BIODIVERSITY BUILDING BLOCKS FOR POLICY

D1.6 International Science-Policy Landscape Analysis

31/05/2024

Author(s): Yanina V. Sica, Shawn Dove, Sabrina Kumschick, Quentin Groom, Hanno Seebens

Funded by the European Union

Prepared under contract from the European Commission
Grant agreement No. 101059592
EU Horizon Europe Research and Innovation Action

Project acronym:	**B3**
Project full title:	**Biodiversity Building Blocks for Policy**
Project duration:	01.03.2023 – 31.08.2026 (42 months)
Project coordinator:	Dr. Quentin Groom, Agentschap Plantentuin Meise (MeiseBG)
Call:	HORIZON-CL6-2021-GOVERNANCE-01
Deliverable title:	Landscape analysis
Deliverable n°:	D 1.6
WP responsible:	WP 1
Nature of the deliverable:	Report
Dissemination level:	Sensitive
Lead partner:	JLU
Recommended citation:	Sica,Y.V., Dove, S. Kumschick, S., Groom, Q. & Seebens, H. (2024). ***International Science-Policy Landscape Analysis***. B3 project deliverable D1.6.
Due date of deliverable:	Month n° 15
Actual submission date:	Month n° 15

Deliverable status:

Version	Status	Date	Author(s)
1.0	Final	31 May 2024	Yanina V. Sica, JLU
2.0	Revised	3 February 2025	Yanina V. Sica

Table of contents

Key takeaway messages

- The global biodiversity policy landscape is complex, involving various international initiatives, conventions and agreements.
- Key on-going international Multilateral Environmental Agreements (MEAs) were reviewed and the indicators proposed were revised in terms of data requirements.
- Stakeholders were mapped to better understand the science-policy landscape and consulted to bridge the gap between data products and policy needs.
- Consultations with stakeholders revealed the need for open workflows, indicator development, and alignment with existing platforms for data hosting and on-the-fly indicator calculation.
- We suggest developing tools for harmonising datasets, adapting workflows for known indicators, and piloting new workflows for indicators that currently lack methodology.
- Collaboration with global initiatives like GEO BON and UNEP as well as continuous dialogue with stakeholders are crucial for the project's success in enhancing biodiversity data management and analysis.

Executive summary

The Biodiversity Building Blocks for Policy (B3) project aims to streamline biodiversity data management and analysis through the development of data cubes and other tools to facilitate tracking of biodiversity changes. By engaging with stakeholders in the international science-policy arena, the project seeks to align data products with policy needs, particularly around reporting to international policies. The report delves into the indicators and data requirements from on-going Multilateral Environmental Agreements (MEAs) while mapping and analysing the international science-policy landscape.

Conventions like the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), RAMSAR convention on wetlands, and the Sustainable Development Goals (SDGs) play a crucial role in shaping the global biodiversity policy landscape. This task identifies stakeholders and decision-makers within these organisations and consults with them on ways to enhance biodiversity information flow to ensure the development of efficient workflows and indicators that meet reporting needs.

Our consultations with stakeholders emphasise the importance of open and understandable workflows for available indicators, indicator development for monitoring gaps, and alignment with existing platforms for data hosting and calculation. Findings suggest that B3 can have a major impact if the project works to adapt workflows for known indicators, pilot new workflows for indicators proposed but not yet developed, and ensure collaborations with long-term organisations.

Continuous dialogue with stakeholders and partnerships with global initiatives like the Group on Earth Observations - Biodiversity Observation Network Intergovernmental or the United Nations Environment Programme are essential for the project's success in improving biodiversity data management and analysis on a global scale.

Non-technical summary

The Biodiversity Building Blocks for Policy (B3) project aims to streamline biodiversity data management and develop tools for tracking biodiversity change. Through engagement with stakeholders in the international science-policy arena, the project seeks to bridge the gap between data products and policy needs. This deliverable delves into indicator screening in Multilateral Environmental Agreements (MEAs), stakeholder mapping, and consultation to enhance the flow of biodiversity information for decision-making. Key international biodiversity initiatives and policy programs such as the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), RAMSAR convention on wetlands, and the Sustainable Development Goals (SDGs) are the focus of this task.

We identified stakeholders within the international science-policy arena and consulted with them to understand their reporting needs and challenges. Stakeholders emphasised the importance of combining open and private data sources, the need for clear indicator frameworks, and the necessity of user-friendly interfaces for reporting biodiversity status. Challenges in the international policy landscape include the lack of global biodiversity reporting standards and continuity in data workflows.

Based on these findings, we propose four ways forward in which B3 can have a major impact: adapt workflows for known indicators and tools for harmonising datasets, pilot new workflows for indicators that are proposed to used but lack clear methodology, align with long-term initiatives for hosting data and workflows, and collaborate with organisations providing user-friendly interfaces. Continuous dialogue with stakeholders and partnerships with global initiatives like Group on Earth Observations - Biodiversity Observation Network Intergovernmental or the United Nations Environment Programme are crucial for the project's success.

List of abbreviations

B3	Biodiversity Building Blocks for Policy (B3)
BIP	Biodiversity Indicator Partnership
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EBV	Essential Biodiversity Variables
EU	European Union
FAO	Food and Agriculture Organization
GBF	Kunming-Montreal Global Biodiversity Framework
GEO	Group on Earth Observation
GEO BON	Group on Earth Observations - Biodiversity Observation Network Intergovernmental
IAS	Invasive Alien Species
IMO	International Maritime Organization
IPBES	Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
IUCN	International Union for Conservation of Nature
MEAs	Multilateral Environmental Agreements
NGOs	Non-governmental Organisations
SDGs	Sustainable Development Goals
UNEP	United Nations Environment Programme
WHO	World Health Organization
WTO	World Trade Organization

1. Introduction

1.1.Background and goals of B3

To halt and reverse the biodiversity crisis, rapid, pragmatic, innovative and science-driven solutions are demanded. Decision-makers at local, national, and international levels need accurate and reliable information about the status, trends, and threats to biodiversity but they also need these data to be accessible and ready to use (Gadelha et al., 2021; Geijzendorffer et al., 2016). Biodiversity Building Blocks for Policy (B3) aims to streamline biodiversity data management, analysis, and transformation from a disconnected, labour-intensive activity into an agile, rapid, and responsive process.

