ECOLOGICAL CONNECTIVITY INDICATORS FOR MEASURING PROGRESS TOWARDS THE POST-2020 GLOBAL BIODIVERSITY FRAMEWORK

A Report of expert and CBD Party consultations

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Convention on Biological Diversity
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Executive Summary

Ecological connectivity is defined as **the unimpeded movement of species and the flow of natural processes that sustain life on Earth**[1]. It is a fundamental requirement for functioning ecosystems and for migratory species. Parties to the CBD recognised the importance of connectivity in Aichi Biodiversity Target 11 of the Strategic Plan for Biodiversity 2011-2020 and it is recognised across the draft post-2020 global biodiversity framework.

This document summarizes recent discussions on relevant indicators for measuring ecological connectivity across the post-2020 global biodiversity framework, drawing on the outcomes from a virtual expert workshop convened in April 2022, and further discussion in an online webinar with Parties to the CBD and observers in October 2022.

Key messages arising from the virtual expert workshop held in April 2022 were:

1. Currently, the proposed headline, component and complementary indicators in the draft monitoring framework for the post-2020 global biodiversity framework do not cover key aspects of connectivity. Important gaps include measuring connectivity in relation to the connectivity for migratory species and coastal/marine and inland aquatic ecosystems.

2. To address this need, the workshop participants proposed that a headline indicator could be developed within the next two years and would be expressed as follows: *"Status and trends in ecological connectivity: structural, functional, and migratory connectivity across terrestrial, coastal/marine, and inland aquatic ecosystems".* The indicator could be developed drawing on available data from component and complementary indicators of relevant goals and targets.

3. In addition, the currently proposed component and complementary indicators should be supplemented with additional indicators to fill some of the current gaps, including migratory species and coastal/marine ecosystems.

These recommendations were discussed during a webinar on 31st October 2022, attended by 241 participants from 121 countries. There was discussion about the process by which a headline indicator on connectivity might be proposed and developed. Participants also noted the relevance of maintaining and monitoring ecological connectivity in relation to restoration under draft target 2 of the post-2020 global biodiversity framework, and the importance of filling existing data gaps for measuring connectivity.

[1] UNEP/CMS/Resolution 12.26 Improving ways of addressing connectivity in the conservation of migratory species. Available at https://www.cms.int/sites/default/files/document/cms_cop13_res.12.26_rev.cop13_e.pdf

1. Introduction

The importance of ecological connectivity for achieving biodiversity conservation outcomes is reflected within the draft goals and targets of the post-2020 global biodiversity framework[2]. Ecological connectivity is a core element of draft Goal A which seeks to ensure "*the integrity, connectivity and resilience of natural ecosystems* ….". In addition, draft target 1 seeks to improve spatial planning to enhance ecological connectivity and deliver conservation outcomes; draft Target 2 applies restoration to enhance connectivity; draft Target 3 seeks to expand area-based conservation that is well-connected and draft Target 12 seeks to increase connectivity of 'green and blue spaces' in urban areas. Given this recognition of the importance of ecological connectivity for achieving the 2050 Vision for Biodiversity, understanding how ecological connectivity might be measured is a key need for the post-2020 global biodiversity framework[3].

2. Summary of key outcomes from the expert workshop

An expert workshop was held virtually on 20-21 April 2022, convened by the Center for Large Landscape Conservation (CLLC), the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) and Secretariat of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). The workshop convened 34 experts (Annex 1) to discuss the proposed and available indicators for the relevant goals and targets of the post 2020 global biodiversity framework in terms of i) what each one measures, ii) their benefits and limitations and iii) recommendations for refinements and improvements to deliver and use them.

