaches. It was noted that many of these ideas have a terrestrial focus, with relatively few covering the world’s oceans (National Geographic Society is focussing on efforts to help fill this gap). It was also noted that maps of restoration needs and restoration potential of land and sea are only now being developed and none are published yet. Another important distinction is between target-setting exercises (e.g. Half Earth, Nature Needs Half, Global Deal for Nature, Retention Targets etc.) and decision-support tools, which are agnostic to the level of ambition (e.g. Map of Life, NatureMap, Three Conditions, and tools that report progress towards reaching targets such as the UN Biodiversity Lab and the Biodiversity Indicators Partnership Dashboard). As these contain different biodiversity components each approach thereby provides some kind of implicit prioritisation.

Other related approaches focus on spatially defined areas of importance in terms of ‘benefits’ by mapping ecosystem services and nature’s contributions to people, for example, those being developed by Conservation International. This would focus on the identification of areas of potential critical natural capital and ecosystem service provision globally, and nationally.

18 IUCN (2016) A global standard for the identification of Key Biodiversity Areas, version 1.0.
21 See https://naturemap.earth/
22 See https://mol.org/
24 How China will protect one-quarter of its land? https://www.nature.com/articles/d41586-019-01563-2
25 See the following links for information on Conservation International’s efforts to map global critical natural capital: https://drive.google.com/file/d/1ynFKJp636VkXWum5T1Eqda74pPCpsiO8/view?usp=sharing; https://www.youtube.com/watch?v=vBApg0uFmdc&feature=youtu.be
informed by the creation of 12-13 global layers of different ecosystem service provision that could be used alongside maps of the global distribution of biodiversity.

II. Approaches that focus on **defining and acting on intervention levers (actions or ‘wedges’) that address drivers of biodiversity loss.**

These approaches are based on the assumption that taking action to address the root causes of biodiversity loss will help improve the status of biodiversity. This could also entail undertaking actions that are known to positively promote or restore biodiversity, as well as slowing its decline. A similar approach is used in the UNFCCC to address the drivers of climate change by noting actions that can be taken at different scales to stem greenhouse gas emissions. Application of this concept in the context of biodiversity is outlined in a number of different proposals (e.g. Bending the Curve26, *Science Based Targets*) that cover different spatial scales (i.e. national to local) and target a range of stakeholders (i.e. governments and companies). Each approach also aims to deliver biodiversity outcomes that would be assessed using a number of different indicator metrics (see next section).

The WWF Global Science Programme is also developing a proposal that aims to set targets for objectives, drivers and enabling conditions to create a pathway for transformative change. WWF proposed three global goals for 2030: Goal 1: Zero loss of natural habitats; Goal 2: Halve the footprint of production and consumption; Goal 3: Zero human-induced extinction of species. Global targets that drive transformative actions by specific sectors and actors that impact on biodiversity (e.g. infrastructure, mining) should complement these goals. The focus is on the key drivers of biodiversity loss identified by IPBES: land/sea use change; direct exploitation; pollution; alien invasive species; climate change; unsustainable consumption.27 WWF’s proposal was presented at the first meeting of the OWEG on the Post-2020 Global Biodiversity Framework (26-31 August, 2019 Nairobi, Kenya).

The approaches in this category include area-based actions, but also include actions relating to the economy, trade, consumption, waste, invasive alien species, hunting, sea use change, climate change, and other drivers identified in the IPBES Global Assessment.

III. Approaches that **focus on biodiversity and climate.**

The conceptualisation of the NatureMap project and the Global Deal for Nature stem from the realisation that biodiversity and climate change strategies need to be integrated and the latter has achieved more policy traction. Hence, one approach to the post-2020 biodiversity framework could be to forge a strong link to the objectives of the Paris Agreement adopted under the UNFCCC, also in recognition of the dependency of meeting international climate targets on the role of nature-based solutions. Such a strategy would seek to integrate biodiversity considerations (in terms of both nature-based solutions and safeguards) into national climate strategies, including the Nationally Determined Contributions and the mid-century Low-Emission Development Strategies. We know there is a broad correlation between carbon and biodiversity in many biomes, but this does not always hold true (for example in

---


ancient semi-desert areas where there is low carbon and high biodiversity). This correlation may also become less congruent at smaller spatial scales\textsuperscript{28}.

In 2018, CBD Parties at the UN Biodiversity Conference agreed to consider developing\textsuperscript{29} biodiversity commitments. Experiences from Nationally Determined Contributions and science-based targets for business in the climate field are relevant. The Paris Agreement has been successful in catalysing action and expanding implementation beyond national governments to local and regional governments, cities, and the private sector. This might also be possible for biodiversity using similar mechanisms.