B3 is a stakeholders-oriented project that provides tools for generating models and indicators that track biodiversity change. It employs data cubes to simplify access to and compatibility between heterogeneous biodiversity datasets. To ensure the development of efficient workflows and indicators that can be easily accessed, used, and re-used by policy-makers and other stakeholders, B3 works in close collaboration with stakeholders across policy. By developing the capabilities of these tools in consultation with key members of the science-policy arena, we will greatly increase the impact and expand the use of biodiversity information, smoothing the flow of information from primary data to decision-making. This way of working shifts us away from a linear vision of biodiversity monitoring (including sampling, data transformation, and

provisioning) – where data providers are at one end of a chain and data products are at the other – to a data and processing cycle whereby all the stakeholders are involved in the whole cycle and have a real stake in the inputs and outputs (Fig. 1)(Groom et al. 2019).

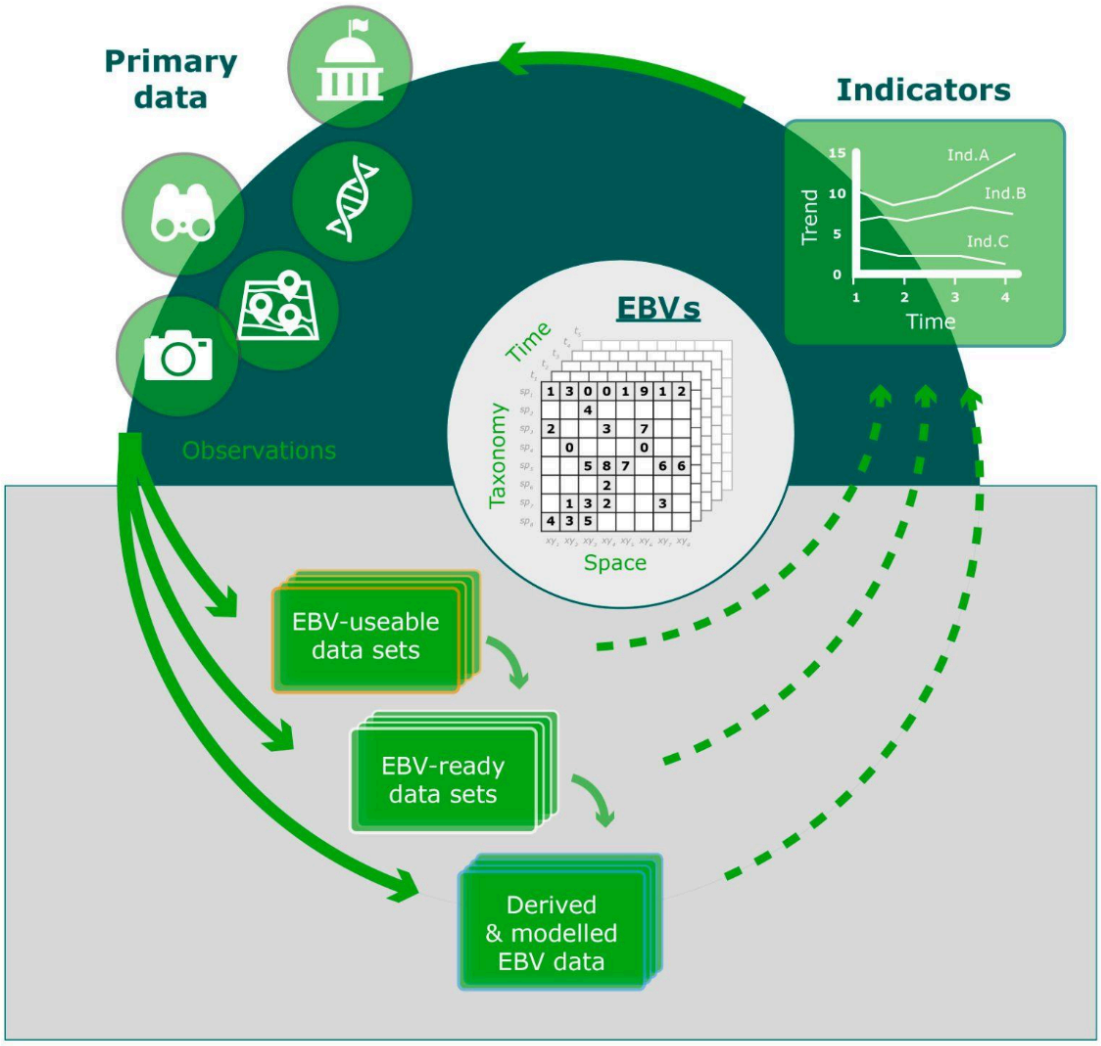

Figure 1: The cycle from and to stakeholders who create and use biodiversity data. Primary observations are transformed into indicators through intermediate cubes of data that are independently referenceable. Each cube has the dimensions of taxonomy, time, and space.
Aggregation takes the primary data to a gridded occurrence cube and models are used to project data into gaps and to predict future scenarios. All indicators are created with measurements of their uncertainty and all have sufficient metadata on provenance to be able to reproduce the result. All components are open source, modular, and configurable (adapted from Kissling et al. 2018).

1.2.International science-policy convergence

In Task 1.6, we focused on engaging with stakeholders from the international science-policy arena to explore opportunities for aligning B3 products (i.e. data processes, models, and indicators) with global biodiversity initiatives and policy programs. The overall aim of Task 1.6 was to get an overview of current practices and needs of international organisations in their reporting on biodiversity status and trends and how B3 products could potentially help them in their efforts. We specifically looked at the needs of organisations such as the Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the Intergovernmental Panel on Climate Change (IPCC), the United Nations Environment Programme (UNEP), and the Convention for Biological Diversity (CBD) for their reporting, policy-making, and writing their global and thematic assessment reports. We were particularly interested in understanding whether they are using indicators and other metrics to report and/or assess biodiversity change and what are the main challenges that can be eased with B3 products. While here we focus on initiatives central to biodiversity policy, we are aware that there are many other actors at a global level that need access to data on biodiversity, collect data, and/or are engaged in policy development that impacts biodiversity. Such organisations include the WHO, IPPC, FAO, IPCC, IMO, WTO and UNDP (see list of abbreviations).

The global biodiversity landscape is complex, consisting of many actors and regulations at various administrative levels. To address such a complex landscape, we first reviewed the existing Multilateral Environmental Agreements (MEAs) at global level (most negotiated under the auspices of the United Nations) to understand how and which indicators and metrics are used and/or required in the policy landscape (section 2). We identified which indicators are being proposed to track progress and their common requirements in terms of data and methods. Then, we mapped B3 stakeholders and identified the key players in the international science-policy arena that could help us understand how B3 can facilitate or bridge the gap between data products and policy needs (section 3). Finally, we gathered stakeholder needs for reporting to these MEAs and other decision-making tools in a series of informal, unstructured interviews (section 4). Based on this information, we defined different ways forward regarding indicator development and provided feedback to other Work Packages (e.g. WP4 and WP5).

