

23 DECEMBER  
2021

# GEO BON

Highlights 2021





## **GEO BON Secretariat**

23 December 2021

**Editor:** Adriana Radulovici

**Design:** Amaani Ataullah

**Contributors:** Tom Christensen, Hiroyuki Muraoka, Haigen Xu, Yvan Le Bras, Andreas Bruder, Jennifer Lento, Frank Muller-Karger, Carlos Guerra, Petteri Vihervaara, Mike Gill, María Cecilia Londoño-Murcia, Simon Ferrier, María Vallejos, Gary Geller, Sean Hoban, Robert Guralnick, Andrew Skidmore, Nicholas Coops, Mark Costello, Helena Olaya, Andrew Gonzalez, Katie Millette, Jean-Michel Lord.





# Table of Contents

1

## **GEO BON Secretariat**

Welcome Message	2
New Leadership	3
Membership	5
Strategic Plan	6
Projects	7
GEO & GEO BON	11
Collaborations	13

## **GEO BON Network** 15

### **Working Groups**

Genetic Composition	16
Species Population	17
Species Traits	18
Community Composition	19
Ecosystem Structure	21
Ecosystem Function	22
Ecosystem Services	23
BON Development	25

## **Biodiversity Observation Networks**

French BON	26
China BON	27
Colombia BON	29
Arctic BON	30
Asia-Pacific BON	32
Freshwater BON	33
Marine BON	35
Soil BON	37

### **Task Forces**

Remote Sensing	38
Data	38
Policy	39

## **Looking Forward to 2022** 41



# Welcome message

---

The new team helping GEO BON through its next phase started its mission during COVID-19 times – those few years when people realized that biodiversity is connected to climate change and human health and well-being, things that scientists have known and repeated for decades.

While the world was closing down, GEO BON was opening up: hiring a new Secretariat team, setting up offices in a new and beautiful location, Montreal, Canada – a North American city with European charm, harbouring diverse ethnic groups and with a bilingual approach to life.

The city is already hosting a few biodiversity-related organizations such as the UN Convention on Biological Diversity,

Commission for Environmental Cooperation, or Future Earth, and is administered by a mayor with strong interests in biodiversity, the ICLEI Ambassador for Local Biodiversity, Valérie Plante. It only felt natural that GEO BON would also be hosted in this city.

Transition times are never easy but the new team is excited to be part of the large GEO BON network, to slowly ‘meet’ its members. Remote work was not an impediment to tackle new tasks and plan for the mandate ahead. The entire team remains optimistic that before too long GEO BON members will be able to meet in person and build new projects and partnerships.

We are looking forward to a new phase of growth for our network!

***GEO BON Secretariat***



Once the mandate of the previous leadership team reached its end, things were set in motion for the establishment of a new team. The election of new GEO BON co-Chairs in 2020 was followed by hiring a new Secretariat team in 2021. After South Africa and Germany, the GEO BON headquarters moved to Canada. Montreal, a hub for artificial intelligence, biodiversity-related organizations and the third North American city for international organizations (after New York and Washington DC), won the bid to host the new Secretariat for the upcoming mandate. Support from the three levels of the Canadian government (federal, provincial and municipal) as well as from academic institutions and organizations such as Montreal International ensured a smooth transition between the Secretariats. The new GEO BON Secretariat is hosted by Quebec Centre for Biodiversity Science at McGill University.

**Andrew Gonzalez, Co-Chair** – Professor at McGill University, Fellow of the Royal Society of Canada, Liber Ero Chair in Conservation Biology and founding director of the Quebec Centre for Biodiversity Science, Andrew brings over 22 years of expertise into the field of biodiversity science, with a focus on the causes and consequences of biodiversity change, to support the restoration of ecological connectivity in human-dominated landscapes. A considerable amount of his time is dedicated to translating biodiversity research into knowledge for conservation and policy in Canada.

**María Cecilia Londoño-Murcia, Co-Chair** – Senior researcher in the Biodiversity Assessment and Monitoring Program at Instituto Humboldt in Colombia, María Cecilia's main research interests focus on the use of biodiversity geographic analysis for decision making. She works on the production of biodiversity indicators for multiple users and on the development of web platforms for biodiversity data dissemination. María Cecilia coordinates research that contributes to implementing the knowledge-to-action cycle related to specific problems in the context of biodiversity conservation and sustainable development.

**Adriana Radulovici, Executive Secretary** – With expertise in DNA barcoding of marine invertebrates, data management and capacity-building, Adriana brought a wealth of expertise to her new role. Previously, she worked at the University of Guelph, being heavily involved in the International Barcode of Life Consortium, and at the Secretariat of the UN Convention for Biological Diversity.



**Katie Millette, Science Officer** – With expertise in molecular ecology and landscape genetics and an interest in the effect of human-induced environmental stressors on intraspecific genetic diversity, Katie took up the new position after graduating from McGill University and working for the Secretariat of the UN Convention for Biological Diversity.

**Jean-Michel Lord, Developer and Scrum Master** – With expertise in software development with a wide range of technologies and having worked previously in the private sector, developing technological aids for people with low vision or blindness, Jean-Michel joined the new team as Scrum Master for developing new platforms one small sprint at a time.

**Communications and Engagement Coordinator: vacant position** (previously occupied by Cristiana Mandru).

Hosted at McGill University, the Secretariat benefits from assistance also from work-study students. In 2021, the following students provided very valuable support: Anmol Gupta, Sia Ham, Ibrahim Naveed, Violet Wei (IT), Amaani Ataullah, and Fatima Khalladi (communications).

**While 2021 was a year of new beginnings, it was also the year that the GEO BON community lost one of its prominent members, Bob Scholes, key founder and first Chair. He will always be remembered as a pioneering leader in climate and biodiversity science and the one who helped GEO BON carve its place at the science-policy interface.**

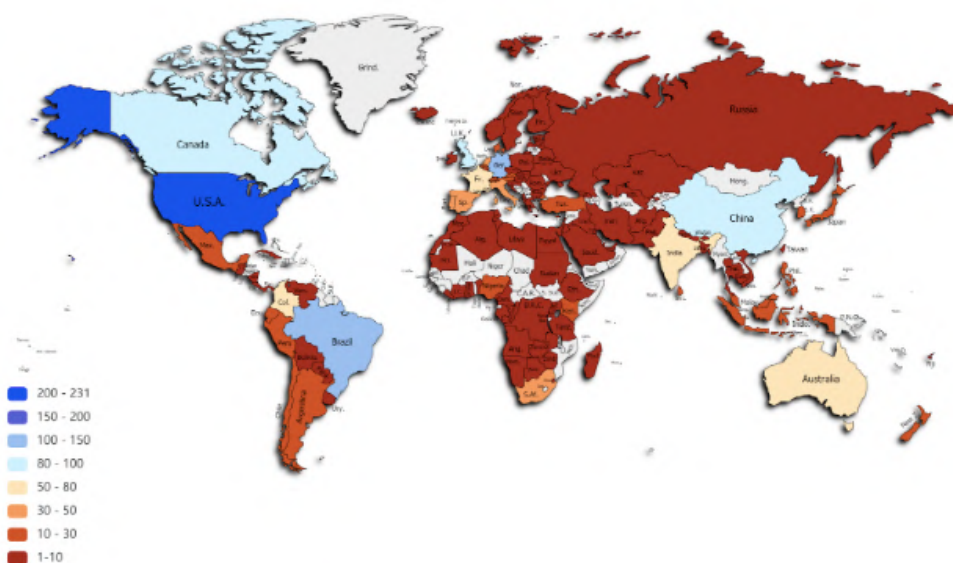


# GEO BON SECRETARIAT

## Membership



A steady increase in GEO BON membership saw the network overpassing 2,000 members towards the end of 2021. Mapping all the organizations and individuals involved, the current GEO BON global map shows an overwhelming presence in North America. Committed to ensure equity, diversity and inclusion, the Secretariat is working to improve communication within the network and build strategies to attract members from under-represented countries which are also the most biodiverse countries, in need of biodiversity monitoring and capacity-building.