More broadly, a joining of the climate and biodiversity agendas into a single approach, using some of the same implementation strategies, could create considerable synergies, streamline policy, and enhance delivery on the ground. It is worth considering, however, that there are areas of the world and issues that are specific to the conservation of biodiversity that cannot be addressed using a climate lens. One example is the conservation of centres of endemic species in low carbon habitats and actions targeted to reduce particular threats to species.

IV. Approaches focused on mainstreaming natural capital into sectoral reforms. There are fewer established examples of these approaches, but they include concepts such as “Ecological Civilization”\textsuperscript{30}, the “Satoyama initiative”\textsuperscript{31}, and “Natural Capital Accounting” approaches that are undertaken at national scales.

A related concept, operationalised through implementing wide series of actions and reforms, aims to ensure that we remain within a “Safe Operating Space”\textsuperscript{32} for humanity on planet earth and not transgress one of nine defined “Planetary Boundaries”. The Sharm to Kunming Action Agenda may also fall into this grouping.

Each of these ideas could be further elaborated to represent an overall approach to the post-2020 global biodiversity framework and align with the 2050 Vision. In addition, the synergies between these ideas could result in flexible and generic proposals for the operationalization of these concepts, produced and offered to Parties as templates for national action.

<table>
<thead>
<tr>
<th>Broad categories of existing scientific approaches</th>
<th>Area-Based</th>
<th>Intervention to Outcome Based</th>
<th>Biodiversity &amp; Climate Change Linkages</th>
<th>Mainstreaming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half-Earth</td>
<td>Bending the Curve</td>
<td>Global Deal for Nature</td>
<td>Planetary boundaries</td>
<td></td>
</tr>
<tr>
<td>30% by 2030</td>
<td>Science-based targets for biodiversity</td>
<td>Nationally Developed Contributions</td>
<td>Ecological Civilisation</td>
<td></td>
</tr>
<tr>
<td>Three Global Conditions</td>
<td></td>
<td></td>
<td>Satoyama Initiative</td>
<td></td>
</tr>
</tbody>
</table>


\textsuperscript{29} As appropriate to national contexts, individually or jointly, and on a voluntary basis

\textsuperscript{30} See \url{http://www.chinadaily.com.cn/china/19thcpncnationalcongress/2017-11/04/content_34115212.htm}

\textsuperscript{31} See \url{https://satoyama-initiative.org/about/}

3. Outlining scientific proposals for an overall biodiversity status index (including biodiversity benefits to people), or set of indicators that could be useful to measure progress to 2030

Each of the overall approaches set out in the section above contains ideas of what the overall ‘status’ measure for the post-2020 biodiversity framework, and/or the 2050 Vision might be. There is ongoing work to consider options for an overall biodiversity status index, or a small set of indicators, aligned to the 2050 Vision. Based on the ideas presented at the meeting, three broad groupings might be recognised:

I. The importance of a communications-oriented target and associated indicator

The 2°C target is a politically-defined target that captures what the Paris Agreement is aiming to achieve to tackle climate change. A number of scientists are considering a similar type of target for the post-2020 global biodiversity framework. Although many concerns were raised about the concept, one suggested equivalent to the ‘2°C equivalent communication target for biodiversity’ might be the ‘rate of species extinction’. The potential for communicating a metric linked to such a target was demonstrated by the IPBES Global Assessment where the ‘1 million species face extinction’ measure received significant global media attention (also in part as being the main message promoted by IPBES itself). The workshop discussion made it clear that such an indicator would represent only a very narrow aspect of the breadth of the biodiversity concept. For example, this metric would not capture the ecosystem element of the biodiversity definition, nor the ecosystem services/nature’s contributions to people element of the 2050 Vision, nor the abundance of species not close to extinction. Extinction risk might also not be responsive enough to assess smaller changes in biodiversity and hence give a false impression of security.

Another proposed option was using threat-related metrics, such as the Human Footprint Index, and focus messaging on how that metric is being reduced in different geographical units of the planet. This kind of communication metric would potentially relate to the main drivers of biodiversity loss outlined in the IPBES Global Assessment.

A political decision will need to be made on whether a communication level target and indicator is useful, and which of the various options best aids communication and promotes action.

II. Indicators relating to different approaches

Several proposals have been made for overall indicators that can track the outcomes of the different approaches to the creation of the post 2020 biodiversity framework that are outlined above. These indicators can be broadly grouped into those relating to ‘area-based approaches’ and ‘action-based

---

33 For more on this topic refer to policy brief “From Paris to Beijing: Insights gained from UNFCCC Paris Agreement for the post-2020 global biodiversity framework”

34 Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, available from:
approaches'. Many of these ideas remain at the conceptual stage with no supporting publications. However, all are actively being worked on and detailed supporting materials will become available in coming months.