2. International science-policy landscape

To better understand how biodiversity data is used to assess, monitor and report on the status of biodiversity at the global level, we reviewed the monitoring frameworks of widely adopted MEAs. We identified which tools are proposed to track progress towards biodiversity goals and explored the type of information that needs to be reported along with the proposed methods (i.e., what type of indicators are suggested).

We considered two approaches, a broad review of indicators and other metrics used in the science-policy arena, where we identified the main current MEAs and searched for widely used

metrics (section 2.1). The second approach was a more detailed assessment of data and model requirements to calculate the indicators proposed by the main MEAs (section 2.2)

2.1. International policy analysis

Tracking progress toward environmental goals requires robust descriptors of nature and the environment that can take the form of indicators (e.g., Pereira et al., 2013; Tittensor et al., 2014; Geijzendorffer et al., 2015). These indicators are standardised forms of data, information, and knowledge that can be quantitative (numerical values representing a certain condition) or qualitative. In the context of B3, we define an indicator as a specific measure or metric that is used to assess or represent some aspect of biodiversity within a spatial unit or over time.

Indicators in the international biodiversity policy are often used to measure or describe the status and trends of our planet's biodiversity, identify threats, and inform policy decisions aimed at conservation and sustainable use. **Status** refers to the state of biodiversity at a specific point in time. It can encompass the abundance and distribution of species, the genetic and trait diversity within and between species, the condition of ecosystems, and the services or goods they provide to humanity. **Trends,** on the other hand, indicate the direction and rate of change in the state of biodiversity over time. Tracking trends helps our understanding of how biodiversity responds to drivers, including habitat loss, climate change, pollution, invasive species, and overexploitation. Trends can also show the effectiveness of policies over time.

Over the last couple of decades, we have witnessed a boom in ecological indicators (e.g. Birk et al., 2012), driven either by environmental policies or research. Many on-going MEAs (e.g., GBF, SDGs, UNCCD) explicitly propose indicators to quantify progress towards their targets (Hughes et al., 2022). However, not every target has a supporting indicator and some targets can be addressed by multiple metrics reflecting different aspects of the target. In addition, it is unclear if different MEAs require similar reporting metrics and what type of data is needed to construct such indicators.

To have a better understanding of the monitoring and reporting requirements within the global policy landscape, we listed all indicators proposed in current, global MEAs:

- Convention on Biological Diversity, Kunming-Montreal Global Biodiversity Framework (GBF) (https://www.post-2020indicators.org/)
- Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development (SDGs) (https://unstats.un.org/sdgs/indicators/indicators-list/)
- United Nations Convention to Combat Desertification (UNCCD) (https://www.unccd.int/)
- Ramsar Convention (Ramsar) (https://www.ramsar.org/)
- International Consortium on Combating Wildlife Crime (ICCWC) (http://www.cites.org/eng/prog/ICCWC.php)
- Convention on Migratory Species (CMS) (https://www.cms.int/)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (https://cites.org/eng/disc/what.php)

We acknowledge that many more environmental agreements are not included in this analysis, some, like the Cartagena Protocol on Biosafety (2003) and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of the Benefits arising from their Utilization (2010), were considered to be out of scope of B3. Others, such as the Commission for the Conservation of Antarctic Marine Living Resources, the Convention on the Protection and Use of Transboundary Watercourses and International Lakes or the African-Eurasian Migratory Waterbirds are focused on specific regions rather than globally.

We accessed the monitoring and/or indicator frameworks of the mentioned MEAs and extracted the indicators proposed. In general, these indicators are embedded in resolutions and annexes that accompany the main regulatory documents. The following documents were revised:

- The global monitoring framework of Kunming – Montreal Global Biodiversity Framework package in CBD/COP/DEC/15/5 and the associated website (https://www.post-2020indicators.org/)
- The Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development in A.RES.71.313 Annex
- Good Practice Guidance on SDG Indicator 15.3.1 “Proportion of Land That Is Degraded Over Total Land Area” in support of UNCCD (Sims et al. 2021)
- The Integrated Framework for wetland inventory, assessment, and monitoring (Ramsar Convention Secretariat 2010)
- The ICCWC Indicator Framework for Combating Wildlife and Forest Crime
- The Strategic Plan for Migratory Species 2015-2023 (2014) and the indicators on CMS-listed and migratory species in UNEP/CMS/ScC-SC4/Doc.8/Rev.1/Annex 3 (BirdLife International 2019)
- The revised set of indicators to measure progress with the CITES Strategic Vision 2008-2020

We found 647 metrics that describe different aspects of the socio-ecological environment (i.e., nature (biodiversity and ecosystems), governance, ecosystem services, human assets, direct drivers of change, human well-being and knowledge systems). Some of the proposed indicators are composed of multiple measurements (e.g. indicators proposed for SDG 5.5.1 Proportion of seats held by women in (a) national parliaments and (b) local governments). In these cases, we split the indicator according to the measurements suggested (e.g., Proportion of seats held by women in national parliaments and Proportion of seats held by women in local governments). Hence, the total number of indicators proposed by each MEAs might be slightly higher than the ones reported in the agreement documentation.

Interestingly, there is not much overlap in the proposed indicators, only one indicator (i.e., ‘Proportion of land that is degraded over total land area’) is proposed in 3 monitoring frameworks (GBF, SDG, and UNCCD) and 54 indicators are proposed both in GBF and SDG (Table 1).

Table 1: Counts of indicators proposed in different MEAs. *Values in parenthesis indicate the number of unique indicators proposed in the MEA.

MEA	Number of indicators proposed*
GBF	307 (253)
SDGs	257 (204)
ICCWC	50 (50)
CITES	41 (41)
CMS	25 (25)
RAMSAR	18 (18)
UNCCD	4 (2)
GBF and SDG	52
GBF and UNCCD	1
GBF, SDG and UNCCD	1

A subset of 199 indicators focused on measuring aspects of biodiversity (74), invasive alien species (5), ecosystems (97) and ecosystem services (25) which are in the scope of B3. All MEAs analysed, except ICCWC, included at least 1 indicator within B3 scope, GBF was the only one to include indicators on invasive alien species (Fig. 2)

