GEO BON

DECEMBER
2022

GLOBAL BIODIVERSITY OBSERVING SYSTEM

Science Brief for the Post-2020 Global Biodiversity Framework

A GLOBAL BIODIVERSITY OBSERVING SYSTEM TO MEET THE MONITORING NEEDS OF THE GLOBAL BIODIVERSITY FRAMEWORK

DECEMBER 2022

Citation:

GEO BON, 2022. A Global Biodiversity Observing System to meet the monitoring needs of the Global Biodiversity Framework. Available from https://geobon.org/science-briefs/.

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Summary

As rates of biodiversity loss accelerate, the status and trends of biodiversity remain insufficiently known to monitor global progress, and some 80% of species await discovery. A global biodiversity observing system (GBiOS) is needed to support the monitoring framework for the Global Biodiversity Framework (GBF) specifically, for biodiversity planning, tracking progress and guiding action across all four Goals: Targets 1-8 on threats to biodiversity and Targets 9-13 on maintaining benefits to people of the Global Biodiversity Framework, Targets 14 -16 and 19.2 on implementation and mainstreaming and Target 20 so that traditional knowledge and scientific information are available for decision making. GBiOS will guide the collection of biodiversity observations worldwide needed to produce the data needed to update the indicators of the monitoring framework for the GBF. Over time, a GBiOS will support observations and monitoring to keep pace with the changing rates and states of biodiversity in terrestrial and aquatic ecosystems worldwide.

A GBiOS may follow a similar model to the Global Basic Observing Network of the World Meteorological Organization that supports the UNFCCC's Climate Agreement by regularly assessing the status of the global climate observations. A GBiOS can be assembled as a network of existing and new national and subnational biodiversity observation networks, composed of interconnected observation stations and sites maintained by observing communities. This globally federated network will not only transform our current capacity to monitor global, regional, and national trends in biodiversity, but it will provide a crucial service of guiding where and when to collect new data, to support conservation planning and action. The economic risks for biodiversity change are estimated to be in the trillions of dollars, an investment in science and knowledge sharing would identify and guide action to reduce risks.

Investment will be needed to address gaps in basic observations through additional data collection, including reinforcing national and subnational monitoring programs particularly in resource-poor countries, including those led by indigenous peoples and local communities. Resources are necessary to then connect various information systems that gather observations at the national and global levels. GBiOS will deliver methodologies and build capacity to allow good use of data, develop essential biodiversity variables and use them to conduct trend assessments, perform predictive modeling and provide tailored information products for state and non-state actors to guide monitoring and support decisions for conservation and spatial planning.

The need

To be successful, the Global Biodiversity Framework needs to be underpinned by four components each complementing one another: firstly, research; secondly, data and observations; thirdly, assessment; and fourthly, policy. Without these four components fully in place, the interface, that is the delivery of policy relevant information based on sound science and knowledge, which is based on appropriate data and observations, will not function optimally. The climate change community has had all these four components for several decades, including IPCC for the assessment component, and the Global Climate Observing System (GCOS), to organise the long-term operational collection of climate relevant observations at multiple scales. The biodiversity community established (in 2012) an assessment mechanism (IPBES) but has not yet established a global biodiversity observing system, which organises the long-term operational collection of biodiversity relevant data at multiple scales. Measuring change across the multiple dimensions of biodiversity, from genetic diversity to ecosystem health, on land and in the ocean, is difficult and requires a range of expertise, strong collaboration among organizations, and appropriate technologies and infrastructure.

The monitoring framework

An essential part of the Global Biodiversity Framework (GBF) is a monitoring framework (described in CBD/SBSTTA/24/3), which includes indicators that will be used to track both national and global progress and will be included as a core component of the national reporting template for countries to report on their actions toward the targets and goals. The scientific community, under GEO BON, has been working on the key characteristics of a possible Global Biodiversity Observing System (hereafter referred to as "GBiOS"), planned and designed to monitor how, where, and why biodiversity is changing, but which would also inform where and how to invest in monitoring infrastructure and networking indigenous peoples and communities working to assess trends in biodiversity and drivers need to implement the GBF.