*Area-based approaches*

**Half Earth, Nature Needs Half, 30% protected by 2030.** The primary indicator for these approaches would be protected area coverage and change over time, based on the World Database on Protected Areas (WDPA) \(^{35}\), but also including data not currently within the WDPA. These approaches cover land and sea, and consider government, community and privately conserved areas, and “Other Effective Areas Based Conservation Measures” (OECMs). A measure of conservation outcome - for ecosystems and species - could also be included as proposed by Visconti *et al.* (2019).\(^{36}\) Despite the simplicity of these area-based measures, it was widely commented at the workshop that a simple area-based target is insufficient unless it also incorporated targets on the other aspects of Target 11 such as equitable management and governance (and resource mobilization Target 20). The adequacy of management and funding are key to an area-based target achieving the underlying conservation vision, and so funding and management levels should be tracked and targets established. The degree to which any expanded PA system increases coverage of species, or habitats/ecosystems, or ecosystem services, is also important (and recent PA expansions have performed poorly).

**Three Global Conditions for Biodiversity Conservation and Sustainable Use.** This proposed framework maps the terrestrial world by combining global maps of the wide range of human land-uses and eight human-caused pressures on land determined by the Human Footprint v 2.0 and sorts Earth's land into three broad conditions: Cities and farms (Condition 1), Shared landscapes (Condition 2) and Large wild areas (Condition 3). It analyses several conservation and human use variables: human population, above- and below-ground carbon, existing protected areas, distribution of vertebrates and threatened vertebrates, Key Biodiversity Areas, indigenous interests in land, and food calories produced. These values and uses are differentially present in each condition. This permits the identification of suites of conservation and sustainable use actions and practices appropriate to those values for each condition. Metrics can be developed for these actions and practices. For example, the Human Footprint provides an overarching metric of relevance to Condition 3. An article detailing this approach has been submitted to a journal for publication.

**Retention Targets.**\(^{37}\) This proposal argues that protected area targets, regardless of their ambition, will never be large enough to achieve the full suite of global nature conservation goals. Outside of protected areas, destruction of the natural world continues, extinguishing options for further conservation. There is therefore an urgent need for new targets that maintain humanity’s life support system and its options for the future. Retention targets, set high, would conserve our options to maintain critical ecosystem services for humanity, and make room for growth in protected areas. It is argued that global retention targets must meet three criteria: 1) they are measurable and relate to a target state, not a target rate of change; 2) they are set high; and 3) they act as a framework designed to enable and support the achievement of multiple targets aimed at securing the full range of different goals for nature and human wellbeing. A post-2020 global conservation strategy with a focus on ends, not just means, needs measurable targets for the retention of nature to avoid an irreversibly

---

35 See https://www.protectedplanet.net/
impoverished natural world. The authors of the original thought-piece are now generating a global assessment of what a series of nature retentions targets need to look like, focusing on biodiversity, carbon, water and human well-being needs.

*Indicators for actions based approaches focusing on species*

**The ‘Aiming Higher’ or ‘Bending the Curve’ concept.** Mace *et al.* (2018) propose three state indicators to measure the biodiversity outcomes delivered by a suite of actions aimed at reducing, and then reversing, biodiversity loss. The proposed indicators are: The Red List Index of extinction risk over time (RLI) derived from the IUCN red list; the living planet index (LPI) of species population trends derived from the Living Planet Database; and the Biodiversity Intactness Index (BII), which is derived from a model of how the species assemblage responds to land use change and other factors. These three indicators cover the species and (to some degree) ecosystem elements of biodiversity. Although not specific, this approach is largely terrestrial focused and some of the indicators do not exist for the marine environment (BII).

**Science-Based Targets Network biodiversity hub.** This approach has a similar logic to Bending the Curve but is primarily aimed at businesses, and uses different indicators. The biodiversity hub of the science-based targets network has proposed the use of two measures - one for species and one for ecosystems. For species, they propose an index that assesses how the reduction of threat affects the IUCN red list index (STAR index). The science-based targets biodiversity hub is also working on an equivalent index for the ecosystems elements of biodiversity. No measure is proposed for genes. This approach could be used on land and in the oceans, but at present there is no published supporting documentation.

*Indicators for ecosystems based approaches*

**Measures of ecosystem collapse.** Although not a strong focus of the meeting, the workshop also considered measures of ecosystem health and possibility for ecosystem collapse and how this might be measured. A number of recent papers have elaborated this concept38 39 40. Other related ideas include ‘tipping points’ which are implicit in planetary boundaries discussions, i.e. setting the boundary high enough that the tipping point can be avoided. The IUCN Red List of Ecosystems, although only partly developed, provides a framework and set of thresholds for measuring progression towards the collapse of whole ecosystems. Ecosystem-scale condition indicators can also be developed, for example, forests using the Global Forest Watch tool. Ideally these condition indicators would also capture trends in the processes and functions of the ecosystem upon which the delivery of service provision depends.