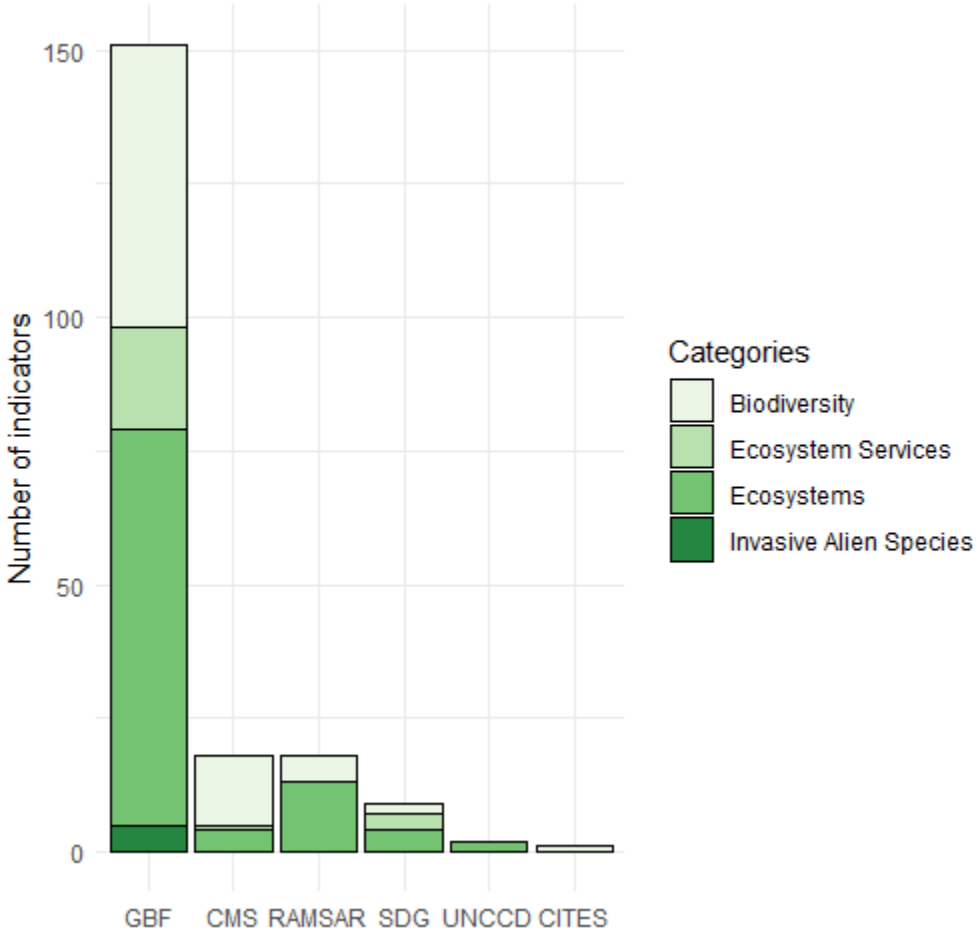

Figure 2: Number of indicators proposed in the different Multilateral Environmental Agreements. Colours show the categories of indicators selected that fit the scope of B3.

Only indicators that described some aspect of biodiversity and ecosystems were further explored to understand its data and methods requirements.

2.2. Analysis of indicators proposed in MEAs

We inspected the 176 indicators that measured some aspect of biodiversity, including invasive alien species, and ecosystems and took a further look at the workflows and data requirements to calculate them. We identified which ones could use species occurrence data (e.g., data available through GBIF or the newly developed occurrence cubes), and/or any of the data cubes produced by B3 (i.e., suitability cubes, dissimilarity cube and network invasibility cube).

We found that the vast majority of the proposed indicators rely on multiple data types, and most of them do not require species occurrence data. Only 11 indicators proposed by the GBF can be supported by species data cubes (Table 2). From the headline indicators proposed in the GBF (minimum set of high-level indicators to capture the overall scope of GBF goals and targets),

only three have been identified as being of potential relevance for B3: ‘Proportion of fish stocks within biologically sustainable levels’, ‘Rate of invasive alien species establishment’, and ‘Indicator on biodiversity information for monitoring the global biodiversity framework’. From the proposed component indicators (optional indicators that together with the headline indicators cover all components of the goal and target of the GBF), seven indicators could potentially be recalculated using occurrence cubes in addition to other types of data like species ranges, information on habitat requirements for species, phylogenetic data, etc. These are ‘Evolutionarily Distinct and Globally Endangered (EDGE)’, ‘Red List Index (for utilised species)’, ‘Species Habitat Index’, ‘Species Protection Index’, ‘Rate of invasive alien species spread’, ‘Number of invasive alien species introduction events’ and ‘Species status index’. The ‘Biodiversity Habitat Index’ is the only complementary indicator (optional indicator for thematic or in-depth analysis of each goal and target in the GBF) that could be assessed further since it uses species occurrences as input together with multiple types of environmental data.

‘The proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type’ proposed as an indicator for SDG 15 is currently being calculated using Key Biodiversity Areas (KBAs). It could be further explored using the suitability cubes proposed within B3. Similarly, ‘Status and trends in wetland ecosystem extent’ proposed in RAMSAR could be recalculated using freshwater species occurrences.

Table 2: List of GBF indicators that could potentially be further explored within B3.

Indicator	Type of indicator	Availability	References	Data requirements
Proportion of fish stocks within biologically sustainable levels	headline	Available	FAO (2011)	occurrence data (?) + catch data (time series, fisheries)
Rate of invasive alien species establishment	headline	Data pending		occurrence data of IAS + invasion status
Indicator on biodiversity information for monitoring the Global Biodiversity Framework	headline	Under development		occurrence data (?)
Evolutionarily Distinct and Globally Endangered (EDGE)	component	Available	Isaac et al. (2007)	occurrence data of EDGE species (?)
Red List Index (for utilised species)	component	Available	Butchart et al. (2010)	occurrence data to estimate AOO (?)
Species Protection Index	component	Available	Powers et al. (2019), Jetz et al. (2021)	occurrence data + protected areas + habitat data + range data

Rate of invasive alien species spread	component	Under development		occurrence data of IAS + native/alien range data
Number of invasive alien species introduction events	component	Data pending		occurrence data of IAS + data of introduction
Species Habitat Index	component	Available	Powers et al. (2019), Jetz et al. (2021)	occurrence data + habitat data + range data
Species Status Index	component	Available	Oliver et al. (2021), Meyer et al (2015)	occurrence data + range data
Biodiversity Habitat Index	complementary	Available	Ferrier et al. (2020), Hoskins et al. (2020)	occurrence data + range data + environmental data

The potential for implementing these indicators within B3 will be explored further in Task 5.1.

3. International stakeholder mapping

The global biodiversity policy landscape is complex with many actors playing different roles (i.e., biodiversity data collectors and aggregators, researchers, policy-makers, and governments reporting progress towards agreed goals). To identify the actors who could play a role in the project's development processes, we conducted an international stakeholder landscape analysis and mapped the potential collaborators, beneficiaries, or users of B3 products.