A GBiOS is needed to accelerate the monitoring of the status and trends of biodiversity at the scales needed to effectively track distance to target and thereby, guide conservation action and sustainable use. This system would be assembled by leveraging existing capacity and data in addition to existing and developing national and regional biodiversity monitoring networks with strategic investment required to fill priority gaps. National governments and other stakeholders, including indigenous communities and local communities, would need to work together to provide the capacity and resources to establish and use such a global biodiversity observation system. GBiOS would also support the needs of other biodiversity focused conventions (Convention on the Conservation of Migratory Species of Wild Animals, Ramsar Convention on Wetlands) and frameworks (e.g., Sustainable Development Goals and UN System of Environmental-Economic Accounting).

Filling global information gaps

A GBiOS is needed to mobilize the best available information from all sources and generate the new data required to implement the monitoring framework (CBD/SBSTTA/REC/24/2). At this time, the international community does not have the biodiversity data needed to assess progress to the goals and targets of the GBF worldwide. It is important to understand the large gaps in taxonomic, geographic, and temporal coverage in both aquatic and terrestrial environments mean that many regions cannot easily assess their progress. This important knowledge gap was identified in the Summary for Policymakers of the IPBES Global Assessment of Biodiversity and Ecosystem Services (Appendix 4).

Several recent studies highlight significant and ongoing gaps in the Global Biodiversity Information Facility (GBIF) and the Ocean Biodiversity Information System (OBIS). They find that the large amounts of existing data in these global repositories is geographically and taxonomically biased and highly insufficient to meet monitoring needs for all countries. Specifically, they find that current data in these global repositories cover a tiny portion of the planet (Figure 1A). For example, species records in GBIF and OBIS cover less than 7% of the world's surface at 5 km resolution, and less than 1% for most taxa at higher resolutions (Figure 1a, Hughes et al. 2021). For marine taxa, coastal records make up 30–

50% of records and the busiest marine shipping routes only cover 2% of ocean area but contain 18% of records and 41% of species. This issue is exacerbated by the broad geography of biodiversity – records disproportionately come from few, already well-sampled species and from, considering their diversity, oversampled places (Meyer et al. 2015). In the past twenty years, the ability of GBIF data to inform about the status and trends of species has either remained steady or even decreased in most countries (Fig 1b, c; Oliver et al. (2021); https://mol.org/indicators/coverage).

A shortfall in institutional support, recognition and capacity exacerbates existing trends on data availability, leading to the biased global databases. An increase in institutional support for systematic biodiversity monitoring would reduce existing biases in global databases. New technologies such as environmental DNA, ecological acoustics, camera-traps, and hyperspectral cameras can be mobilized locally to produce rapid assessments and surveys over large extents, including through collaborations with indigenous peoples and local communities on the ground.