The workshop participants identified 13 indicators of most relevance to connectivity that were suggested for inclusion in the draft monitoring framework at that time (Table 1). The workshop identified 3 additional indicators (ie, those that are currently available and published but not in the draft monitoring framework) and 3 indicators that are currently under development and can fill important gaps. All three of the additional indicators are relevant for target 3. Two of these, namely the Protected Area Isolation Index PAI (Brennan et al. 2022), and the Protected Network metric ProNet (Theobald et al. 2022) and are now included in the in the latest draft monitoring framework[4] which will be considered by Parties at CBD COP15. ConnIntact, which measures structural connectivity provided by intact lands (Ward et al. 2020), is not currently included.

[2] Recommendation WG2020 4/1, adopted by the Open-ended working group on the post-2020 global biodiversity framework. Available at https://www.cbd.int/doc/recommendations/wg2020-04/wg2020-04-rec-01-en.pdf

[3] Recommendation SBSTTA 24/2, adopted by the Subsidiary Body on Scientific Technical and Technological Advice on the proposed monitoring framework for the post-2020 global biodiversity framework. Available at https://www.cbd.int/doc/recommendations/sbstta-24/sbstta-24-rec-02-en.pdf

[4] Draft decisions COP/15/2 for the fifteenth meeting of the Conference of the Parties to the Convention on Biological Diversity, Part 9B, pg.14. Available at https://www.cbd.int/doc/c/e8d3/33c3/656975535276d053bebf97c4/cop-15-02-en.pdf

Table 2 summarizes the gaps relating to measuring different aspects of connectivity, including structural connectivity (which includes recognition of ecological corridors)[5], functional connectivity, coastal/marine ecosystems and migratory species.

Table 1. Indicators in the current draft monitoring framework, additional and future/in development indicators for ecological connectivity as they relate to draft Goal A and draft Targets 1,2, and 3 (headline, component and complementary indicators are shown)

Goal/Target	Indicators in the monitoring framework	Additional indicators currently available	Indicators that are in development
Draft Goal A	- Species Habitat Index (SHI) - Conservation status of migratory species, as a proxy indicator of connectivity - Ecosystem Integrity Index (EII) - Forest Landscape Integrity Index (FLII) - Bioclimatic Ecosystem Resilience Index (BERI) - Ecosystem Intactness Index (EII) - Biodiversity Habitat Index (BHI)		
Draft Target 1			- Number of National Biodiversity Strategies and Action Plans including provisions for improving ecological connectivity in spatial planning - Number of national laws, regulations, and policies promoting ecological connectivity - Number of international projects

[5] IUCN 'Guidelines for conserving connectivity through ecological networks and corridors' https://portals.iucn.org/library/node/49061

			promoting ecological connectivity in spatial planning
Draft Target 2	- Forest Landscape Integrity Index (FLII) - Free-flowing rivers (FFR) - Bioclimatic Ecosystem Resilience Index (BERI) - Maintenance and restoration of connectivity of natural ecosystems		
Draft Target 3	- Protected-Connected Index (ProtConn) - Protected Area Representativeness and Connectedness Index (PARC) - Protected Area Isolation Index (PAI) - Protected Areas Network metric (ProNet)	- Structural connectivity provided by intact lands (ConnIntact)	- Extent to which protected areas and other effective area-based conservation measures (OECMs) cover Key Biodiversity Areas that are important for migratory species - Condition of KBAs that are important for migratory species

Table 2. Summary of available indicators in the monitoring framework and future needs for indicator development in relation to measuring aspects of connectivity.

	Indicator currently available for measuring aspects of connectivity related to ...								
	Individual species	Multi-species	Ecosystem	Structural	Functional	Terrestrial	Freshwater	Coastal /Marine	Migratory species
Goal A	■	■	■	■	■	■			
Target 1									
Target 2				■			■		
Target 3	■	■		■		■			

■ Currently proposed/available indicators

□ In need of an indicator

Acknowledging that institutional and national level capacity support will be required for the development and use of connectivity indicators, the workshop delivered the following key messages:

1. There was a shared understanding that current formulations of proposed indicators across headline, component and complementary indicators do not cover important aspects of connectivity.
2. The workshop participants proposed that a comprehensive headline indicator could be developed in the next two years and would be expressed as follows: *"Status and trends in ecological connectivity: structural, functional, and migratory connectivity across terrestrial, coastal/marine, and inland aquatic ecosystems".* The indicator should be developed drawing on available data from component and complementary indicators of relevant goals and targets.
3. In the interim, it is suggested that the currently proposed indicators be supplemented with additional component and complementary indicators to fill some of the current gaps. Table 2 shows the indicators that have been identified as currently available that measure connectivity and can contribute towards overall measurements of the goals and targets.