We took three steps to map stakeholders in the international science-policy arena. First, based on the B3 target groups from the original proposal and the further developed stakeholder groups in the Plan for Exploitation, Dissemination and Communication (D1.2. from WP 1), we explored the stakeholders that work with an international scope and better defined their roles in relation to indicators and metrics development and use (section 3.1). Then, we compiled a contact database of the relevant stakeholders identified among internal B3 partners and assessed their role in the international science-policy landscape (section 3.2). Finally, we clustered and prioritised the identified stakeholders based on their potential relevance and interest in B3 (section 3.3).

3.1. Stakeholder characterization

Based on the B3 stakeholder groups developed for the project proposal and further analysed in the Plan for Exploitation, Dissemination and Communication (D1.2.), we defined the different groups of stakeholders within the international science-policy arena (Table 3).

Table 3: B3 stakeholder groups targeted in this task. These groups are based on the ones described in the Plan for Exploitation, Dissemination and Communication (D1.2.). *This category is the focus of Task 1.5 not in this deliverable.

B3 stakeholder groups				
Scientific community (S)	Policy and governance (P) at EU-level*	Organisations (O) at the global level	General public (GP)	Industry and practitioners (IP)
Researchers and informaticians in biology, ecology, environmental and data sciences.	National ministries with responsibility for monitoring and reporting on biodiversity, policy users, implementers, and practitioners (e.g. conservation NGOs)	Organisations concerned with the protection of biodiversity at the global level, such as the IUCN, the Secretariat of the CBD and the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), IPBES, the United Nations and other NGOs.	Citizens, indigenous peoples and local communities who are concerned with biodiversity at the local scale and want to understand the changes that are occurring.	Companies and land managers that are concerned about the impacts of their activities to the biodiversity

Within these focused stakeholder groups, we differentiated the main roles related to the use of data and indicators, though most, if not all, actors contribute to these roles to some extent. Besides the data collector role which already has a dedicated stakeholder group in D1.2, we identified two other important roles – developers and users of indicators:

- **data collectors**, including researchers, naturalists, citizen scientists, and their organisations who are using the collected data or seeking to see active use of their data in nature conservation, research, and monitoring. They are often supported in this by governments, civil society and NGOs with tools, events and funding.
- **developers of indicators**, including researchers, policy-makers, companies and NGOs that develop environmental metrics, variables, and indicators to assess the state of biodiversity
- **users of indicators**, including researchers, policy-makers, companies, ministries, and NGOs that use the models and metrics already developed to report on the status of biodiversity. This large group includes multiple actors in the science-policy interface (conventions like CBD, SDGs, UNs), international organisations (e.g., GEO BON, IUCN), international and regional assessments (e.g., IPBES, IPCC, GEO, RAMSAR), regional

and national reporting systems (ministries, people reporting at various governmental levels, companies), governmental and non-governmental conservation programs (national park systems, sustainable land management).

This framework of stakeholder groups and their roles was used in the following exercise of identifying key stakeholders.

3.2. Identification of key stakeholders

We reached out to the internal B3 partners and listed potential stakeholders (organisations or individual people) together with available contact information (email address, institution or organisation, etc.) and the identification of the stakeholder group they adhere to (academia, governments, international organisations, or civil societies), and the geographic scope of their work (regional, global). This was not meant to be a comprehensible list of B3 stakeholders, but a first step to identifying stakeholders within the international science-policy arena that can provide valuable information to the project.

This stakeholder database is an online internal living document that gathers information about the stakeholders in a centralised way but is not publicly shareable since it contains sensitive contact information (Table 4).

Table 4: Modified version of the B3 stakeholder database showing institutions, the stakeholder group they belong to and the scope of their work. *Stakeholders that have participated or collaborated in previous tasks within B3 (e.g. T1.7).

Institution	Region (scope)	Sector
On the EDGE/IUCN SSC Phylogenetic Diversity	Global	NGO
CBD/GBF	Global	Multilateral organisations
GEOBON	Global	Multilateral organisations
Conservation International	Global	NGO
The Nature Conservancy	Global	NGO
WWF	Global	NGO
WCS	Global	NGO
GIZ	Global	National Organizations
Humboldt Foundation	Global	National Organizations
CONABIO	Central America	National Organizations
AfriMAB	Africa	National Organizations
Ministry of Environment	South America	National Organizations
IEB	South America	National Organizations

CAPES	South America	National Organizations
SCB (Cono Sur)	South America	Academia
BirdLife International	Global	NGO
UNEP-WCMC	Global	Multilateral organisations
APN	South America	Government
SENARP	South America	Government
Natural State	Africa	Companies
Biodiversity Indicators Partnership	Global	Multilateral organisations
5th World	Global	Companies
IUCN	Global	Multilateral organisations
University of Kansas	Americas	Academia
Interamerican Development Bank	Global	Companies
IPBES	Global	Multilateral organisations
ICIMOD	Asia	NGO
Smithsonian Institution	Global	Academia
GEO	Global	Multilateral organisations
ASEAN Centre For Biodiversity	Global	Academia
Biodiversa+	Global	Multilateral organisations
Centre for Ecological Research and Forestry (CREAF)	Europe	Academia
Knowledge Centre for Biodiversity	Global	Academia
Global Outlook team (GEO 7)	Global	Multilateral organisations
IPCC	Global	Multilateral organisations
GCOS	Global	Multilateral organisations
CBD/SBSTTA working group	Global	Multilateral organisations
ICES	Global	Multilateral organisations
IUCN chair IAS working group	Global	Multilateral organisations
UNEP-WCMC ‘Mind the Gap’ project in combination with BIO	Global	Multilateral organisations
RAMSAR	Global	Multilateral organisations
CMS	Global	Multilateral organisations
World Heritage Convention	Global	Multilateral organisations
UNCCD	Global	Multilateral organisations
IPPC (International Plant Protection Conversion)	Global	Multilateral organisations
IUCN/Unblocking biodiversity data	Global	Multilateral organisations