Distribution of GEO BON members globally. Countries are coloured by the number of their GEO BON members. The USA has the largest membership (>200), while most African countries and many Asian countries have between 1-10 members (dark red on the map).



A new mandate and leadership team also meant a new strategic plan (2021-2023) to replace the previous work plan (2017-2020). To take stock of what has been done during a decade of GEO BON activities, what worked and what needs improvement, a multi-step approach was employed. A survey was sent to all members to weigh in with regards to the network's effectiveness, its status as a major organization within the biodiversity science-policy landscape, and its future evolution. Following the survey, a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis was conducted with the aid of an external facilitator and involving members of the Implementation Committee, Advisory Board and other partners. The SWOT analysis included, among other things, an online workshop convened during the summer 2021, and conducted during multiple days and time zones to accommodate as many participants as possible. Stimulating discussions, Jamboards, Zoom polls and break-out rooms were used to brainstorm on GEO BON's current standing and its evolution into a rising partner that stands ready to provide observational data and data-derived services to the Convention on Biological Diversity and other biodiversity-related organizations. The SWOT workshop proved that the members' boundless energy, their willingness to cooperate, to share ideas, and to engage in constructive discussions, are probably what it takes to nurture the network's growth into a possible next phase - from Knowledge to Action.

The SWOT report constitutes the basis of a new strategic and implementation plan, currently being drafted, which will be finalized in 2022. An executive summary of the SWOT report is to be shared with all GEO BON members by the end of 2021.





### **BON-in-a-Box 2.0: Towards a better understanding of global biodiversity change**

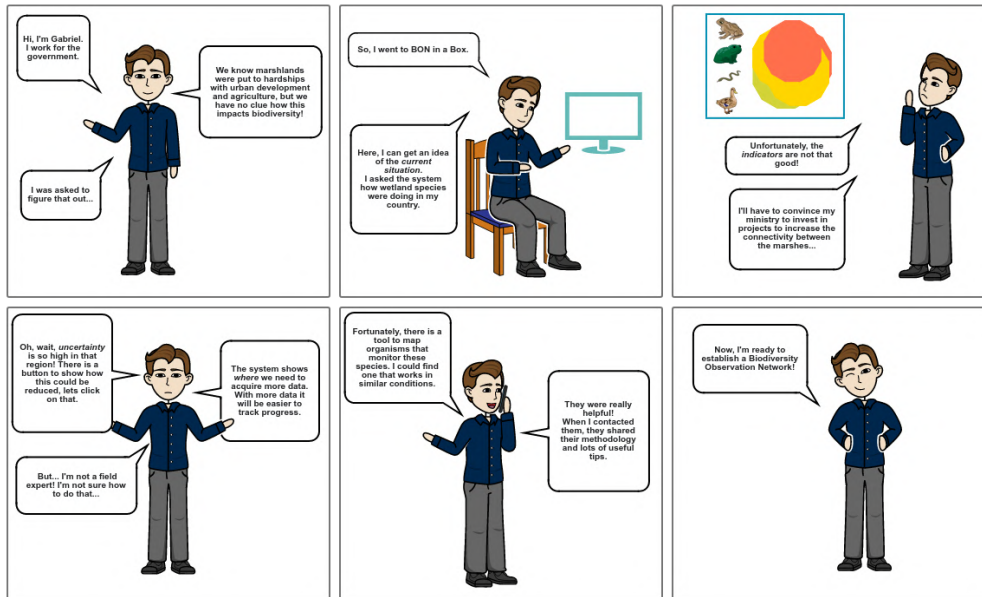
In the context of a growing need for biodiversity observation data and information as the required path towards biodiversity conservation, Microsoft is partnering with GEO BON to establish BON-in-a Box 2.0 as an integrated biodiversity information system to: 1) Monitor and assess biodiversity change across the globe by drawing on multiscale cloud-based observation data, and 2) Support regional, national, and global decision-making to stem biodiversity loss and restore degraded ecosystems. The new platform will help existing BONs reach their objectives as well as guide new users to develop new BONs. This partnership will bring more visibility to previously undetected biodiversity changes and efficiently assess progress to a timely monitoring of the post-2020 global biodiversity framework.

With a large delay due to COVID-19, BON-in-a-box 2.0 is now on track to deliver outputs within a specific timeline (2 years). The teams have been finalized and include a Quebec node (Quebec Centre for Biodiversity Science) and a Colombian node (Instituto Humboldt). The software architecture has been recently decided through in-depth discussions between partners. Currently the scientists involved in the project are evaluating the best models to be included in BON-in-a-box 2.0. At the beginning of 2022, the team will get in touch with various GEO BON members and external partners as part of a large stakeholders meeting planned for later in 2022.

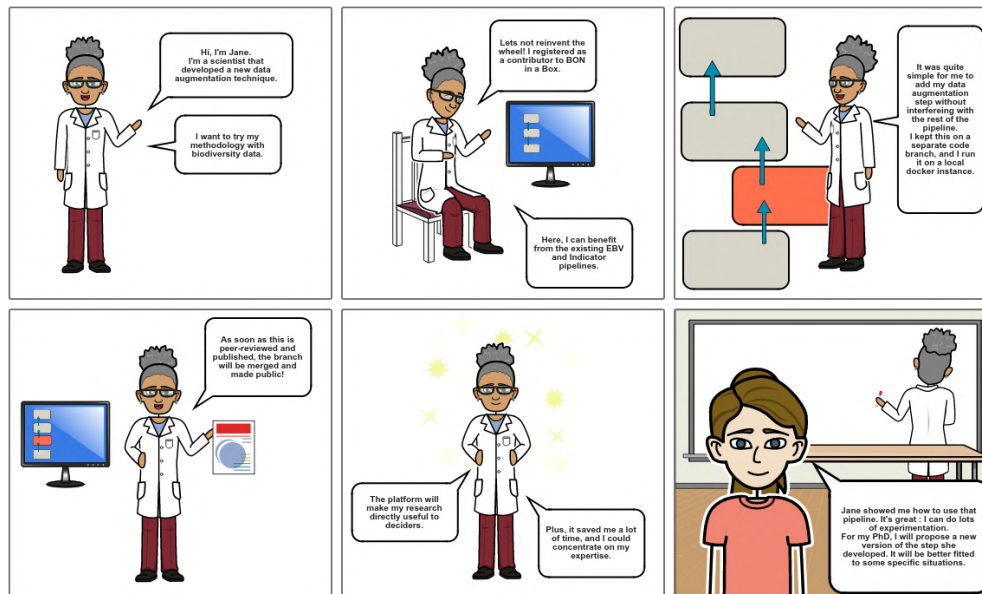


### BON-in-a-Box 2.0: Towards a better understanding of global biodiversity change

The team has developed a few storyboards to help engage users.



Create your own at [Storyboard That](#)



Create your own at [Storyboard That](#)



### Other Projects

A series of projects directly involving GEO BON are either recently finalized or about to be finalized. Through "EBVs on the Cloud", a number of five grants have been awarded specifically to use cloud-computation in support of calculating essential biodiversity variables (EBVs). A previous call funded by NASA targeted projects developing tools directly relevant to GEO and GEO BON. At a later date in 2022, the Secretariat will organize a workshop to discuss possible ways of integration for the various tools developed through all these separate projects.

### Microsoft's AI for Earth program and GEO BON: EBVs on the Cloud

Ruth Sonnenschein (EURAC Research, Italy): Using AI to validate and downscale ecosystem-related Essential Biodiversity Variables (EBVs) in mountain environments

Arlene Young (CZMAI, Belize): AI for the Belize National Marine Habitat Map

Ruben Valbuena (Bangor University, UK): AMAZECO: Covering the Amazon with an Ecosystem Structure EBV product combining satellite and airborne LIDAR

Simon Ferrier, Andrew Hoskins (CSIRO, Australia): Extracting the signal of change in community-composition EBVs from big unstructured species-occurrence datasets through Azure-enabled spatio-temporal analytics

Naomi Bates (Future Generations University, USA): Bioacoustics and Machine Learning for Automated Avian Species Monitoring in Global Biodiversity Hotspots

### **NASA A.50**

Mary Blair (AMNH): Expanding Wallace Biodiversity Modeling Software to Support National Biodiversity Change Indicator Calculations for GEO BON Assessment and Reporting.