**Ecological integrity index.** A proposal has been made by the Wildlife Conservation Society (WCS) and partners (including World Resources Institute (WRI) and UNDP) to develop a high-resolution metric of

---

ecosystem condition that captures habitat loss, degradation and fragmentation effects on land, responding to Principle 7 of the Rio Declaration around ecological health and integrity. This approach maps the integrity of ecosystems and aims to facilitate the setting of quantitative state-based targets for this parameter at global, national level and subnational levels. This target-setting will help to ensure that the integrity of the Earth’s ecosystems (including the most intact ones in each geography, but also recognizing the value of partially degraded ecosystems) are effectively conserved and restored. At present this index is not published; a version specific to forests is being prepared for publication. An equivalent approach for the Oceans is also under development through National Geographic Society (NGS) and WCS. A related paper mapping ecosystem integrity at the scale of terrestrial ecoregions has been submitted for publication.41

III. A Multidimensional Biodiversity Index

Biodiversity is a multidimensional concept that is currently tracked using a variety of indicators measuring different aspects of biodiversity state. Learning from other disciplines (health, poverty, economics) suggests that the complexity of multiple dimensions of biodiversity might be tracked over time in a simplistic way by using a single index. The current concept of a Multidimensional Biodiversity Index (MBI)42 would aim to provide a framework that harmonises and enables flexibility in how biodiversity is measured across scales and contexts. It would combine species, ecosystems and other elements of biodiversity (such as benefits to people) to offer a more integrated approach to monitoring state of biodiversity. If suitable metrics for the genetic component of biodiversity were available, these could also be incorporated into the index, as could measures of ecosystem services/nature’s contributions to people.

It should be noted that there is currently no scientific consensus on the utility of the proposed multidimensional biodiversity index. Workshop participants discussed whether it is feasible or desirable to develop a Multidimensional Biodiversity Index, how the development of such an index might learn from other efforts (for example GDP, Multidimensional poverty index, etc.), and how the 2050 Vision for Biodiversity might be used as a conceptual framework to develop the index. The four elements of the Vision (‘conserved’, ‘restored’, ‘wisely used’ and ‘valued’) could be considered overarching elements of the index. Alternatively, the framework could be simplified to two overarching elements aiming to define 1) the state of biodiversity (constituted by the components of the Vision ‘conserved’ and ‘restored’) and 2) the ‘benefits’ to people (contributions to people) constituted by the elements ‘wisely used’ and ‘valued’.

Other suggestions included the potential for an overarching index around three main elements from the Vision: 1) Protection, 2) Restoration and 3) Benefits. A potential MBI composed of these three elements would be a measure of overall ecological integrity or resilience. Connectivity was also highlighted as an element to incorporate into the measurement dimensions. The dimensions within both the ‘state’ element and the ‘values’ or ‘benefits’ element of the index would need further definition; for example, the ‘health’, ‘education’, ‘economics’ etc. dimensions of biodiversity. The index could potentially include not only measures on state, but measures on commitments and actions (level of commitment towards a biodiversity outcome and actions implemented towards achieving that outcome in terms of, for example, policies and practices).

The development of the Multidimensional Biodiversity Index is ongoing and additional information including proof of concept and its application will be made available in coming months.

42 See https://luchoffmanninstitute.org/work/a-multidimensional-biodiversity-index/
4. Exploring approaches to better connect biodiversity with climate change and land degradation agendas

Workshop participants discussed how the mapping of carbon, its storage, and its sequestration (through restoration and intact ecosystem sinks), might overlap spatially on land and in the oceans with biodiversity and other ecosystem services (such as water provision on land and fisheries in the oceans). Initial work on carbon and biodiversity and how natural areas are required to be conserved for both climate stabilisation and biodiversity conservation are outlined in the proposal for a “Global Deal for Nature” (Dinerstein et al. 2019). The “NatureMap” initiative aims to produce initial high resolution of carbon, biodiversity and water provision maps for the UN Climate Summit in September 2019, with further products produced up to the Kunming meeting. Initial products for carbon, fisheries and biodiversity in the oceans will also be available in September 2019 (produced by a consortium headed by the National Geographic Society). These two groups aim to combine their products into a single set of global layers in 2020 and work with other groups to maximise the synergy and coherence of the products. The potential areas for restoration - linking to the land degradation agenda, the UN Convention to Combat Desertification, and the UN Decade on Ecosystem Restoration (2011-2030) - are being developed by various partners. These ongoing areas of work could be further harnessed to inform the development of the post-2020 global biodiversity framework and make relevant linkages across the Rio Conventions.