3. Key discussions from the webinar for Parties and other stakeholders

Building on the outcomes from the April 2022 expert workshop, a webinar was held on 31st October 2022 that focused on providing information to Parties to the CBD and observers about available and potential indicators for ecological connectivity and providing an opportunity for further discussion. The webinar was convened by UNEP-WCMC, Secretariats to the CBD and CMS, CLLC and IUCN-WCPA, with financial support from WWF-Belgium and the Bezos Earth Fund. The webinar was attended by 241 participants from 121 countries.

Participants during the webinar reiterated the overall importance of measuring ecological connectivity in the monitoring framework of the post-2020 global biodiversity framework. The discussion during the webinar noted gaps that may be important to address, in order to effectively monitor ecological connectivity:

a) *Status and trends in ecological connectivity:* The proposed suite indicators in the draft monitoring framework do not monitor key aspects of connectivity related to structural, functional and migratory connectivity across terrestrial, coastal/marine, and inland waters.

b) *Freshwater systems and inland waters*: Participants noted the importance of connectivity to maintain the integrity of freshwater systems and inland waters (including their riparian zones/floodplains). Many of these areas provide links not only for freshwater but also terrestrial species. Connected inland waters are also important for maintaining marine systems and species.

c) *Marine systems:* Measuring connectivity across marine systems is currently challenging, arising from a lack in data on species distribution, and the challenges in measuring the ability of species to move across the marine matrix.

d) *Impacts of linear Infrastructure:* The expansion of roads, railways, and other linear infrastructure development will further fragment important habitats and impact the ability of animals to move and increase wildlife mortality. The impacts of linear infrastructure should be measured in future.

e) *Restoration:* Connectivity is an important element that underpins the delivery of draft Target 2. This has been evidenced in Global Land Outlook[6] that concluded ecological connectivity is essential for effective restoration and that it can also reduce the cost and technical difficulties of restoration.

f) *Migratory species:* Indicators for migratory species can be disaggregated using existing indices including The IUCN Red List of Threatened Species™ and Living Planet Index to provide a measure of the conservation status of individual migratory species in terrestrial, marine, and freshwater realms. However, migratory species movement needs to be better measured with specific indicators, specifically for wide-ranging species between areas of habitat needed for different life stages, hence both structural and functional indicators are needed.

During the webinar, participants were asked their view on whether or not there should be a distinct headline indicator for connectivity in the monitoring framework. Of the 152 participants who responded to the poll, the results indicate a range of views, but with the majority of participants in favour: 68% of respondents were in favour, 21% were unsure and 10% indicated there was no need for a distinct headline indicator. Some noted that the headline indicator recommended by the April 2022 expert group was multi-dimensional and is helpful in terms of covering more key aspects of connectivity. However, it was also noted that a multi-dimensional indicator can become more challenging to interpret. This means that the component and complementary indicators that it is comprised of are important for interpreting the status and trends.

There was discussion about the process and scope for proposing a new headline indicator. The proposed purpose of headline indicators is to provide a minimum set of high-level indicators that capture the overall scope of the goals and targets of the post-2020 global biodiversity framework and are used by Parties in their national reporting. Headline indicators can be supplemented with component and complementary indicators, and any additional measures, subject to national needs and circumstances. During the webinar a representative from the CBD Secretariat noted that there is a demand from Parties to the CBD to minimise/reduce the number of headline indicators in the monitoring framework. As such, the inclusion of headline indicator on ecological connectivity would require a proposal and significant support from Parties at COP-15, or such a proposal may be considered by the proposed Ad Hoc Technical Expert Group on indicators for the post-2020 global biodiversity framework, for inclusion in a later iteration of the monitoring framework.