Walter Jetz (Yale University): Activities to Advance, Build, and Deliver Remote-Sensing Supported Species Distribution and Species Abundance EBVs.

Gretchen Daily (Stanford University): Improving Linkages Between EO and Ecosystem Service Models with EBVs.

Maria Kavanaugh (Oregon State University): Dynamic Seascapes to Support a Biogeographic Framework for a Global Marine BON.

Víctor Gutiérrez-Vélez (Temple University): Integration of EO for Decision Making on Biodiversity Management and Conservation in Colombia: Consolidation of the Colombian BON.

Howard Epstein (University of Virginia): Ecosystem Functional Diversity of the Circumpolar Arctic Tundra.

Patrick Jantz (Northern Arizona University): Quantifying Forest Vertical Structure Using Spaceborne Lidar: A GEO BON EBV Application in Colombia.

Enrique Montes (University of South Florida): Laying the Foundations of the Pole-To-Pole MBON of the Americas



GEO BON is a flagship of the Group on Earth Observations (GEO). Just as GEO BON, GEO went through a transformation in 2021 by hiring a new Secretariat Director and filling its leadership team with senior officers, including an SDG coordinator which also fills the position of biodiversity liaison.

The closest collaboration with GEO in 2021 was around climate change and biodiversity. GEO BON was invited to produce a [poster](#) for Earth Information Day at COP26 of the UN Framework Convention on Climate Change, to support GEO's presence at COP26. Among the statements received in preparation for Earth Information Day, the USA specifically mentioned GEO BON and Marine BON:

***“Understanding climate-driven changes to ecosystems and marine life.*** *There is an increasing effort to improve global coordination of data and information about climate change-driven ecosystem change and biodiversity impacts. Systematic observations of physical, chemical, and biological parameters are essential for measuring change and understanding the potential impacts of climate on species and ecosystem conditions. Efforts like **GEO's Biodiversity Observation Network** and the **Marine Biodiversity Observation Network**, along with the Global Ocean Observing System and other partners, are working to identify needs of society and the economy for biodiversity observations and to better connect observations to improving ecosystem assessments and predictive capabilities. The discussion could include presentations on advancements in marine life observing and how those data can be integrated into societally relevant products and services”.*

GEO BON was represented at various regional GEO meetings and the Secretariat was heavily involved in the GEO Week (November 2021) with participation in an anchor session on nature-based solutions and the organization of a side-event (“Biological earth observations in support of transformative commitments and sustainable development”) together with Marine BON, the Ministry of Environment and Energy of Costa Rica and UN Development Programme. Slides and recordings are available [online](#).

GEO BON was also mentioned in Canada's statement at the GEO plenary during the GEO Week:

*"Canada is proud of its on-going involvement in GEO and the EO advancements we have achieved in the past year. GEOBON has established a Secretariat at its new Canadian headquarters in Montreal, hosted by the Quebec Centre for Biodiversity Science at McGill University. The community is working to advance GEOBON's vision and supporting the implementation of the Post-2020 Global Biodiversity Framework. GEOBON is also working with Canadian biodiversity and EO experts across government, academia, industry, and indigenous communities to explore the possibility of developing a Canada BON to facilitate access to Canadian multi-scale and multi-source observations. Biodiversity is of significant importance for Canada."*

The Secretariat is looking forward to continuing the discussion on biodiversity monitoring with Canada GEO and strengthening the collaboration with the Canadian government.





A transition year for the Secretariat, 2021 proved to be a very busy year in working with partners as well. The most important collaboration, with regards to information services and tools, involved the Secretariat of the Convention on Biological Diversity (CBD), the United Nations Statistics Division (UNSD), the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), and the UN Regional Commissions. A series of webinars to support the implementation of the post-2020 global biodiversity framework (GBF) stemmed from this collaboration. While UNSD took the lead on high-level webinars and WCMC on platforms for national reporting, GEO BON focused on technical aspects of implementation of the post-2020 GBF. A number of biodiversity change indicators originating from [GEO BON's work](#) are currently included as headline indicators in the GBF (still under negotiation). GEO BON organized three webinars in 2021 on the following topics: species populations and area-based conservation, genetic diversity and ecosystem extent and integrity. All webinars were well attended by CBD Parties and non-Parties, researchers and practitioners. Slides and recordings are available [online](#).

# COLLABORATIONS

## Webinars

The need to organize these webinars (and future ones) was identified based on previous experience around the Aichi targets and the general failure to reach them by 2020. Parties to the CBD have been struggling to track progress towards national targets due to their limited access to user-friendly indicator methodologies and the reliable data needed for these indicators. Therefore, there was a clear need for technical support to calculate fit-for-purpose indicators associated with targets, goals and milestones in the new GBF.

GEO BON is positioning itself as a global organization of biodiversity experts, ready to support CBD Parties by providing information, workflows and data products based on EBVs as foundation for scalable indicators in support of countries' monitoring and assessment needs.

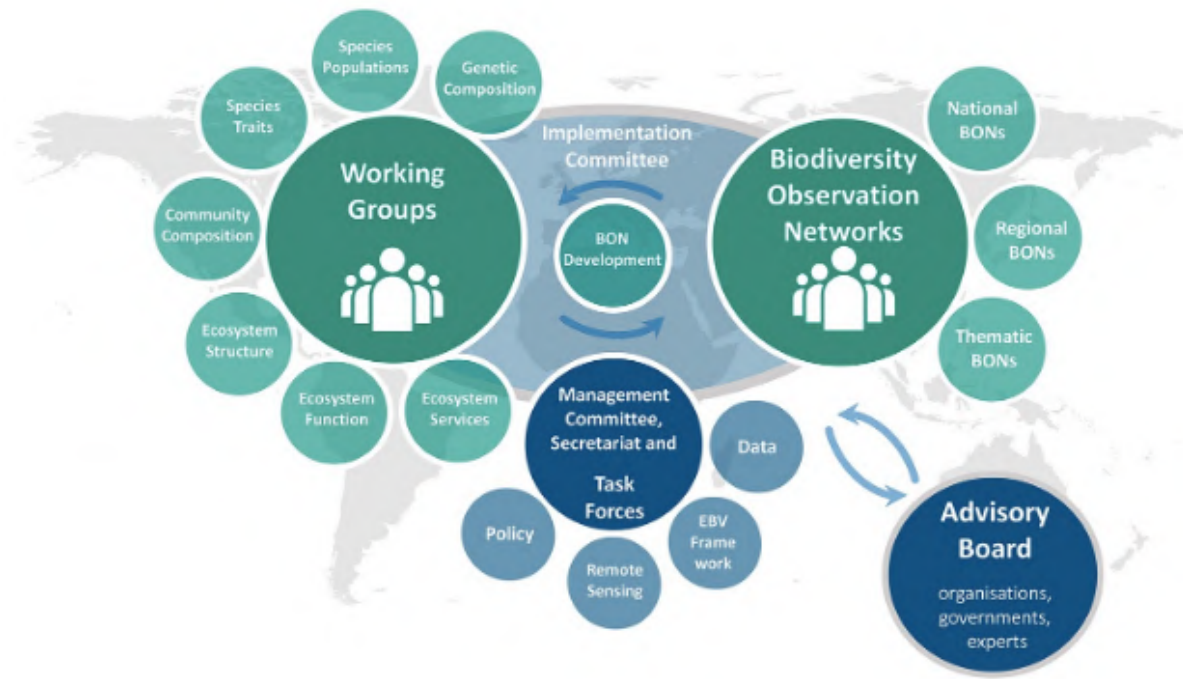
Two more webinars are planned for 2022 (marine indicators and connectivity) after which the need for additional webinars will be reassessed in collaboration with the above-mentioned partners.