Detailed work to map ecosystem services and the linkages between biodiversity and the SDGs is also being undertaken with leadership from the Natural Capital project, and Conservation International, but with work also being done at UNEP-WCMC, IUCN and elsewhere. Initial products highlight the potential of this approach using the same datasets, indicators and spatial map products for measuring progress towards the achievement of the SDGs and to-be-agreed post-2020 global biodiversity framework.

5. Progress towards the development of action-oriented targets

When developing the post-2020 global biodiversity framework, lessons can be learned from previous target-setting processes and their implementation. For example, recent studies suggest that SMART (Specific, Measurable, Achievable, Relevant, Time-bound) Aichi targets were more likely to gain traction under the current Strategic Plan for Biodiversity 2011-2020. Developing indicators and indexes in parallel to the development of the framework and its targets will help to ensure that necessary indicators and spatial data at national and sub-national scales are in place at the adoption of targets. This would also inform their measurability through the provision of baselines and distance to target measures.

---

Proposals for targets linked to indirect drivers

Workshop participants discussed the possibility of developing targets related to the following indirect drivers: a) production and consumption patterns, b) human population dynamics and trends, c) trade, d) technological innovations and e) local through global governance. Participants suggested that there are good data available to track trends in some of these (e.g. population trends), but others are more challenging (e.g. local to global governance). It is also challenging to link the indirect drivers to some of the proposed biodiversity ‘state’ indicators of species and ecosystems, although some modelling approaches might be able to help (for example the IIASA GLOBIOM model)\(^{47}\). There was also discussion about how these indirect drivers and related targets could be part of the post-2020 framework. The discussion was not conclusive although it was widely recognised that this is an extremely important topic where more scientific attention is required.

Proposals for targets linked to direct drivers

The workshop considered the feasibility of defining targets that relate to the direct drivers of loss in biodiversity and ecosystem services / nature’s contributions to people: a) changes in land and sea use; b) direct exploitation of organisms; c) climate change; d) pollution; and e) invasive alien species. Of these, it was concluded that datasets suitable to track changes over time are poorly developed for the direct exploitation of organisms (other than marine fish) and for invasive alien species. The relationship between these direct drivers and changes in biodiversity state measures is better known than for indirect drivers, though this knowledge is mostly based on modelling. It will be challenging to set targets to reduce the direct drivers of biodiversity loss and accurately relate these to a change in the biodiversity state; however, only by addressing the drivers of biodiversity loss will the 2050 vision and any 2030 milestones towards it be realized. Understanding and measuring the biodiversity outcomes resulting from actions to address drivers remains a scientific challenge to address.

Missing targets

In light of the above discussion, workshop participants highlighted an important element from the IPBES Global Assessment that is missing within the current Aichi targets. This is the external impact of unsustainable international trade, one of the major indirect drivers of biodiversity loss. This target involves enhancing the sustainability of commodity supply chains, the transparency of supply chain data and trade impacts, and would have a larger focus on private companies and investors. This issue is not addressed by the current Aichi Targets.

Proposals for new targets

The workshop reviewed proposals for new targets in both the scientific literature and in the government submissions to the CBD in April 2019. The aim was to provide negotiators with an overview of existing proposals. The consolidation of these proposed targets and suggested measures of success is contained in “A list of proposed targets” for the post-2020 global biodiversity framework. Most of the proposed new targets stem from the academic community and relate to protected areas and the conservation of species. A few also relate to unsustainable and illegal wildlife trade,] the removal of invasive alien species and the establishment of national biodiversity observation systems.

There may also be reports as well as scientific papers that contain proposals for targets that were not captured in this preliminary exercise. As a result, we see this element as a work in progress that can be maintained and made available to support the post-2020 process as it continues over 2019.

**Improvements of existing targets**

Participants noted there are two recent papers (Butchart et al. 2016\(^{48}\) and Green et al. 2019\(^{49}\)) that have looked in detail at the existing Aichi Targets and assessed to what extent these targets have been successfully achieved, where they might need adjusting, and how the role of a SMART target is linked to measurable progress towards that target. These two papers are recommended for use in upcoming discussions on target setting. National level assessments of the progress towards the achievement of targets are also in preparation by NatureServe.

The workshop looked in more detail at **three of the existing Aichi Targets** for which participants had particular expertise: 5, 11 and 15. The discussions are summarized below.