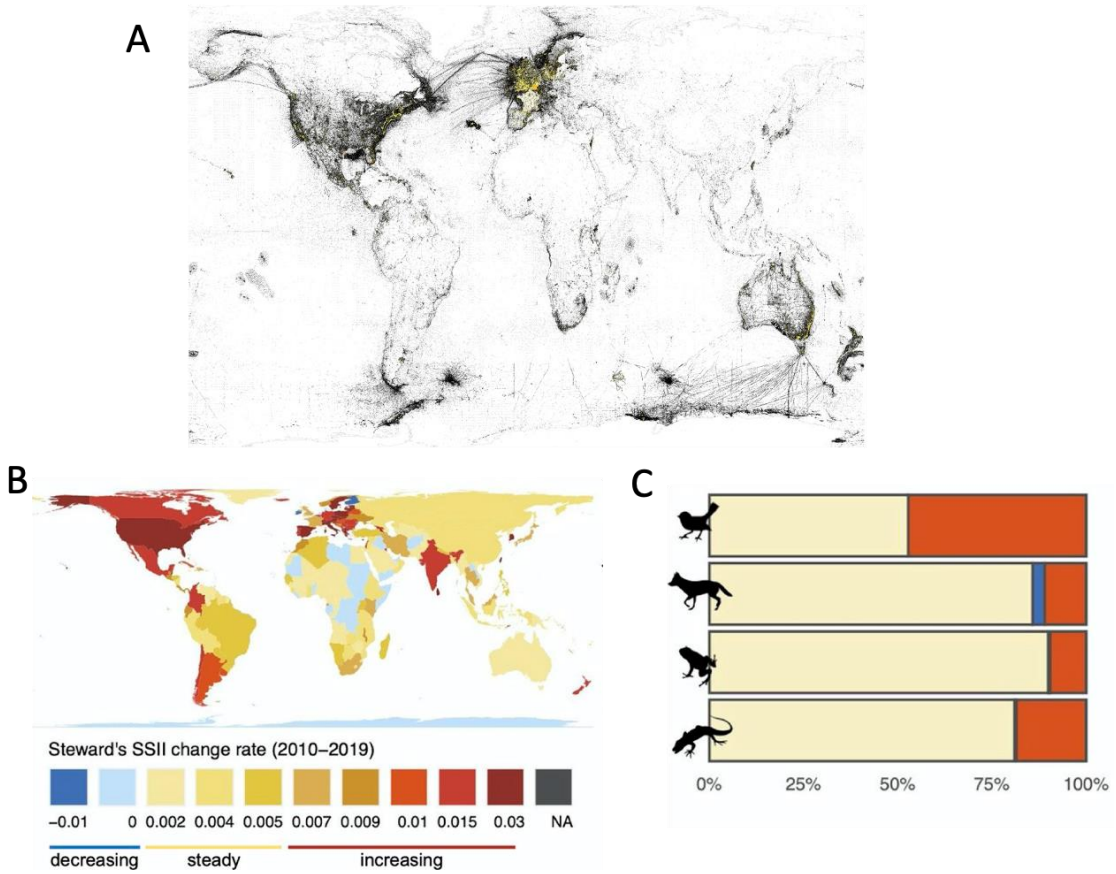

Figure 1: Ongoing sampling gaps. a) Areas with records in GBIF and OBIS databases. Black dots show locations with 1-50 records; vast areas of the planet have few to no records. Terrestrial and marine systems are mostly unsampled (based on all databased records; figure from Hughes et al. 2021). b) and c) Trends in biodiversity data coverage by GBIF data 2000-2019 for all ca. 31,000 extant terrestrial vertebrate species. Colors refer to the rate of increase (red) or decrease (blue) in GEO BON's Species Status Information Index (SSII), which measures annually how well sampled occurrence data address status and trends in species populations (from Oliver et al. 2021). Maximum values for the rate of change in coverage in each color bin are labeled below the map (b).

Why is a global biodiversity observing system critical to implement the goals and targets of the CBD?

A GBiOS will overcome four critical issues that will support the monitoring framework and action to meet the targets of the GBF (see also CBD/ID/OM/2022/1/INF/2):