For more information about other projects, collaborations, publications, please visit <https://geobon.org/>.



# GEO BON NETWORK

## Working Groups



The previous implementation plan (2017-2020) included a new structure for GEO BON. This structure had two main poles, working groups (WG) built around the 6 EBV classes, and biodiversity observation networks (BON), with a national, regional or thematic scope. A new WG was created around essential ecosystem services variables (EESV) and another WG was tasked with linking EBV WGs and BONs and creating BON development workflows to facilitate the growth of GEO BON at a true global scale. In addition, task forces (TF) with cross-cutting activities across WGs and BONs were set in motion with specific objectives and timeframes for activities as well as direct involvement of the Secretariat.

Waves of change affected multiple GEO BON groups in 2021. Multiple WG leads or BON Chairs stepped down in 2021. Some positions have been filled, some are waiting to be filled. COVID-19 brought many delays in reaching many objectives of various groups. One regional BON, Americas BON, saw its leadership stepping down and while on standby, awaiting potential new support, the page dedicated to this BON is no longer available on GEO BON's website.

Below, a list of updates from each group. Membership updates as of 20 December 2021.



# WORKING GROUPS

## Genetic Composition

- Leads: Sean Hoban (The Morton Arboretum, USA), Margaret Hunter (U.S. Geological Survey, USA), Anna MacDonald (Australian National University, Australia)
- Members: 196



One of the aims of the Genetic Composition WG is to support the integration of genetic data and monitoring into management and policy. Over the last year, the GCWG's main focus has been the UN Convention on Biological Diversity (CBD), given the urgent need to improve the wording on genetic diversity in the post-2020 global biodiversity framework. The co-leads and members of the GCWG have been working to advocate for more actionable genetics targets, goals and indicators in the CBD framework, for all species (not just agricultural).

This has included hosting seminars for CBD representatives, country and NGO focal points, attending CBD meetings, and developing peer-reviewed papers and policy-relevant documents for stakeholders in the CBD. Members of this WG evaluated how genetic diversity is presented in CBD National Reports ([Hoban et al. 2021](#)), they have provided a second revision of the Genetic Composition EBV paper, and published on the emerging field of macrogenetics ([Leigh et al. 2021](#)). In addition, the leads and other members of this WG organized a GEO BON - CBD [webinar of genetic diversity](#). GCWG is coordinating with IUCN Conservation Genetics Specialist Group, Society for Conservation Biology, and G-BIKE on policy efforts through the Coalition for Conservation Genetics.



# WORKING GROUPS

## Species Populations

- Leads: Walter Jetz (Yale University, USA), Melodie McGeoch (La Trobe University, Australia)
- Members: 358



This year proved to be very busy for the leads of the Species Populations WG. As the new Global Biodiversity Framework is being negotiated by Parties to the CBD, a number of indicators [developed by GEO BON](#) have been included in the GBF monitoring framework. Species Habitat Index and the Rate of Invasive Alien Species Spread Indicator, developed through the efforts of this WG, have been updated and are currently on the provisional list of headline indicators for GBF. Members of this WG were directly involved in organizing the GEO BON - CBD webinar '[Species populations and area-based conservation](#)' earlier this year (recording available on GEO BON's YouTube channel). Recent publications from this WG provided an overview of the global and national trends, gaps, and opportunities in documenting and monitoring species distributions ([Oliver et al. 2021](#)) and urged Parties to CBD to include biodiversity representation indicators in area-based conservation targets ([Jetz et al. 2021](#)).





# WORKING GROUPS

## Species Traits

- Leads: Mark Costello (Nord University, Norway), Jens Kattge (Max Planck Institute for Biogeochemistry, Germany)
- Members: 237



A few years ago, [Kissling et al. \(2018\)](#) showed how to apply the EBV concept to species traits: monitoring the density distributions of trait states of species over time. This approach has a successful history in fisheries and forestry for monitoring economically relevant and managed species populations. However, long-term monitoring of species traits is challenging and therefore rare in biodiversity research. Some promising examples include: phenological traits (the timing of migrant arrivals, flowering or hatching), morphological traits of monitored species (length of bird wings; body sizes of fishes), or traits derived from historical collection (leaf area from herbarium specimen images).

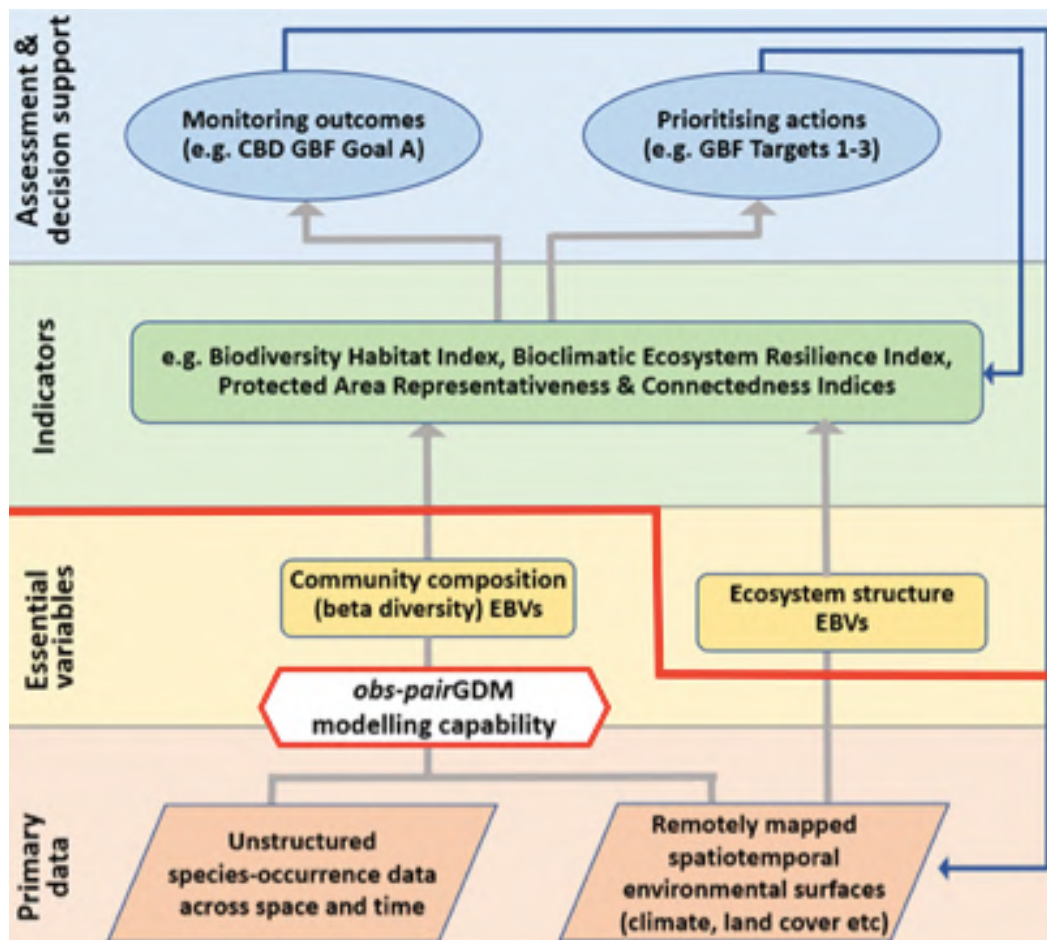
The identification of such data and its transformation into EBV data products needs domain-specific expertise. Therefore the co-leads of this WG suggest an increase in the number and diversity of group leads to represent the relevant domains (i.e., terrestrial flora, terrestrial fauna, marine species, freshwater species) and that specific goals and timelines are defined for WG.