**Aichi Target 5: Conserving Habitats**

Workshop participants commented that current targets are narrowly framed around conserving state and reducing loss.\(^{50}\) The suggested improvements to this target were to:

- frame the target around retention, restoration and connectivity rather than loss and fragmentation;
- within each significant ecosystem, at all relevant scales, maintain and enhance the extent and integrity of natural vegetation (or whatever the desired ecosystem outcome is) to avoid the perverse outcome of the overall rate of loss being reduced, while certain ecosystems continue to be destroyed;
- broaden the focus from forests to all ecosystems;
- clarify the baseline, i.e. ‘halving’ the rate of loss relative to what baseline, or move to a state based outcome on ecosystem condition;
- focus on qualifying and targeting ecosystem area and quality (via an ecosystem integrity index) and on outcomes for biodiversity rather than just area alone. It was also noted that Targets 5 and 15 need to be linked and reinforce each other.

**Aichi Target 11: Protected and Conserved Areas**

Progress towards this target has been better than for most others. However, there are a number of ways in which the target could be improved. One key element would be for the target to focus on the delivery of a positive change in the state of biodiversity within protected areas. Other important elements discussed were: coverage (x%); representation (e.g. habitats; ecoregions; species); areas of importance; connectivity; equity; ecosystem services and effectiveness.

The definition of many of these elements need further clarification (i.e. how should areas of importance be defined?). Indicators were proposed for the headline target (total area); representation (proportion of relevant category of biodiversity within protected areas); areas of importance

---


\(^{50}\) Visconti et al. (2019) have put forward a proposed formulation for a new target: “The value of all sites of global significance for biodiversity, including key biodiversity areas, is documented, retained, and restored through protected areas and other effective area-based conservation measures.” However, there is currently no consensus on this formulation.
(proportion of important sites protected) and connectivity. However, workshop participants were unsure of existing data that could be used as an indicator for equity, ecosystem services and effectiveness. Participants suggested that connectivity and ecosystem services may require their own targets. It was also proposed that there could be a new indicator for any future update to Target 11: Mean Target Achievement metric (see Jantke et al., 201951).

Aichi Target 15: Resilience and climate change mitigation through conservation and restoration

Workshop participants noted the current target on resilience and climate change mitigation does not clearly address the expected impacts of climate change on the location and composition of ecosystems. The two proposed pathways to achieve the target are assumed to be conservation and restoration.

It was concluded that ‘resilience’ is an intuitively attractive concept, but is difficult to define and use as a guide for ecosystem-related decision-making. Defining ‘resilience of what, to what’ is important because ‘resilience’ will usually mean different things for different pressures (e.g. climate change, pollution, habitat fragmentation, invasive species).

Suggested ideas for updating the current Target 15 include a stronger focus on promoting ecosystem-based adaptation to climate change, with a maximum contribution to carbon sequestration and storage. It was recognized that a global percentage ambition for this target cannot be meaningfully defined for diverse ecosystem types. The emphasis on ‘promote’ rather than ‘ensure/achieve’ recognizes that it is not realistic to ensure adaptation. Suggested metrics/indicators for a revised target were: a) Persistence of species composition; b) Carbon stored and carbon sequestered/emitted; c) Persistence of vegetation structure; d) Persistence of food web structure; Ecosystem functional diversity e) a holistic measure of ecological integrity.

6. Summarising the scientific status of potential indicators to measure progress towards 2030

Workshop participants used the Driver, State, Pressure, Responses, Benefits framing to discuss available/soon to be available data, gaps and potential further developments on indicators that might be useful in the context of the post-2020 framework.

Workshop participants drew upon existing work to create “A (preliminary) list of indicator trend data available”. This table of data is based on the Ad hoc Technical Working Group on indicators for the Strategic Plan for Biodiversity 2011-2020.52 The table also includes indicators that have been developed by the Biodiversity Indicators Partnership (BIP), as well as indicators from the SDG goals and targets process, and the IPBES Global Assessment. The table was updated at the workshop and contains a detailed overview of indicators that might be used to track progress towards targets that could be eventually defined within the post-2020 global biodiversity framework. The session concluded that although there are many indicators available, there has not been a major increase in scope since 2010 and there has been limited uptake and use of these indicators in National Reports to the CBD. Indicator gaps remain for sustainable use, hunting on land, invasive alien species, illegal wildlife trade, human-wildlife conflict, restoration, and trends in habitats beyond forests and wetlands.

It is envisaged that the overview of indicator data will be updated and shared with the BIP Secretariat to support discussion on indicators to assess progress towards the post-2020 global biodiversity framework. This information would also be used to assess proposed targets to determine their measurability as suggested by UNEP-WCMC and NatureServe.

7. Summarising the scientific status of spatial data that can assist countries and other stakeholders to plan ways to implement the post-2020 global biodiversity framework

Many countries have developed various maps of spatial importance for biodiversity and ecosystem services within the framework of National Biodiversity Strategies and Action Plans (NBSAPs). Platforms such as the UNBiodiversity Labs tool or ResourceWatch have helped provide relevant spatial data for countries. It is expected that this support will continue to be developed during the implementation of the post-2020 global biodiversity framework.