1. **Systematic biodiversity monitoring**: Currently, there is a highly incomplete taxonomic and geographic coverage of biodiversity monitoring and even sparser availability of long-term data sets needed to assess change. This lack of data has been noted by IPBES assessments (e.g., Appendix 4 of the Global Assessment Science for Policymakers, Knowledge gaps).
2. **Monitoring drivers of biodiversity loss**: Realizing the actions needed to achieve the targets of the GBF will require regular monitoring of the drivers (direct and underlying causes) of biodiversity change. In some cases, information on drivers will be obtained directly, such as invasive species occurrence and impact. But, for many human drivers observations will be obtained from other networks in the Global Earth Observation System of Systems (https://www.earthobservations.org/geoss.php).
3. **Capacity and technologies**: GBiOS can guide the implementation of monitoring methodologies (e.g., site-based sampling and Earth Observation) and data standards so that rapid updates of the status of different dimensions of biodiversity via the indicators for the Goals and Targets can be made available to national and subnational governments.
4. **Essential variables for indicators**: GBiOS will provide data and information critical to assessing progress to Goal A and Goal B. The indicators can be calculated from essential biodiversity variables (EBVs) and essential ecosystem service variables (EESVs) that underpin many of the indicators for these Goals and many associated Targets (e.g., Target 2, 3, 4, 6, 11, 12, 19.2, 20). The common use of EBVs and EESVs allow a harmonization of datasets collected by different governmental and non-governmental organizations (e.g., Community-Based Monitoring and Information System) so that they can be compared and combined to give a clear picture of how biodiversity is changing around the world.

Does the Climate Change Convention have an observing system?

GBiOS would follow a model like that of the World Meteorological Organization's Integrated Global Observing System, that networks observations made by national climate networks, and the Global Climate Observing System (GCOS) that supports the Climate Agreement by regularly assessing the status of the global climate observations. The GCOS (https://gcos.wmo.int/) was established in 1992 to ensure that the climate observations and information are made available to all potential users. The GCOS is not a single, centrally managed observing system. Rather, it is a composite "system of systems" comprising a set of climate-relevant observing, data-management, product-generation and data-distribution systems.

National climate networks are key units in the GCOS network. The purpose of a National Climate Reference Network is to monitor climate on long term period and detect climate change signal at national level with great degree of reliability. GCOS regularly assesses the status of global climate observations and produces guidance for its improvement. GCOS works towards a world where climate observations are accurate and sustained, and access to climate data is free and open. The observations supported by GCOS contribute to solving challenges in climate research and underpin adaptation measures.

What would a biodiversity global observing system look like?

A GBiOS would function as a comprehensive and intercommunicating system of biodiversity observation networks (BONs) and other monitoring schemes operating from the local to the global scale. In a first phase, GBiOS could be established as a globally coordinated network of biodiversity observation networks (text box, Figure 2). Each network would develop an understanding of the ongoing biodiversity sampling activities in its geographic or thematic area. Based on this it will recommend and support additional sampling activities, such as focal campaigns by researchers, indigenous peoples and local communities, and additional sites and stations conducting observations from the ground, air or space, as well as data integration, all guided by the goal of maximizing information around biodiversity status and trend that emerges from the combined evidence.