# WORKING GROUPS

## Community Composition

- Leads: Simon Ferrier (CSIRO, Australia), Willfried Thuiller (CNRS, France)
- Note: In January 2022, Simon will step down from the leadership position and this WG will look for a new co-lead.
- Members: 373



In 2021 this WG stepped up their work on EBVs and focused on analytics involving cloud computation. As part of the GEO BON and Microsoft AI for Earth "EBVs on the Cloud" grant program, CSIRO worked closely with Microsoft to develop a new cloud-computing capability for deriving community-composition EBVs from unstructured species-occurrence datasets. Big-data initiatives such as GBIF have revolutionized access to a massive, and rapidly growing, volume of spatially explicit data on known occurrences of over a million species worldwide. There is now growing interest in possible approaches to detecting biodiversity change through analysis and modelling of such data over both space and time.



# WORKING GROUPS

## Community Composition

However, in contrast to structured biological datasets, long considered the ‘gold standard’ in biodiversity monitoring, species-occurrence data accessible through facilities such as GBIF tend to be highly unstructured – i.e. records distributed across time have most often been generated not through repeated standardized sampling of the same spatial locations, but rather through largely opportunistic or *ad hoc* observation and collection activities.

The analytical capability being developed by this project adopts a highly novel approach to extracting the signal of biodiversity change from unstructured spatio-temporal datasets, which sidesteps any need for spatial binning and instead works directly with the raw resolution of occurrence records. This employs a statistical machine-learning technique obs-pair GDM, which is an extension of generalized dissimilarity modelling designed to work effectively with unstructured species-occurrence data. By modelling the probability of mismatch in species identity between pairs of occurrence records as a function of spatio-temporal differences in remotely mapped environmental covariates (e.g. climate, land cover) this approach can contribute directly to populating both the spatial and temporal dimensions of Beta Diversity EBVs within the Community Composition EBV class.

Implementation on the Azure cloud-computing platform, accelerated and supported by Microsoft’s Planetary Computer, will place this capability directly in the hands of users worldwide. It is envisaged that EBVs generated using the new capability will, in turn, serve as a foundation for deriving indicators supporting CBD post-2020 reporting, and prioritization of actions, at both national and global scales. Discussion is also underway regarding potential linkages with the upcoming development of BON-in-a-Box 2.0.





# WORKING GROUPS

## Ecosystem Structure

- Lead: Gary Geller (NASA/Jet Propulsion Laboratory, USA)
- Note: Two co-leads, Ilaria Palumbo from JRC and Brian O'Connor from UNCCD, stepped down in 2021. This WG will look for a new co-lead in 2022.
- Members: 389



Now that the Ecosystem Structure EBVs have been identified, the WG activities have narrowed and tend towards working with organizations and individuals with regards to their further implementation. A number of proposals were submitted to the Microsoft AI for Earth “EBVs on the Cloud” grant program and several were funded. “AMAZECO: Covering the Amazon with an Ecosystem Structure EBV product combining satellite and airborne LIDAR”, with Ruben Valbuena as PI, combines a variety of data sources to create a raster product of profile-related ecosystem traits (height, cover, complexity). “Using AI to validate and downscale ecosystem-related Essential Biodiversity Variables (EBVs) in mountain environments”, with Ruth Sonnenschein as PI, looks at Ecosystem Extent and ecosystem fragmentation in mountain areas. A number of WG members participated in webinars related to Ecosystem Extent, one a joint session with CBD, UNSD, UNEP-WCMC, and GEO BON, and the other hosted by UNSD-SEEA. Additionally, there are ongoing discussions with several organizations regarding the development of indicators for ecosystem integrity, for which the Ecosystem Structure EBVs play a central role.



# WORKING GROUPS

## Ecosystem Function

- Leads: Ghada El Serafy (Deltares, Netherlands), Pedro Leitão (Technische Universität Braunschweig, Germany)
- Members: 430



Activities related to EBVs of the Ecosystem Function class have been greatly slowed down since the beginning of the COVID-19 pandemic. In 2021, this WG was mainly connected to the NASA A.50 project led by Howard Epstein "Arctic Ecosystem Functional Diversity".

The leads plan to reinvigorate this WG in 2022.



# WORKING GROUPS

## Ecosystem Services

- Leads: Ilse Geijzendorffer (Louis Bolk Institute, Netherlands), María Vallejos (University of Buenos Aires, Argentina), Odirilwe Selomane (Stellenbosch University, South Africa)
- Note: In January 2022, Ilse will step down from the leadership position. This WG will remain under the leadership of María and Odirilwe for the time being. If deemed necessary, a third lead will be added at a later date.
- Members: 386



### Completed tasks:

As a result of the session at the Open Science Conference 2020 “Monitoring Ecosystem Services: From global to local”, organized by members of the Ecosystem Services Working Group, an article was published: “The journey to monitoring ecosystem services: Are we there yet?”, by Sofía Vaz et al. (2021), in Ecosystem Services.

On June 8, 2021, several members of this WG participated in the Session T3 of the ESP Europe conference “Ecosystem Services indicators in the era of big, coarse data”, led by Alexander Van Oudenhoven.

### Work in progress:

The article by Balvanera et al. presenting the conceptual framework of the Essential Ecosystem services Variables passed the first review.



Great progress was made in the review and analysis of data for the study of Landscape Aesthetics Indicators from Earth Observation, led by Arjan Gosal and Ana Sofia Vaz.

The WG began to collect information for the elaboration of an internal communication document for the working group, to facilitate the flow of information before the incorporation of new members to the WG. Action led by María Vallejos.

Likewise, the WG started analyzing the connections between EVBs and EESVs to understand the interdependence of both in the context of biodiversity monitoring. Action led by Odirilwe Selomane.

### **Future steps:**

A working group was formed to study interoperability and data, standards and models. This effort links multiple efforts both within and outside of GEO BON. Ken Bagstad and Valia Drakou will be coordinating this effort and will reach out to those interested in being involved in this task, for a possible meeting in early 2022.

The leads formalized the collaboration of WG members with the ESA Biodiversity Precursor-Freshwater, led by Petra Philipson. This project will study how satellite observations can be synergistically integrated with digital technologies and biodiversity modelling into Earth System Science approaches, cooperating closely with the most prominent players and relevant projects to ensure that project results can be integrated into existing or planned international initiatives for wider dissemination.

# WORKING GROUPS

## BON Development

- Leads: Petteri Vihervaara (Finnish Environment Institute, Finland), Mike Gill (NatureServe, Canada), María Cecilia Londoño-Murcia (Instituto Humboldt, Colombia)
- Members: 203



The BON Development WG has continued its work to develop a manual for BON Development in view of a growing interest in national BONs from Parties to the CBD. The setup of a new GEO BON Secretariat brought some delays in moving forward the official process of BON development and endorsement. However, BONs are one of the pillars of GEO BON and a close collaboration between the Secretariat and this WG in 2022 will streamline the process and provide much needed support to those organizations looking to set up biodiversity observation networks around the world. Previous and existing projects on implementing a 9-step design process for new BONs will provide much needed background information to reach the objectives of this WG.

# BIODIVERSITY OBSERVATION NETWORKS

## French BON

- Chairs: Yvan Le Bras and Jean-Denis Vigne (National Museum of Natural History, Paris)
- Members: 43

French BON is represented by the French Biodiversity data hub (PNDB) at the National Museum of Natural History in Paris. In 2021, PNDB grew with the addition of Olivier Norvez, as an animation coordinator. Olivier will facilitate communication with international networks, including GEO BON. While this BON has been largely research oriented so far, there is a growing interest in policy and in attracting experts in this field to become members of the French BON.

### **PNDB initiatives oriented towards EBVs / GEO BON:**

[GO FAIR BiodiFAIRse Implementation network](#) animation since 2019, new roadmap proposes to implement FAIR tools in practice, notably Galaxy-E and related EBV workflows, as a case study of [Global Open Science Cloud](#) with GEO BON and IPBES (proposal writing in progress).

French PNDB e-infrastructure scientific committee was working particularly this year on “evaluating” (what is existing, what is lacking, what can be improved) existing EBVs. A report will be submitted to the GEO BON Secretariat.