A list of spatial data available was produced prior to the workshop and participants had the opportunity to make additions over the course of the week. During the meeting, workshop participants reviewed many of these layers against the Driver, State, Pressure, Responses, Benefits framework. This was done for available data and soon to be available data. Participants also identified gaps and potential further developments on spatial data layers that might be used by countries and others to help define actions at national scale and on the ground.

Scientists are continuing to develop spatial data layers at the global scale that might be useful to support implementation of the post-2020 framework at a national scale, and this is expected to continue.

The meeting concluded that a range of datasets on the species and ecosystems elements of biodiversity are available, but there are no readily available datasets on the genes element of the CBD definition of biodiversity.

Participants also concluded that there are available data for some aspects of pressures on biodiversity. However, there are gaps in data for some of the key drivers identified by the IPBES Global Assessment relating to direct exploitation of species (hunting on land (fishing in the sea is well covered), illegal wildlife trade) and invasive alien species. Datasets and indicators for some of these are under development.

Some elements of responses – such as state managed protected areas - are well covered by existing data. However, there are gaps for other responses, such as community and other non-state conserved areas, restoration of habitats, and improved agricultural systems. More broadly, the workshop participants struggled to identify data that relates to the ‘levers of transformational change’ identified in the IPBES Global Assessment.

Available work on mapping benefits from ecosystem services or nature’s contributions to people at global and national scales is not as elaborated or available as for other areas, except for specific cases,

53See https://docs.google.com/spreadsheets/d/1pPN8P6azPXMQeAs3gNZLm-kDxUwmjoY2Bpx7GW5fSjU/edit#gid=0
such as forest carbon. However, work is progressing rapidly and there will be datasets to cover the global distribution of a number of ecosystem services before the end of 2019. These new datasets can feed into the ongoing IPBES methodological assessment regarding the diverse conceptualisation of values of nature and its benefits, including biodiversity and ecosystem services. This would allow countries to better plan the use of areas of land and sea that deliver key ecosystem services or nature’s contributions to people and need particular management to maintain these benefit flows.

**Linking state, pressure, response and benefits datasets.** Linking data on responses to changes in pressure and improvements in state is challenging, and workshop participants were unable to make this link, except for a few key interventions such as protected areas. However, it was noted that this has been successfully done by the IIASA team in Austria for the Bending the Curve analyses which are included in the IPBES Global Assessment. Much could be learned from that approach, potentially when applied at regional or national scales. There are also opportunities to advance this via collaboration with advanced data analytics as offered by the SAS Corporation to NatureServe.

**Criteria for robustness of datasets and indicators.** The workshop participants discussed the need for criteria to assess the robustness of spatial datasets and indicators that are available to support the post-2020 process. It was noted that the Biodiversity Indicators Partnership (BIP) already has criteria for indicators (Table 2). Criteria for spatial data on threats are contained in the paper by Joppa et al. (2016)55 (Table 3), and there were other examples of criteria available – such as FAIR56 data principles and criteria.57 These approaches might assist in setting standards for spatial data and indicators to be used in implementing the post 2020 biodiversity framework.

| Table 2 Criteria for assessing indicators proposed for inclusion in the Biodiversity Indicators Partnership (BIP) |
|-------------------------------------------------|-------------------------------------------------|
| **Policy relevant**                             | **Essential:** Indicator(s) relevant to one or more of the Aichi Biodiversity Targets.  
**Desired:** Indicator features in the indicative list of indicators for the Strategic Plan for Biodiversity 2011-2020.  
Indicator(s) relevant to the Targets of other biodiversity-related MEAs and processes, including the SDGs. |
| **Temporal data production and sustainability**  | **Essential:** Plans in place to continue indicator production and produce regular updates – not an isolated one-off study.  
**Desired:** Indicator data updated annually. |
| **Aggregation and flexibility**                  | **Essential:** Indicator applicable at the global or regional scale.  
**Desired:** Indicator aggregated from national level data or can be disaggregated to the national level. |
| **Scientifically sound**                         | **Essential:** Indicator(s) must be based on clearly defined, verifiable and scientifically acceptable data, which are collected using standard methods with known accuracy and precision, or based on traditional knowledge that has been validated in an appropriate way. All underlying data sources must be used in compliance with any associated terms of use, with clear acknowledgement of the source.  
**Desired:** Peer reviewed in scientific literature |

56 Findable, available, interoperable, reusable
57 See [https://www.go-fair.org/fair-principles/](https://www.go-fair.org/fair-principles/)
Complementarity

**Essential:** Indicator complements existing indicators in the BIP suite. Indicator provider will work with providers of relevant existing indicators to develop joint storylines.