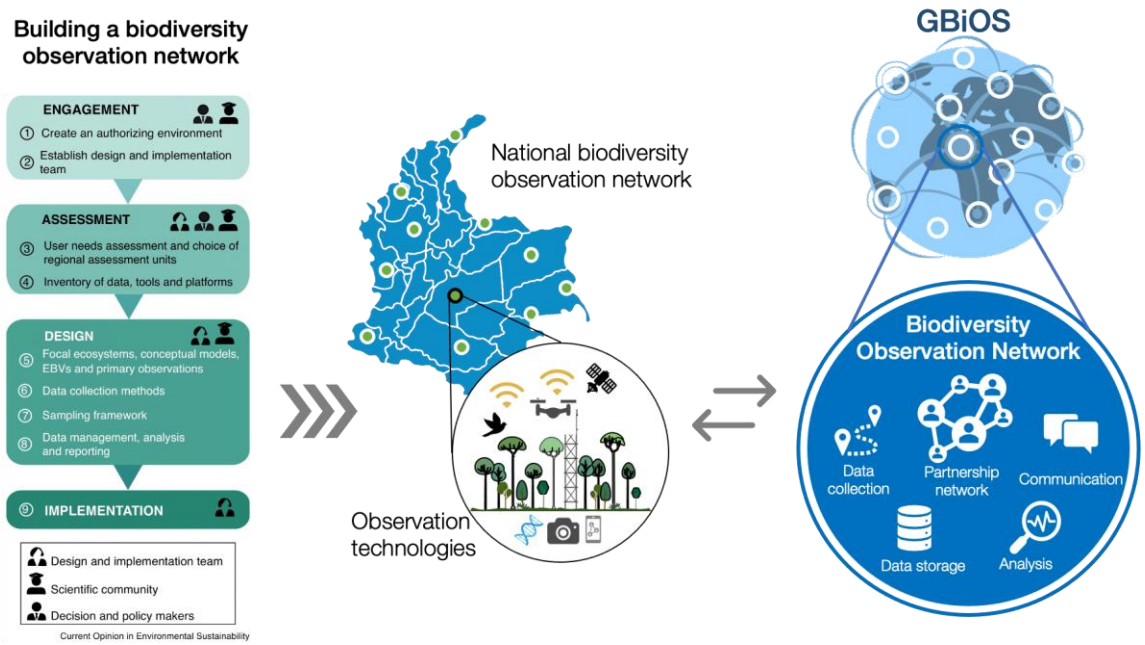

Figure 2: GBiOS as a global network of interconnected national and regional biodiversity observation networks (BONs) supporting and conducting monitoring: Left) Countries without national BONs can establish and implement such network following the 9 steps of the process established by GEO BON. Middle) Each national BON follows harmonized methods for biodiversity observations, data curation and sharing, detection and attribution, modeling, and policy-decision support. Right) Biodiversity observation networks contribute to GBiOS by sharing information and in so doing allow the global community to make rapid global assessments of progress.

A GBiOS would interlink relevant elements of existing and upcoming observation efforts worldwide. New sites or stations would be distributed to reduce existing gaps and uncertainties and begin the process of tracking biodiversity change in response to the implementation of the Global Biodiversity Framework by Parties and relevant organizations. Investment will be needed first to address gaps in basic observations and to connect various information sources into an information network dedicated to providing services for supporting the use and sharing of data, trend assessments, predictive modeling to guide monitoring and decisions for conservation, spatial planning, and sustainable use.

Initially, it will be crucial to fill the large geographic gaps by investing in new biodiversity observing sites that have the infrastructure, methods, and human capacity needed to measure the essential variables required for the GBF. Over the last decade, the Group on Earth Observations Biodiversity Observation Network (GEO BON; https://geobon.org/), has coalesced to support the establishment of biodiversity observation networks that aim to meet this need, including work with indigenous peoples and local communities (Figure 2). Guidelines for network establishment are publicly available (https://geobon.org/bons/bon-development/) and describe how to create an 'enabling environment' that assembles the partnerships, human capacity and scientific infrastructure needed to build a network of observation sites and stations. Tools are available for designing BONs to meet thematic (e.g., ecosystem types), conservation and policy needs.

An analysis of biodiversity information gap would be a priority after COP15, followed by an estimate of the funding needed to progressively grow the GBiOS network over time as its underlying network of stations and sites evolve to meet the GBF's needs. The GBF could quantify commitments and progress for the establishment of national and regional network of stations as part of its Target 20 (Information and knowledge). The national, regional, and thematic networks should be designed by participating members, and tied closely to the national and subnational organizations responsible for implementing the GBF.

Do we already have some of the components of such a system?

The global community is organizing itself to share the technology and science needed to monitor the state of Earth's biodiversity and ecosystems on the ground and from space. Progress is being made in linking biodiversity data repositories (GBIF and OBIS) with active national and international monitoring activities.