French PNDB e-infrastructure funded projects of particular interest for GEO BON:

- [GALLANTRIES](#) (2020-2023): European project to create Galaxy-E tools, develop training material (Biodiversity data exploration + modeling) and provide special “hybrid” training sessions with hundreds of attendees
- [IA-Biodiv](#) (2021-2026): French project to create IA-Biodivnet (information system dedicated to give access to raw and highly structured biodiversity data that can be used to train artificial intelligence algorithms to create biodiversity metrics and indicators)
  - Access to the French AI supercomputer from Galaxy-E platform
- [GAIA-DATA](#) (2021-2029) => 65M€ Climate / Biodiversity / Remote sensing (CNES notably)



# BIODIVERSITY OBSERVATION NETWORKS

## China BON

- Chair: Haigen Xu (Nanjing Institute of Environmental Sciences)
- Members: 51



By 2021, the China BON-Birds has established a total of 380 sampling areas in 31 provinces (autonomous regions and municipalities directly under the central government), covering a variety of representative ecosystems, including forests, grasslands, deserts, wetlands, farmland and cities, including more than 100 national nature reserves. Nanjing Institute of Environmental Sciences (NIES) of the Ministry of Ecology and Environment of China integrated resources, involved professional and technical personnel and volunteers, and established cooperation with more than 100 institutions in the process of bird monitoring. A total of 1,146 species of birds (24 orders, 98 families) accounting for 83.59% of the total number of bird species (1,371) in China were monitored.

# BIODIVERSITY OBSERVATION NETWORKS

## China BON

Among them, there are 66 species of national first-level protection animals, 229 species of national second-level protection animals.

The book entitled 'China's Bird Diversity Monitoring' will be published in early 2022 to reflect the 10 years' work of China BON-Birds. The book will comprehensively introduce the status of bird diversity in China, the status of bird observation at home and abroad, and the construction of a bird observation network. Based on the 10 years' data, the spatial and temporal patterns of bird diversity, the status of rare and endangered species, the characteristics of bird communities in typical habitats, and the status of threatened and protected birds in China and seven zoogeographical regions will be described in detail in this book. At the same time, based on long-term field monitoring, some suggestions will be put forward to further improve the biodiversity observation network.

# BIODIVERSITY OBSERVATION NETWORKS

## Colombia BON

- Leads: Bibiana Gómez and Helena Olaya (Instituto Humboldt, Bogotá)
- Members: 66



With the election of María Cecilia Londoño-Murcia as GEO BON co-Chair, Colombia BON was in need of new leadership. The new team steering the wheels of this network for the near future are all based at the Alexander von Humboldt Biological Resources Research Institute (aka Instituto Humboldt) in Bogotá: Bibiana Gómez and Helena Olaya as new co-Chairs, supported in their work by Adriana Restrepo and Oriana Ceballos. This team took over a large network and conducted a survey among its members to gauge the interest in continuing participating in the network as well as take stock of what has been accomplished so far. The network has been working on a few topics so far: species distribution models, indicators, landscape ecology and connectivity, functional traits of populations and communities, use of genetic data. New plans for 2022 include a workshop to consolidate and grow the network, align the goals of the network with CBD objectives, propose a new implementation plan for Colombia BON (2022-2025) and participate in BON-in-a-Box 2.0.





# BIODIVERSITY OBSERVATION NETWORKS

## Arctic BON

- Chair: Tom Christensen (Aarhus University, Denmark)
- Members: 38
- Website: <https://www.caff.is/monitoring>



The Circumpolar Biodiversity Monitoring Programme (CBMP) is the Arctic BON of GEO BON and includes four thematic groups: Marine, Freshwater, Terrestrial, and Coastal. In 2021, CBMP-Terrestrial released the first State of the Arctic Biodiversity Report (SABR) for [terrestrial ecosystems](#), a follow-up to the [special issue](#) of Ambio that was released in 2020. The terrestrial SABR joins the [marine report](#) (released in 2017) and [freshwater report](#) (released in 2019). The CBMP Coastal group finalized their monitoring plan in 2019 with a [co-production of knowledge approach](#) with Indigenous partners. The group is planning for their first SABR for coastal ecosystems for 2024/25.



# BIODIVERSITY OBSERVATION NETWORKS

## Arctic BON

CBMP-Marine developed its next [implementation plan](#) during 2021 to guide their work in the coming years, and released updates to the marine SABR for marine mammals and seabirds. CBMP-Freshwater finalized the remaining papers for a special issue of Freshwater Biology, which includes an [introduction; circumpolar assessments of water chemistry, benthic diatoms, plankton, benthic macroinvertebrates, and fish](#); regional assessments of [Russian plankton, Fennoscandian rivers, and lakes, Norway/Iceland fish, and North American rivers](#); and a literature review of [Indigenous Knowledge](#). The final paper in the issue, which is a synthesis of circumpolar biodiversity patterns across organism groups, will be published in January 2022, when the full issue is formally released.

The CBMP is working with many international partners within and outside the Arctic Council. One example is INTERACT (the International Network for Terrestrial Research and Monitoring in the Arctic) to develop an [online tool](#) to guide users through the implementation of CBMP-Freshwater and CBMP-Terrestrial monitoring plans at INTERACT field stations. The CBMP is also contributing to the development of a collaboration between CAFF (Conservation of Arctic Flora and Fauna) and AMAP (Arctic Monitoring and Assessment Programme) to assess impacts of ecosystem change on Arctic biodiversity and feedbacks to the climate, as well as the impacts of climate change on ecosystem services and Indigenous communities in the Arctic.

# BIODIVERSITY OBSERVATION NETWORKS



- Chairs: Hiroyuki Muraoka (Gifu University, Japan), Runi Sylvester Pungga (Forest Department Sarawak, Malaysia), Yongyut Trisurat (Kasetsart University, Thailand)
- Members: 125
- Secretariat: Biodiversity Center of Japan, Nature Conservation Bureau, Ministry of the Environment
- Website: <http://www.esabii.biodic.go.jp/ap-bon/>



Asia-Pacific BON (APBON) went through a wave of changes in 2021. Three new co-chairs have been elected, spanning three countries (Japan, Malaysia, and Thailand) and academic and government organizations. After 10 years of activity, and based on achievements from the first decade of existence, as well as the regional network's recent needs, APBON finalized its new Strategic Plan to take the network into 2030 (Takeuchi et al., 2021). While the COVID-19 pandemic has been limiting research and workshop activities around the world, APBON has pursued the initiative of collaboration, information exchange, and team building, through the organization of workshops and webinars on regional biodiversity issues and activities.

Regional GEO meetings, such as the Asia-Oceania GEO Symposium, benefited from APBON-organized sessions on biodiversity and climate change.

More details on APBON activities as well as reports, presentation slides or webinar recordings, are available on the APBON website.



- Chairs: Eren Turak (NSW Department of Planning, Industry and Environment, Australia), Andreas Bruder (University of Applied Sciences and Arts of Southern Switzerland), Jennifer Lento (University of New Brunswick, Canada)
- Members: 211
- FWBON elected a third co-Chair, Jennifer Lento, in 2021. With this addition, the network has a leadership distributed across the main regions and time zones of the globe, an asset in improving communication and responding to the needs of its members.



Looking back, FWBON has been engaged in the following activities:

- Promotion and support of the calls for greater visibility and more explicit consideration of freshwater biodiversity in the post-2020 Global Biodiversity Framework through active participation in the GEO BON Policy Task Force;
- Coordination Committee member contributions to the initiation and lead of the newly-formed IUCN SSC Global Freshwater Macroinvertebrate Sampling Protocols Task Force (GLOSAM), which has the goal of establishing and promoting global standards for macroinvertebrate sampling and data collection methods;
- Coordination Committee member participation in regional freshwater biodiversity monitoring and assessment efforts (e.g., the Circumpolar Biodiversity Monitoring Program);

- Discussions of the potential for greater collaboration with other thematic and regional BONs and Working Groups to increase FWBON's capacity to reach its goals.