**Desired:** Indicators fill demonstrable ‘gaps’ in the existing suite.

Sensitivity

**Essential:** Indicators should be sensitive to show trends and detect changes in systems in time frames and on the scales that are relevant to the decisions, but also be robust so that measuring errors do not affect the interpretation.

---

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Definition and Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freely available - 153 data sets (53%)</td>
<td>These data sets are freely available (at least for non-commercial use). Being freely available is necessary, but insufficient, as a free data set may be impossible to access, depending on the technical capacity of users.</td>
</tr>
<tr>
<td>Spatial resolution - 124 data sets (43%)</td>
<td>These data sets are at a gridded spatial resolution of ≤10 km × 10 km or are stored in vector format. Of species on the IUCN Red List, 23% have ranges smaller than 1000 km², which could be covered with no more than 10 grid cells, a minimum desirable resolution for most analyses.</td>
</tr>
<tr>
<td>Up to date - 149 data sets (51%)</td>
<td>These data sets were produced within the last decade: a time frame sufficiently recent to inform current and future policy.</td>
</tr>
<tr>
<td>Repeated - 163 data sets (56%)</td>
<td>These data sets are available for at least two time points. Changes over time are fundamental for many conservation assessment criteria and for understanding impacts of regulatory policies.</td>
</tr>
<tr>
<td>Assessed for accuracy - 112 data sets (39%)</td>
<td>These data sets are likely either direct observations or modelled data sets that have been assessed for accuracy at a global scale. Conservation assessments are generally subject to independent review, and data sets used must be of sufficient scientific rigor.</td>
</tr>
</tbody>
</table>

The above examples could be used to elaborate further criteria for spatial data layers that can be made available through online platforms (see below) to support national governments and other stakeholders in the implementation of the post-2020 framework.

A further compounding element of both of the above tables is the not uncommon requirement for data to be ‘validated’ for national use by governments, often legally mandated, without which these datasets cannot (and will not) be used by decision makers.

---

8. Summarising the scientific status of web-based platforms that can support countries and others implement the post-2020 global biodiversity framework

Online data platforms have an important role to play in assisting countries and other stakeholders to take action and measure progress. There has been a rapid increase over the past five years in the number of available web-based data platforms. Many of the existing platforms are linked to the policy needs of the CBD, and some are also targeting business users and the general public. As mapping and indicator platforms are part of the scientific contributions to support the development and implementation of the post-2020 global biodiversity framework, the workshop provided an
opportunity to convene the different platform managers who were present, and subsequently reach out to those who were not there.

An output from these consultations is an overview of the different platforms\textsuperscript{58}. This table provides information on the spatial and temporal data they collect and the user communities they aim to serve. Most platforms are differentiated by their target user base, with some targeting countries and the needs of the CBD and other conventions, while others target companies or the general public. Most platforms are using a similar base of data layers and indicators that are supported by relatively few partners over the longer term. This creates a dependency of the platforms on a narrow range of partners, and the limited financing available to maintain global public good biodiversity datasets. Work led by the Group on Earth Observations - Biodiversity Observation Network - is focusing on improved systematic and interoperable approaches to the coordination and acquisition of biodiversity data to better underpin these decision-support systems.

Most platforms use global datasets. For some of the platforms, for example the UN Biodiversity Lab and Global Forest Watch, countries can integrate their national data and use them alongside global datasets. These national data can be retained within password protected private domains where national use restrictions on data can be respected. This may be important for some countries.

In summary, there are a large number of platforms aiming to support countries and other stakeholders to implement area-based and actions-based commitment to conservation. These platforms could also be adjusted and aligned in accordance with the resulting post-2020 framework and provide an important assistance to achieving targets, addressing threats, enhancing the transparency of actions, and reversing the loss of biodiversity. There is also a platform developed and being modified to support continual, forward-looking tracking of the Post-2020 targets at global and national scales.

**Conclusion**

The scientific community is undertaking a considerable amount of work relevant to the post-2020 global biodiversity framework. This work includes: (1) seeking to inform understanding of the 2050 Vision, (2) identifying different approaches to the overall framing of the post-2020 global biodiversity framework, (3) reviewing the potential to develop overarching indicators or indexes of progress towards agreed targets, and (4) compiling the available indicators and spatial data that can be used to track progress. The meeting also brought together a number of groups who are developing, and will continue to develop, online, web-based resources that aim to assist countries to implement and track progress of the post-2020 biodiversity framework. The scientific community - including those represented at the 2019 meeting in Cambridge - is ready to provide further scientific input to support the development of the post-2020 global biodiversity framework, as well as for its subsequent implementation.

\textsuperscript{58} This table is a work in progress and further work will be needed to maintain the database and facilitate cooperation between various tool and platform managers and the services they provide.