GEO BON is an international network of more than 2300 experts spanning 134 countries, so it is designed to offer the expertise needed to inform and support the establishment of a GBiOS. GEO BON can support five key aspects: 1) the design and implementation of a pilot network of interacting national networks, 2) the development and use of essential biodiversity and ecosystem service variables as a rigorous and transparent basis for data to indicator workflows, 3) tailoring information and outreach with the policy and decision-making community, including the private sector, 4) the development of toolkits designed to facilitate the integration of knowledge and data science in #1 and #2, and 5) the development of mechanisms for information flow between projects led by indigenous peoples and local communities and national and global data repositories.

What is a biodiversity observation network (BON)?
A BON is a network of observation sites or stations and a community of practice coordinating biodiversity observations and monitoring responding to data needs. BONs conduct long-term observations to understand biodiversity change. A BON can be subnational, national, or regional in scale of operation and can cover many dimensions of biodiversity (e.g., genetic to ecosystem). A BON can also be organized to focus on specific taxa (e.g., soil organisms) or biomes (e.g., marine or freshwaters) in order to fill large gaps in knowledge.

GEO BON has been working with national, regional, and thematic networks covering aquatic and terrestrial systems on pilot systems that could form a significant starting point for GBiOS. National observing networks would be designed by member countries of GBiOS (and their subnational networks) to meet needs at the national level and agreed needs at the global level.

Such national initiatives are already under development in several countries including China, France, Finland, and Colombia, and could form part of the GBiOS. The China BON is a notable example of a systematic, country-wide monitoring design with broad spatial and taxonomic extent: 441 sites are part of an observation system of over 9000 transects and point counts for birds, amphibians, mammals, butterflies, and vascular plants with the participation of volunteer citizen scientists at each site.

In addition, a growing set of regional networks exist and include the Arctic biodiversity observation network, the Asia Pacific biodiversity observation network and the European biodiversity observation network (EuropaBON). The Arctic Biodiversity Observation Network (the Circumpolar Biodiversity Monitoring Program; www.cbmp.is),for example, is a regional network coordinated by the Conservation of Arctic Flora and Fauna Working Group (CAFF) of the Arctic Council designed to directly serve the priority biodiversity policy needs as defined by the Arctic Council member states.

Finally, several pilot biodiversity observation networks are being developed, focusing on monitoring in particular biomes or ecosystem types worldwide, including a marine, a freshwater and a soil biodiversity observation network. These are particularly effective at networking actors and institutions that share data, at harmonizing methodological practices and at identifying shared infrastructure needs.

Possible next steps toward the establishment of a Global Biodiversity Observing System?

Assessment of value and scope: At this point an assessment of the Global Biodiversity Observing System is needed to define its scope (e.g., dimensions of biodiversity monitored) and needs in terms of

1) the technologies, data infrastructure, governance, partnerships, etc., 2) mechanisms for financing and 3) the components of GBiOS that already exist and could link up to form the first phase of the GBiOS implementation. This initial step would also include an assessment of the knowledge and capacity needs, and the economic costs and benefits (return on investment) arising from an initial investment in GBiOS, followed by alternative pathways for progressive development of its capacity by 2030.

Co-sponsorship and governance: A proposal for a governance model should be elaborated that identifies the key overarching organizations. One option could be for GBiOS to follow the solution taken by the Global Climate Observing System that is co-sponsored by several intergovernmental organizations (i.e., World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO), the United Nations Environment Programme (UN Environment), and the International Science Council (ISC)).

Funding: One option for funding such a system could be a UN coalition fund like the Systematic Observations Financing Facility (SOFF) for the Global Climate Observing System could be established to fund GBiOS. A SOFF for GBiOS would support countries to generate and exchange basic observational data critical for improved biodiversity monitoring, forecasts and ecosystem services. It would provide technical and financial assistance in ways that allow biodiversity observing infrastructure to be established and brought online. The requirements of the Global Biodiversity Observing System should guide investments, create local social and economic benefits while delivering on a global public good. Global data exchange would be an important measure of success. The SOFF would contribute to strengthening societal adaptation and resilience across the globe, benefitting the most vulnerable peoples and countries.

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