The Coordination Committee of FWBON has several goals for the new year, including the development of a new strategic plan to guide its work over the coming years, and improved communication and engagement with the FWBON membership. Many FWBON members are interested in actively contributing to FWBON's objectives of promoting coordinated and harmonized monitoring of freshwater biodiversity, developing a global freshwater biodiversity data portal, and working towards a global assessment of status and trends in biodiversity, and it is a general wish to find the best approach to benefit from the vast expertise within WBON membership.

The Coordination Committee has made plans for a workshop of the Coordination Committee and special session at the World Biodiversity Forum in Davos, Switzerland in June 2022. The workshop will be used to develop FWBON coordination and to work towards the main activities of FWBON as identified in the updated implementation plan. Back-to-back to the workshop will be the WBF and the special session entitled "The role of coordination and harmonization for detection of trends in freshwater biodiversity at a global scale". Most members of the FWBON Coordination Committee will present case studies that showcase the need for coordination and/or harmonization in freshwater biodiversity observations and data – the key goals of FWBON. There will be a discussion slot at the end of the session which, together with other activities during the Forum, will allow interactions and discussions with the membership of FWBON and GEO BON.

The FWBON co-Chairs are looking forward to connecting with their members in the new year.



- Chairs: F. Muller-Karger (University of South Florida, USA), Isabel Sousa-Pinto (University of Porto, Portugal), Masahiro Nakaoka (Hokkaido University, Japan)
- Members: 251
- Secretariat: AIR Center, Portugal (Joana Soares, Alice Soccodato)
- Website: <https://marinebon.org/>
- Marine BON went through a change in their leadership in 2021. Mark Costello stepped down as co-Chair, remaining a co-lead of Species Traits WG, while Masahiro Nakaoka joined Frank and Isabel in leading MBON and facilitating dialogue in the Asia-Pacific region.



One of the highlights for MBON this year was the endorsement of Marine Life 2030 as a UN Ocean Decade Action. The Ocean Decade will see an outstanding alliance of stakeholders (UN agencies, governments, science, industry, NGOs, civil society, philanthropy, media, arts and humanities) working together towards its vision "The Science We Need For The Ocean We Want".



Marine Life 2030 plans to build a global integrated marine biodiversity information management and forecasting system for sustainable development and conservation so that by 2030 and beyond, anyone, anywhere, will have access to information on marine species and ecosystems important to local fisheries, culture, health, and livelihoods. Led by the Smithsonian Institution, the programme gathers a long list of partners from around the world and has a strong participation from MBON.

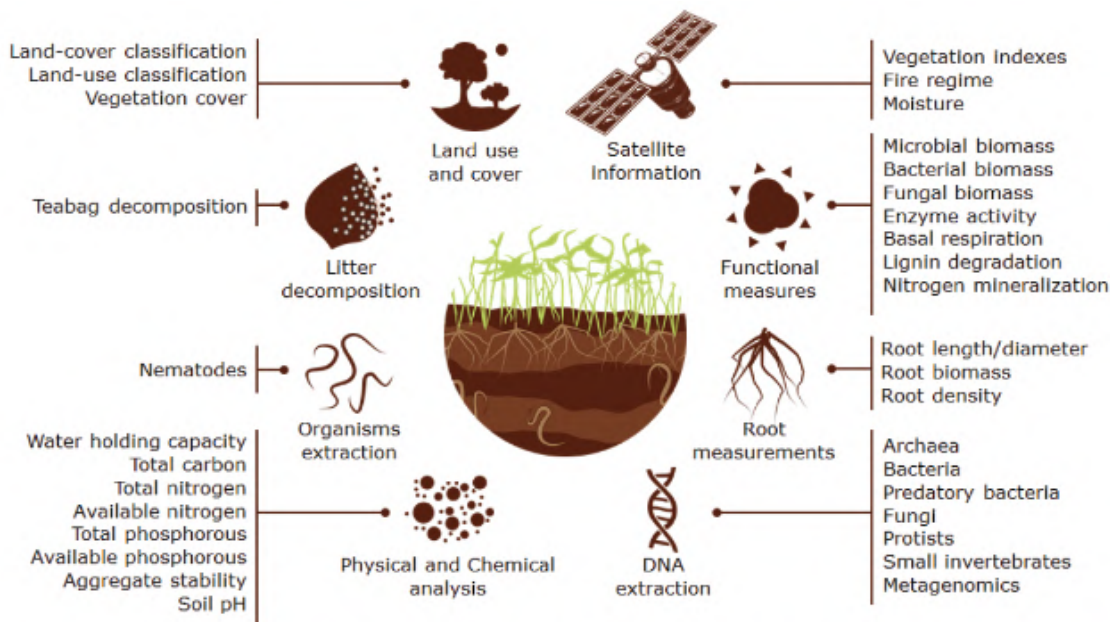
MBON members had a strong online presence this year. Participation in the GEO Week and AmeriGEO Week, AP-MBON “Incubation” Session, and MBON networking sessions are just a few of the 2021 activities. Virtual activities will continue in 2022, joined by, hopefully, in-person attendance to large conferences such as the UN Ocean Conference.

This BON has been active also on the policy front. Portugal’s government highlighted MBON within their policy priorities, EU included marine biodiversity under the Horizon Europe programme and there is growing interest in oceans from the climate convention UNFCCC. MBON members submitted multiple grant applications to various funding organizations (EU and US-based).

On the data front, MBON worked with OBIS and GBIF to integrate ‘omics’ observations into Darwin Core. A long list of publications has emerged from MBON efforts (to be added at the end of the year to the GEO BON website - Publications section).



- Chairs: Carlos Guerra (iDiv, Germany), Diana H. Wall (Colorado State University, USA)
- Members: 227



**Figure 1.** Analyses expected to be done across all soil sampling sites in Soil BON, being related to soil-specific essential biodiversity variables (Guerra et al. 2021). More analyses can be added through strategic partnerships in the future.

Earlier this year, Soil BON launched a major call for collaboration to monitor soil biodiversity around the world. To date, more than 500 individuals from 200 institutions in 81 countries and territories have registered to provide soil samples for analysis. With such an ambitious goal and high interest from participants, a large effort of Soil BON leadership has been focused on streamlining the legal procedures for collecting and shipping soil samples from various countries to Germany. Now that the path through the complex system of the Nagoya Protocol and national legislation has been found, various GEO BON networks can learn from the experience of Soil BON.

Through this global effort to map and [monitor soil biodiversity](#), Soil BON is also strengthening collaboration with major partners such as Global Soil Partnership, Global Soil Biodiversity Initiative, FAO, GBIF and many others.

# TASK FORCES

## Remote Sensing

- Leads: Andrew Skidmore (University of Twente, Netherlands), Nicholas Coops (University of British Columbia, Canada)
- Members: 201

A few years ago, in December 2017, the Remote Sensing TF held an [expert workshop](#) for prioritization and selection of remote sensing based EBVs. The workshop was attended by 40 experts who compiled a list of key biological variables needed to measure the state of biodiversity (EBVs) that can be monitored using remote sensing data. The [publication](#) resulting from that workshop and follow-up meetings was released in 2021.

The TF leads published a [short note](#) on remote sensing and EBVs with an invitation for experts to join the TF as there is a growing need for ecologists to work with remote sensing specialists to ensure that EBVs are operationally realistic from a remote sensing perspective.

For 2022, the leads are planning to increase communication within the TF, provide support and connections for the many remote sensing-based studies on EBVs globally, continue to liaise with space agencies on EBV needs and link GEO BON expertise in remote sensing into CBD and IPBES.

## Data

- Leads: Robert Guralnick (Florida Museum of Natural History, USA), Néstor Fernández (iDiv, Germany)
- Members: 13

For the past year, the leads of Data TF have been working with an international group of ecologists and developers to add a Humboldt Core extension to the Darwin Core. Their goal is to ratify this extension through the official process of the Biodiversity Information Standards (TDWG) in 2022. In addition, a symposium and working group meeting were organized at TDWG in 2021. The EBV Data Portal has also seen a 2021 update in data submission pipeline and user interface.