[6] UNCCD, 2022 Available https://www.unccd.int/resources/global-land-outlook/glo2

4. Key next steps

1. Experts are keen to propose a headline indicator which is listed as 'in development' in the draft monitoring framework, as a placeholder of an indicator to be used by Parties after a period of development. Such an indicator would be expressed as follows: "*Status and trends in ecological connectivity: structural, functional, and migratory connectivity across terrestrial, coastal/marine, and inland aquatic/freshwater ecosystems".* The indicator would be developed by drawing on available data from component and complementary indicators. However, the experts are also aware that uptake and use of such an indicator and indeed its inclusion in the monitoring framework, would require support from Parties.
2. There are important gaps in the suite of proposed headline, component and complementary indicators in the draft monitoring framework in relation to measuring ecological connectivity for example, important gaps include functional connectivity, migratory species, coastal/marine and inland aquatic ecosystems. These may be further considered by an Ad Hoc Technical Expert Group on indicators for the post-2020 global biodiversity framework, as proposed in the draft decisions for COP-15. Experts on connectivity are keen to ensure that ecological connectivity is further considered by such an expert group, if established.
3. The experts and partners are hosting a side-event on the 8th of December 2022 at COP-15. The event is entitled, *'Connecting the crises: Integrating ecological connectivity in the post-2020 global biodiversity framework to combat biodiversity loss, climate change, land degradation and the next pandemic'*. The event will bring together representatives of governments and relevant organisations to highlight why ecological connectivity is crucial to the long-term success of the post-2020 global biodiversity framework.
4. Countries will require capacity development to use and generate the proposed headline indicator. There may be an important role for ecological connectivity partners (including those that are associated with the Biodiversity Indicators Partnership), to mobilise and support countries in their endeavours to measure ecological connectivity, subject to national needs and demand.

5. Annex 1 - Participants List from the expert workshop

Name	Organization
Natasha Ali, Nina Bhola, Matea Vukelic Philip Bubb, Ben Lucas Rafael Antelo	UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) WWF-International
Oscar Blumetto	Instituto Nacional de Investigación Agropecuaria (INIA) Uruguay
Vera Boerger	Forestry Division and Monitoring Task Force, Food and Agriculture Organization of the UN
Janica Borg	European Environment Agency –Biodiversity Ecosystems Data and Information
Angela Brennan	University of British Columbia
Zhuo Cheng	Forestry Division and Monitoring Task Force, Food and Agriculture Organization of the UN
Mary Collins, Gary Tabor Dave Theobald, Annika Keeley, Aaron Laur Giacomo Delli	Center for Large Landscape Conservation /IUCN WCPA Connectivity Conservation Specialist Group Joint Research Centre, European Commission
Wendy Elliott	WWF-International
Simon Ferrier	Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Andrew Gonzalez	McGill University
Hedley Grantham	Wildlife Conservation Society (WCS)
Günther Grill	McGill University
James Hardcastle	IUCN Protected and Conserved Area Team
Jodi Hilty	IUCN WCPA Connectivity Conservation Specialist Group
Walter Jetz	Yale University
Alexander Killion	Yale University
Thibault Ledecq	WWF-Belgium
Brian MacSharry	European Environment Agency
Pablo Martin	Forestry Division and Monitoring Task Force, Food and Agriculture Organization of the UN
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Elena Osipova	European Environment Agency - Biodiversity Ecosystems Data and Information
David Pritchard	Secretariat of the Convention on Migratory Species (CMS)
Fernando Spina	CMS COP-appointed councillor for connectivity
Amy Fraenkel	Secretariat of the Convention on Migratory Species (CMS)