CBD/Ad Hoc Technical Expert Group on Indicators	Global	Multilateral organisations
NatureServe	Global	National organisations
World Environment Situation Room	Global	Multilateral organisations
GEOBON/sTWIST	Global	Multilateral organisations
AP BON	Asia	Multilateral organisations
ColombiaBON	South America	Multilateral organisations
ArcticBON	Global	Multilateral organisations
MBON	Global	Multilateral organisations
FWBON	Global	Multilateral organisations
Biodiversity Information Standards (TDWG)	Global	Multilateral organisations
South African National Biodiversity Institute	South Africa	National Organizations
Institute for Electromagnetic Sensing of the Environment (CNR-IIA)*	Global	Academia
Aston University*	UK	Academia
Harokopio University of Athens*	Europe	Academia
University of Twente*	Europe	Academia
GO FAIR Foundation (GFF)	Global	NGO
German Centre for Integrative Biodiversity Research (iDiv)	Germany	Academia
Belgian Biodiversity Platform*	Belgium	National Organizations
Helmholtz Centre for Environmental Research - UFZ*	Germany	Academia
Research Centre for Ecological Change, University of Helsinki*	Finland	Academia
The Royal Belgian Institute of Natural Sciences (RBINS)*	Belgium	Academia
Philipps Universität Marburg*	Germany	Academia
Newcastle University*	UK	Academia
Arizona State University / NEON*	United States	Academia
Nature Metrics*	Global	Companies
Naturalis Biodiversity Center*	Netherlands	Academia
Utrecht University*	Netherlands	Academia
University of Potsdam*	Germany	Academia
CSC - IT Center for Science*	Finland	Companies
Fondazione Edmund Mach*	Italy	Research institute

University of L'Aquila*	Italy	Academia
University of Turin*	Italy	Academia

3.3. Clustering and prioritisation of stakeholders

We defined our priority group for consultation as the subgroup of stakeholders within Multilateral organisations that are working specifically towards the protection of biodiversity at a global level. Hence, from the list of identified stakeholders (Table 4), we selected a subset of key stakeholders, based on their role in the international decision-making process, their dissemination ability, and their potential to reach out to further stakeholders using the Biodiversa+ Stakeholder Engagement Handbook (Durham et al., 2014) and communication with B3 members.

This subgroup was considered as being both influential (i.e., central actors in the international science-policy arena) and of potential relevance for and interest in B3 products. We considered stakeholders with a wide network and a good overview of the use and requirements of biodiversity indicators. This group included members of key international organisations like IUCN, the Secretariat of the CBD, IPBES, and the United Nations Environment Programme (i.e., Organizations in table 3). We intentionally focused on international organisations outside Europe to not interfere with Task 1.5 and to keep the priority group to a size, which is manageable for our task.

This resulted in a subset of 17 people from 13 institutions to consult and better understand current reporting needs, the use of indicators to report progress, and the challenges and limitations of current policies.

4. Stakeholder consultation

We conducted interviews with individual stakeholders to identify in which ways B3 can facilitate the use of biodiversity data to inform policy. One of the main objectives of the consultation was to understand the perception of stakeholders on the indicators used or proposed to report biodiversity status and trends, the challenges in applying indicators, and the limitations or gaps of currently proposed indicators. This information would help us align B3 developments (particularly the processing tools and workflows from WP2-5) with current policy needs and ensure the uptake and engagement with B3 products.

Stakeholders would, in turn, benefit from co-developing workflows and indicators that will support their work including easy access to data (data cubes) and methodology (automated modelling workflows and software).

4.1. Consultation methods

Through unstructured interviews with stakeholders, we gathered information about their data needs, the coverage of currently used/proposed indicators, and the challenges in calculating

and reporting such indicators. We were also interested in their inputs regarding which processes B3 can facilitate, and how we can ensure B3 product's uptake.

We predefined guiding questions that would help us structure the interview and divided them in four sets: i) general questions about the stakeholder role in the international science-policy arena, ii) questions about the available indicators proposed in current MEAs and other international policies, including biodiversity data availability and workflows, iii) specific question for stakeholders developing indicators, and iv) specific questions for stakeholders using indicators to report biodiversity status. Depending on the role and involvement of each stakeholder in the reporting or use of data and indicators different questions were used. All guiding questions are listed in Annex (A1).

Interviews were held online, or in person at conferences (e.g., GEOBON 2023) and lasted for 30 minutes.

4.2. Takeaways from consultation

Out of the 17 stakeholders we reached out to (section 3.2), we were able to interview 10 people from the CBD, GEOBON and regional nodes, IPBES, Knowledge Centre for Biodiversity, NatureServe, and UNEP. We had representation from Australia, the Americas, Europe, and Asia and gender balance (5 identified themselves as women and 5 as men).

We gathered insights from 6 key organisations in the international science-policy arena. To some degree, the obtained information varied among interview partners but in several aspects, responses coincided among stakeholders. The information gathered was classified into three topics: data/indicators needs and gaps, capacity needs and reporting requirements, and challenges of the international policy landscape. After analysing these inputs we reflected on the role of B3 in the international science-policy landscape and analysed future perspectives and opportunities for the project.

4.2.1. Data and indicator needs and gaps

Regarding data needs, a key aspect that was mentioned multiple times is the need for a facilitated process to combine open (e.g., public repositories like GBIF) and private data (e.g., from national or sub-national inventories). Many national systems maintain and use their own data and repositories, which are prioritised over public data such as GBIF. The incentive of governments to move data to GBIF is low. Thus, it was repeatedly suggested that workflows developed in B3 should be capable of dealing with GBIF data as well as other data sources, which could potentially be integrated or used in isolation.

In terms of indicators, there is a general agreement that there are too many indicators proposed to report progress on targets set by MEAs but most lack documentation or detailed information on how they should be calculated. Many stakeholders refer to these indicators as 'black boxes'

either because there is no shared workflow or because the description of the indicator is so broad that each party to any MEA can have a different interpretation of it. One of the consulted stakeholders summarised this quite nicely “Indicators are recipes, not the cake. In principle everybody can follow a recipe provided the steps are explained and all ingredients are listed” (A. Niamir, pers comm.). This highlights a significant opportunity for B3 to provide the data and means to calculate indicators in a repeatable way.

All of the consulted stakeholders were very familiar with GBF indicators and pointed out that many proposed indicators even lack a conceptual framework of how to calculate them. According to the CBD, indicators for three GBF targets are still under development and could potentially be supported using occurrence and environmental data cubes produced in B3: i) indicator/s for target 2 on restoration (although progress has been made on developing a monitoring framework for the United Nations Decade on Ecosystem Restoration), ii) indicator/s for target 6 on IAS, and iii) indicator/s for target 21 on data gaps. However, this at least partly requires the development of novel models and workflows which could go beyond the scope of B3.

4.2.2. Capacity and reporting needs

In terms of capacity, countries and organisations vary distinctly in their ability to gather and process data, run models and calculate indicators. There was a general agreement among the consulted stakeholders on the need for public platforms, dashboards, and user-friendly interfaces (nationally based and potentially customised) where not only workflows can be shared but results can be calculated on the fly.

Organisations like NatureServe and the regional BONs within GEO, who are working with parties to multiple MEAs developing local capacity and user-friendly dashboards to facilitate reporting of biodiversity, highlight the usefulness of recreating open and accessible workflows to calculate at least some of the indicators that MEAs propose. Having such tools available would improve parties' participation and willingness to report biodiversity status. Again, highlighting the opportunity for B3 to provide the open workflows.

