





BIODIVERSITY OBSERVATIONS
FOR A BETTER FUTURE

GEO BON




BI-ANNUAL PROGRESS REPORT

2014 - 2015






Biodiversity Observations for a better future
GEO BON Bi-Annual Progress Report 2014-15

November 2015

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Major Partner Organisations

MESSAGE FROM THE CHAIRS:

The GEO Biodiversity Observation Network

The Convention on Biological Diversity (CBD) Strategic Plan for Biodiversity 2011–2020 states that "*by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people*". Although 193 Parties have adopted these goals, there is still not an organised and coherent infrastructure in place to collect the biodiversity information necessary to monitor progress towards the objectives of the CBD Strategic Plan. Also, the **Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)** requires biodiversity data to be up-to-date, reliable, comparable among sites, relevant, and understandable.

Coordinated, large-scale biodiversity monitoring, linked to other environmental and socio-economic data, is urgently required for a comprehensive Global Biodiversity Observation Network that can support the Aichi Targets of the Strategic Plan for Biodiversity for the year 2020, and it is absolutely essential to meet the **UN Sustainable Development Goals and Agenda 2030**. This is the main motivation for the Group on Earth Observations Biodiversity Observation Network (**GEO BON**).

GEO BON is about the observation of biodiversity change. We focus on the initiation and coordination of interdisciplinary efforts to set up national and regional biodiversity observation systems and how to link them together. Through its global network, GEO BON supports the sharing and dissemination of information and technology available locally or in large existing initiatives. GEO BON also supports the application of the most recent scientific knowledge to advance biodiversity observation collection, integration and interpretation.

GEO BON, in contrast to non-governmental organisations, is not directly involved in advocacy about on-ground conservation efforts, nor focussed on the assessment of the status of biodiversity. GEO BON is a network of stakeholders, a community of practice, focused on improving the infrastructure for monitoring biodiversity change and ensuring that both scientists and decision makers have access to better data.

This report provides an overview of the activities developed by our network over the last two years. It starts with a brief presentation of the GEO BON mission and structure. Next, it presents the two core activities of GEO BON: the development of the Essential Biodiversity Variables framework and of the Bon-in-a-Box toolkit. The different national, regional and thematic biodiversity observation networks associated with GEO BON are presented. Next we highlight the most important activities from each of the nine working groups of GEO BON, where experts around the world work around specific biodiversity monitoring topics. We conclude with an overview of the secretariat activities and budget reporting.

We hope you enjoy reading our report,

Henrique Pereira and Mike Gill

Henrique M. Pereira
Chair

Mike Gill
Vice-Chair

2014-15 at a glance

March 2014
New Executive Director

- Jörg Freyhof starts at the GEO BON Secretariat as Executive Director

April 2014
GEO BON Newsletter

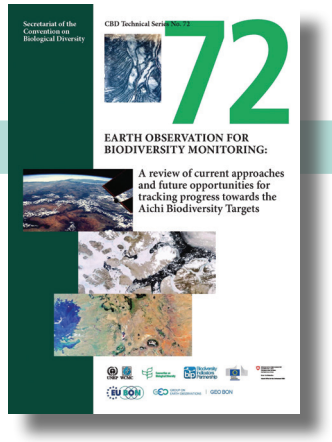
- The 1st GEO BON newsletter is shared through the network

May 2014
New Administrative Assistant

- Ariane Korn provides assistance with all administrative and management tasks

2014
CBD Technical Series No. 72

- GEO BON contributes to the CBD Technical Serie *"Review of current approaches and future opportunities for tracking progress towards the Aichi Biodiversity Targets"*



2014
New Working Group leads

- Dirk Schmeller becomes the new co-lead of GEO BON Working Group 2. Eugenie Regan/Neil Brummitt become the new leads of GEO BON Working Group 9

September - October 2014
GEO BON workshop

- GEO BON & EU BON workshop on EBV development at iDiv

October 2014
COP 12 & AP BON workshop

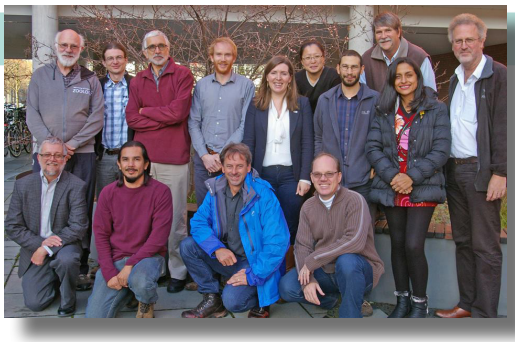
- GEO BON contributes to the 12th meeting of the Conference of the Parties to the CBD and the annual AP BON workshop in Korea

October 2014
GEO BON on Facebook

- GEO BON joins Facebook and reaches 100 likes within five days

October 2014
New WG 7 co-lead

- Walter Jetz from Yale University joins Simon Ferrier as a co-lead in GEO BON Working Group 7



December 2014
Arctic Biodiversity Congress

- GEO BON participates at the Arctic Biodiversity Congress in Trondheim

January 2015
Sino-BON meeting

- GEO BON joins the First National Workshop on Biodiversity Monitoring in Beijing

January 2015
IPBES 3 plenary

- About 20 GEO BON experts are deeply involved in various assessments and infrastructure developments at the IPBES 3 plenary in Bonn