# TASK FORCES

## Policy

- Leads: Laetitia Navarro (Estación Biológica de Doñana, Spain), Cornelia Krug (University of Zurich, Switzerland)
- Members: 32

The Policy TF worked closely with the new Secretariat to prepare and attend CBD and IPBES meetings throughout the year.

GEO BON prepared and submitted two statements for [SBSTTA-24](#): post-2020 GBF and marine and coastal biodiversity ([Statements](#)). On behalf of GEO BON, Andrew Gonzalez gave an oral and written statement during the contact group on the definitions and role of baselines in the context of the proposed monitoring framework for the post-2020 GBF. This was well received and unblocked discussion on this topic. GEO BON was thanked for its contribution. GEO BON also submitted two items for Parties' consideration: '[Scalable data, observation systems and indicators to support effective monitoring of goals and targets for the post-2020 global biodiversity framework: GEO BON support for implementation](#)' and '[Inclusion of genetic diversity in the post-2020 global biodiversity framework: scientific and technical knowledge](#)'.

A written [statement](#) was also submitted for [OEWG3](#), highlighting the importance of EBVs to harmonize and standardize biodiversity data into indicators, as well as the role GEO BON can play to meet the demanding scientific and technical capacity required by countries to achieve the framework's targets. GEO BON contributed an information document on the Species Habitat Index (methodology, and current availability to Parties), one of the headline indicators proposed in the GBF monitoring framework (CBD/WG2020/3/INF/6). During the contact group 2 on reducing threats for biodiversity, GEO BON made a statement on Target 4 regarding the need to include text to ensure that the genetic diversity of populations is protected, maintained, managed, and monitored, at levels ensuring adaptive potential.

At [IPBES 8](#), GCWG and the Coalition for Conservation Genetics submitted a poster on the importance of genetic diversity for biodiversity and ecosystem services.

For the past three months, the GEO BON Secretariat together with the Policy TF and other GEO BON members have joined forces with Future Earth (bioDiscovery program) to convene a group of 50+ biodiversity experts to provide additional scientific input into the post-2020 GBF. This work is currently submitted for comments to the CBD Secretariat and OEWG co-Chairs. The final information document will be submitted to CBD at the beginning of January, to be considered by Parties in preparation for the resumed CBD meetings in March 2022.

As such, the Policy TF is preparing for another busy year with multiple CBD meetings including the long-awaited COP15, delayed for the last two years due to COVID-19 and expected to make a breakthrough in protecting biodiversity globally through the negotiation of a new global biodiversity framework.

# LOOKING FORWARD TO 2022

Catalyze an **integrated Global BON**: Knowledge hubs enabling national, regional and international collaboration and capacity building

Provide **biodiversity information and services** to CBD Parties (GBF monitoring framework) and partner organizations (e.g., IPBES), governments, researchers, businesses.

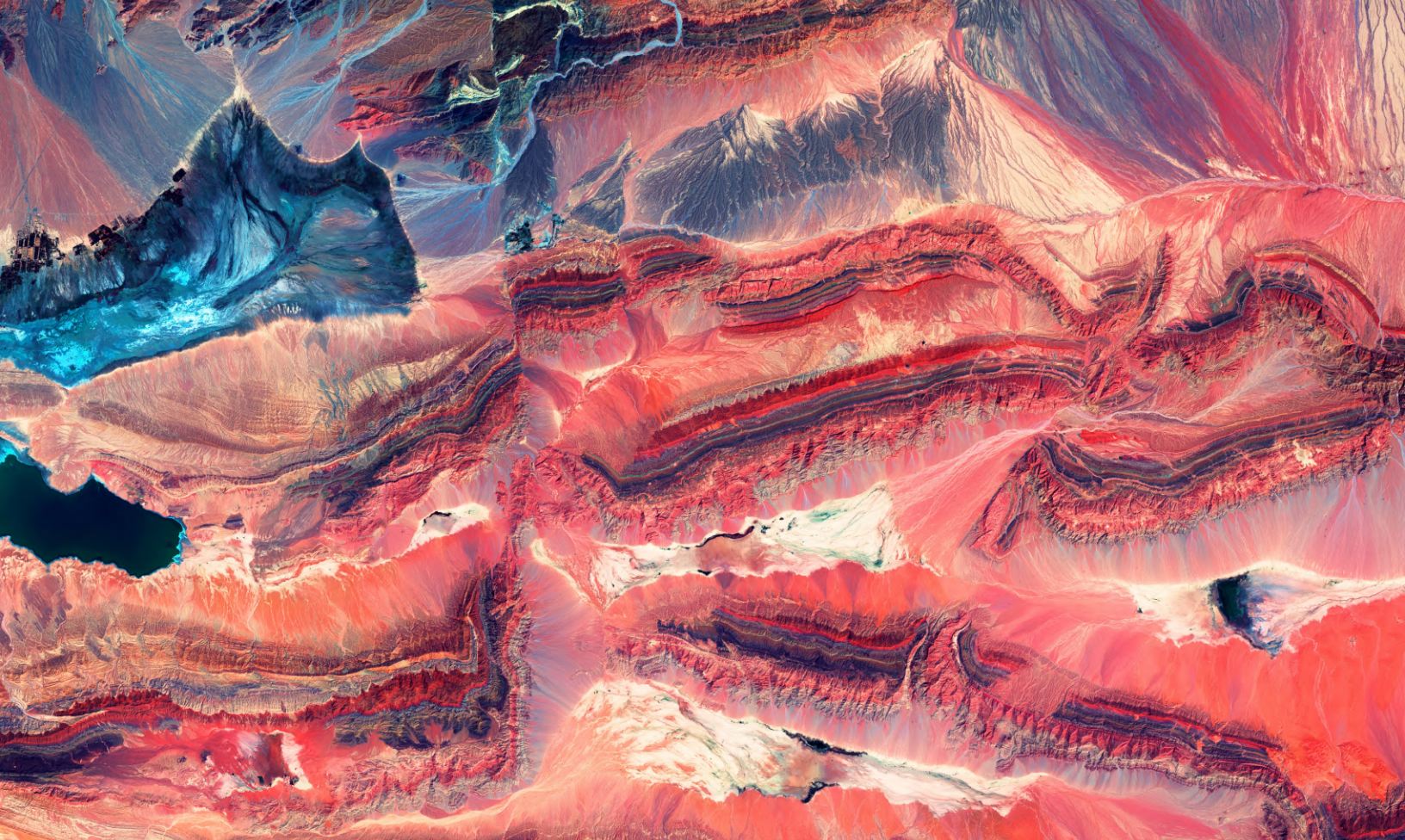
Grow **communities of practice**: build capacity for biodiversity monitoring design workflows (data to decision support).

The year ahead will be again a busy year despite heading into it with lockdowns in many countries. A new strategic plan will be finalized to take GEO BON into its new phase. Closer collaboration with various GEO flagships, initiatives and activities will be sought to strengthen the biodiversity component across GEO. Continued work with the CBD Secretariat and CBD Parties will help consolidate GEO BON's position as provider of biodiversity

information and services. This type of partnerships, whether with UN agencies, other IGOs, NGOs, governments, academia or private sector, will help build the knowledge hubs that GEO BON would like to implement. BON-in-a-box 2.0 will see an advancement in its development and partial roll-out. The GEO BON larger family will grow and solidify as a community of practice for biodiversity monitoring.

Note: Despite the current pandemic situation, the Secretariat is planning to organize a hybrid Open Science Conference and All Hands Meeting towards the end of 2022. Stay tuned!





# STAY CONNECTED

- Follow us on Twitter and Facebook.
- Read our Newsletter.
- Check our YouTube channel regularly for recordings of webinars and other relevant talks.
- Check our website regularly for news from the Secretariat and our network, projects and publications.