Regarding reporting challenges, it was mentioned that the current MEAs share very few similarities in their implementation and reporting requirements. There is a lack of indicators or methodologies where a single data compilation and calculation can support monitoring and reporting requirements for several conventions and treaties. The exception is the current collaboration between the Task Force on Monitoring from FAO and the working group on Target 2 of the GBF that have developed a draft methodology for monitoring areas under restoration which would be applicable for reporting progress under the UN Decade and can be disaggregated to provide evidence for Target 2. Several stakeholders manifested the usefulness of building workflows that could address several MEAs at the same time.

4.2.3. Perspectives on the international policy landscape and its challenges

The international policy landscape is complex and two main challenges were identified by the stakeholders consulted. The first one is the fact that there is no global biodiversity reporting model or international entity with the mandate to manage biodiversity data. This gives enough flexibility to the parties that conform the agreements to report based on their capacities and willingness, but also creates high heterogeneity in the way parties use the available data and report the status of biodiversity in their territories.

This statement is supported by Bhatt et al. (2020) who evaluated the extent to which countries are using measurable indicators from global sources by surveying the 5th National Reports to the CBD. They found that nationally generated indicators were used 11 times more frequently than global indicators and only one-fifth of indicators matched those recommended by the CBD (Bhatt et al. 2020). Even though these findings could limit the ability of B3 to deliver useful tools since no solution or tool will work for every party or reporting agency, by providing the means to calculate some elements needed for reporting, B3 could help reduce this burden and facilitate some homogeneity in the reporting.

Another challenge identified is the continuity and maintenance of workflows and data. Previously formed partnerships like the Biodiversity Indicators Partnership (https://www.bipindicators.net/) are sometimes unable to keep up to date with the metadata and methods available. UNEP-WCMC is trying to provide longer-term support services to support the implementation of the GBF (https://gkssb.chm-cbd.net/global-knowledge-support-service-biodiversity). The Global Knowledge Support Service for Biodiversity aims to build on and interconnect existing tools and networks to support national efforts for the implementation, monitoring, and reporting of progress towards the agreed goals of the GBF. Such a decentralised support system could help surpass the challenges within the international policy community and also the uneven capacity needs of parties. B3 should align with this type of effort that fosters technical and scientific cooperation.

4.2.4. B3 role and opportunities

After collecting, reviewing and synthesising the information from policy-makers and other stakeholders in the international arena, we identified the main areas where we should continue working with partners within and outside B3 to ensure the uptake of its products:

- Adapting workflows for known/developed GBF indicators (partners in WP2-5).
    - B3 could recreate the workflows for the proposed indicators and share them openly, incorporating flexibility in the data sources used
- Develop workflows for indicators that are still under development and test if available data is good enough (partners in WP5)
    - For instance, B3 could develop metrics for GBF Target 21 and 6
- Develop data processing tools focusing on harmonisation of datasets that would ease the reporting to multiple conventions or agreements at the same time
- Align with long-term initiatives and organisations to host data and workflows

    - GBIF ensures continuity and maintenance of data, and the workflows are coordinated (task 3.1) to ensure they are developed and published in such a way that they will be maintained.
- Partner with long-term initiatives that focus on delivering user-friendly interfaces and platforms
- Encourage the publication of data openly to GBIF by promoting the benefits of data sharing and collaboration. However, we recognize the current limitations and support the integration of closed data into data cubes as an alternative when open publication is not possible.
- Develop workflows in B3 that can efficiently handle both GBIF data and other data sources, ensuring flexibility in data use and integration.

4.2.5. Consultation limitations

We acknowledge current limitations in the approach taken since we were not able to consult with every stakeholder that we reached out to. On top of this, the B3 project has multiple stakeholders in the international community, and we only focused on one group in particular that would inform us on the international policy landscape.

We decided to have unstructured interviews with the identified stakeholders because we wanted the consultation to flow like an everyday conversation, with both parties speaking or listening according to how the conversation unfolded. This approach removed the rigid design of a structured interview that can feel more formal with no flexibility to deviate from a script. However, unstructured interviews can make side-by-side comparisons more difficult with very few chances to deliver any quantitative assessment of responses.
This task on alignment with international policies was proposed for the first year of the B3 project but will need continuous dialogue with the main stakeholders to ensure proper alignment and engagement. This will be addressed by other partners within WP1 and WP6, including with stakeholders specific to the case studies selected.

5. Input for Work Packages within B3 and external collaborations

5.1. Internal collaboration

We are working closely with partners in WP5 to investigate the feasibility of developing metrics on completeness indicators for GBF Target 21 and Invasive Alien Species indicators for GBF Target 6. We participated in a CBD Ad Hoc Technical Expert Group meeting on Indicators that particularly focused on Target 21 to understand the needs of such indicators. In parallel, we are partnering with Melodie McGeoch who is leading a Task Force in charge of developing methods to report on the spread of IAS. Such metrics could be tested in WP6 and could be the focus of the General Biodiversity Indicator case study (Task 6.1).

We will periodically reassess our findings with the stakeholders by working closely with the rest of the partners in WP1. As an example, we have participated in Task 1.5 and keep an open dialogue with EuropaBON and the Joint Research Centre of the European Commission.

5.2. External collaboration and engagement

In response to the need for continuity, B3 is working with global initiatives like GEO BON. A potential partnership with them will allow B3 workflows to be hosted in BON in a BOX. In terms of the data produced by B3 we do not anticipate any risks since data cubes and other products will be hosted in GBIF and the EBV Data Portal. Conversations were initiated to also incorporate B3 products in UNEP data platforms like the World environment situation tool and MAPX to deliver our products in a way that is compatible with their country dashboards e.g. https://dicf.unepgrid.ch/.

6. Acknowledgements

We appreciate the contributions of Andrew Gonzalez, Aidin Niamir, Melodie McGeoch, Alice Huges, Mike Gill and other interviewees who kindly agreed to meet with B3 and share their feedback. We would also like to thank the members of the project who collaborated either during the interviews, the review process or in writing the report like Lina Estipinan Suarez, Laura Abraham, Nikol Yovcheva, Andrew Rodriguez, Miguel Fernandez and Louise Hendrickx. Special thanks to the B3 internal reviewers Maxime Ryckewaert and Duccio Rocchini.

7. References

Birk, S., Bonne, W., Borja, A., Brucet, S., Courrat, A., Poikane, S., Solimini, A., Van De Bund, W., Zampoukas, N., & Hering, D. (2012). Three hundred ways to assess Europe's surface waters: An almost complete overview of biological methods to implement the Water Framework Directive. Ecological Indicators, 18, 31–41. https://doi.org/10.1016/j.ecolind.2011.10.009

Teixeira, H., Berg, T., Uusitalo, L., Fürhaupter, K., Heiskanen, A. S., Mazik, K., Lynam, C. P., Neville, S., Rodriguez, J. G., Papadopoulou, N., Moncheva, S., Churilova, T., Kryvenko, O., Krause-Jensen, D., Zaiko, A., Veríssimo, H., Pantazi, M., Carvalho, S., Patrício, J., … Borja, À. (2016). A catalogue of marine biodiversity indicators. Frontiers in Marine Science, 3(NOV), 1–16. https://doi.org/10.3389/fmars.2016.00207

Sims, N.C., Newnham, G.J., England, J.R., Guerschman, J., Cox, S.J.D., Roxburgh, S.H., Viscarra Rossel, R.A., Fritz, S. and Wheeler, I. 2021. Good Practice Guidance. SDG Indicator 15.3.1, Proportion of Land That Is Degraded Over Total Land Area. Version 2.0. United Nations Convention to Combat Desertification, Bonn, Germany.

Ramsar Convention Secretariat, 2010. Inventory, assessment, and monitoring: an Integrated Framework for wetland inventory, assessment, and monitoring. Ramsar handbooks for the wise use of wetlands, 4th edition, vol. 13. Ramsar Convention Secretariat, Gland, Switzerland.

International Expert Workshop on the 2010 Biodiversity Indicators and Post-2010 Indicator Development. UNEP/WCMC/Post-2010/0709/8d

Indicators for the Kunming – Montreal Global Biodiversity Framework. https://www.post-2020indicators.org/ Accessed 21.08.2023

ICCWC Indicator Framework for Combating Wildlife and Forest Crime – Assessment Guidelines. http://www.cites.org/eng/prog/ICCWC.php Accessed 21.08.2023

Convention on Migratory Species (CMS). UNEP/CMS/ScC-SC4/Doc.8/Rev.1/Annex 3 1 ANNEX 3 INDICATORS FOR CMS-LISTED AND MIGRATORY SPECIES. BirdLife International October 2019

Revised set of indicators to measure progress with the CITES Strategic Vision 2008-2020. Revised after SC65 (Jul 2014) & WG SRR meeting (Jan 2015), and in response to comments on Notification to the Parties No. 2015/032. Convention on International Trade in Endangered Species of Wild Fauna and Flora

Durham E., Baker H., Smith M., Moore E. & Morgan V. (2014). The BiodivERsA Stakeholder Engagement Handbook. BiodivERsA, Paris (108 pp).

8. Annex

A1. Guiding questions for stakeholder consultation

These are example questions to ask during “interviews” to semi–structure the conversation. They are separated by stakeholder type.

Generic questions

- How is your work related to biodiversity indicators?
- What are, in your opinion, the most important goals/policies for biodiversity monitoring?

International science-policy

- Do you think that the currently used/proposed **indicators** can cover the aspects of data availability and biodiversity reporting sufficiently?
- Do you think that the internationally proposed indicators (such as CBD headline indicators) are known and used widely enough? If not, do you know why these are not taken up by national agencies?
- What **gaps** do you identify in the current set of available/proposed indicators? For the most important biodiversity goals/targets (according to you based on the policies or goals you are most familiarised with): are their monitoring adequately covered by existing indicators?
- What are the main **difficulties** of bringing timely biodiversity information (data) to policymakers?
    - How to unblock the flow of biodiversity information for decision-making?
    - How to improve confidence in data from infrastructures/data repositories like GBIF?
- What is your take on the **international policy landscape** in terms of its structure? (horizontal -nations doing what they can- vs vertical - nations following proposals)
- Where can **B3** act? Which processes can be facilitated by a project like this?
    - New developments vs creating workflows for current indicators
- How can we ensure **B3 products uptake**? How can we ensure **B3 products are useful for policy**?
- How can data cubes support the development of new/on-progress indicators?
- What current indicator can we make more repeatable and generate more rapidly with data cubes?
- Which gaps can be filled based on species occurrence data (based in GBIF)?
- What other initiative should we analyze? Share contacts?

Users of indicators

- What type of **biodiversity data** do you commonly manage? Are you familiarised with data cubes, GBIF data, Copernicus data?
- What is the preferred way to access available biodiversity data?
    - Downloads
    - API
    - Webpages
    - Literature
    - Reports
- What are the main difficulties of bringing timely biodiversity information (data) to policymakers?
- Are you or your organisation currently using **biodiversity indicators**?
- Do you use indicators proposed by multilateral agreements (e.g. GBF)? Or do you implement your own? Why?
- What is the preferred way to access and run available indicators (**workflows** used)?
- Are your current pipelines to calculate biodiversity indicators repeatable/automatic (data → EBVs/models → indicators)? If not, are you interested in implementing standardised workflows?
- Are you willing to apply newly developed indicators? Do new indicators require a more formal adoption through e.g. agencies or institutions?
- What are your main **challenges** in applying/calculating indicators (e.g., more on the data side or the application of indicators or the lack of indicators)?
- How can we ensure **B3** products satisfy your needs and are useful for policy? What aspects of B3 products are most important to you?
    - Ease of use
    - Speed of processing
    - Configurability
    - Traceability
    - Adaptability
    - Open Source
    - Provenance
    - Availability of standardised data (cubes)
- Can you suggest other experts implementing indicators for reporting whom we could contact?

Developers of indicators

- What type of **biodiversity data** do you commonly use when developing indicators?
- What is your preferred way to access data? (data cubes format, data storages, querying, downloads vs API access, scientific literature, reports)
- Are you familiarised with **data cubes**? Are you interested in using them?
- What is your preferred way to calculate indicators? (usage of cubes, platforms, computer languages)

- Are your current **pipelines** to get and transform data and to calculate indicators repeatable (data → EBVs/models → indicators)? If not, are you interested in implementing standardised workflows?
- What are your main **challenges** for calculating biodiversity indicators?
    - Taxonomic alignment
    - Interoperability with other environmental data
    - Biassed data
    - Spatially and temporally heterogeneous data
- What are the main **bottlenecks of data analysis** in terms of data integration and computation?
- Can you suggest other experts developing indicators for reporting whom we could contact?

General on B3 Impact

- Can B3 effectively inform policy or who should we align with others to facilitate the use of biodiversity data to inform policy? Who should we reach out? Where/how can B-cube have its largest **impact**?
- How can we ensure **B3 products uptake**? How can we ensure **B3 products are useful for policy**?
- **Potential role of B-cube within the global monitoring network system?**