March 2015
New journal publication

- *"Bridging the gap between biodiversity data and policy reporting needs: An EBV perspective"* in the Journal of Applied Ecology

April 2015
BON in a Box workshop

- GEO BON in partnership with Colombia's Instituto von Humboldt held the first BON in a Box regional workshop in Colombia

June 2014
IC / AB Meeting

- GEO BON Implementation Committee and Advisory Board meeting at iDiv in Leipzig

2014
Global Ecological Land Units

- GEO BON Working Group 3 produced a first draft map of Global Ecological Land Units (ELUs)

August 2014
New IT Officer

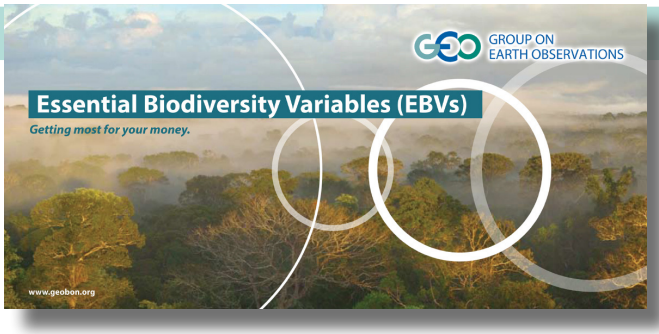
- Christian Langer joins the GEO BON Team as IT Officer

September 2014
New Postdoc

- Miquel Fernandez starts his postdoc position at the GEO BON Secretariat

October 2014
New brochures

- GEO BON publishes 4 new brochures about EBVs, BON in a Box and the biodiversity observation network



November 2014
IUCN World Parks Congress

- GEO BON organises sessions on biodiversity monitoring as well as on freshwater biodiversity in Sydney

December 2014
Global Butterfly Monitoring

- 15 international butterfly monitoring experts come together to discuss and develop a standardised set of global butterfly monitoring guidelines

January 2015
RS4EBV workshop

- 20 leading scientists from all over the world come together at iDiv to design interdisciplinary case studies aiming at a special issue on "EBVs and Remote Sensing"

March 2015
New GEO Science Officer

- Gary Geller manages links between GEO BON activities and the GEO secretariat

March 2015
GEO BON workshop

- GEO BON EBV workshop: *"Towards a global system for assessing, monitoring and reporting on biological invasions"* at iDiv

April 2015
New webpage

- Launch of the new GEO BON webpage *www.geobon.org*

April 2015
IUCN workshop

- GEO BON participates in the 1st IUCN Red List of Ecosystems workshop in Costa Rica

May 2015
New Administrative Assistant

- Helen Matthey is replacing Ariane Korn during her parental leave at the GEO BON Secretariat

June 2015
GLOBIS-B project

- GEO BON is part of the "GLOBal Infrastructures for Supporting Biodiversity research" Horizon 2020 project

June 2015
Ecopotential project

- ECOPOTENTIAL – "Improving Future Ecosystem Benefits through Earth Observation" is a new research project associated to GEO BON

June 2015
IC/AB meeting

- The GEO BON Joint Advisory Board and Implementation Committee Meeting 2015 starts at iDiv in Leipzig

June 2015
EBV workshop

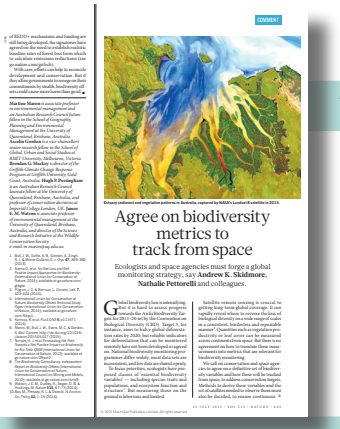
- International experts develop a conceptual framework for the Essential Biodiversity Variable "Species Distribution" at iDiv

June 2015
New Governance structure

- GEO BON implements new Governance structure

July 2015
New journal publication

- GEO BON publishes a new article "*Agree on biodiversity metrics to track from space*" in Nature


COMMENT

Agree on biodiversity metrics to track from space

Ecologists and space agencies must forge a global monitoring strategy, say **Andrew K. Skidmore, Nathalie Pettorelli** and colleagues.

July 2015
Pre-register online

- Start of the online pre-registrations for the 2016 GEO BON Open Science Conference in July 2016

August 2015
New GEO BON paper

- The new GEO BON paper *"Challenges and opportunities for the Bolivian Biodiversity Observatory"* reached 260 'likes' on Facebook

August 2015
New logo & youtube channel

- GEO BON presents its newly designed logo and joins youtube

September 2015
GEO BON newsletter

- The newsletter reaches over 400 subscribers within the network

September 2015
8th GEOSS AP Symposium

- GEO BON takes part in the Asia-Pacific GEOSS and the AP-Biodiversity Observation Network meetings in Beijing

September 2015
New biodiversity indicators

- GEO BON presents a new generation of biodiversity indicators at CBD AHTEG in Geneve

September 2015
over 300 pre-registrations

- Over 300 online pre-registrations are submitted for the 2016 GEO BON Open Science Conference

November 2015
Launch of BON in a Box

- Launch of the first prototype of the web-based, customizable toolkit BON in a Box

November 2015
GEO-XII Plenary

- The Twelfth Plenary Session of the Group on Earth Observations (GEO-XII), takes place in Mexico City, from 11 to 12 November 2015

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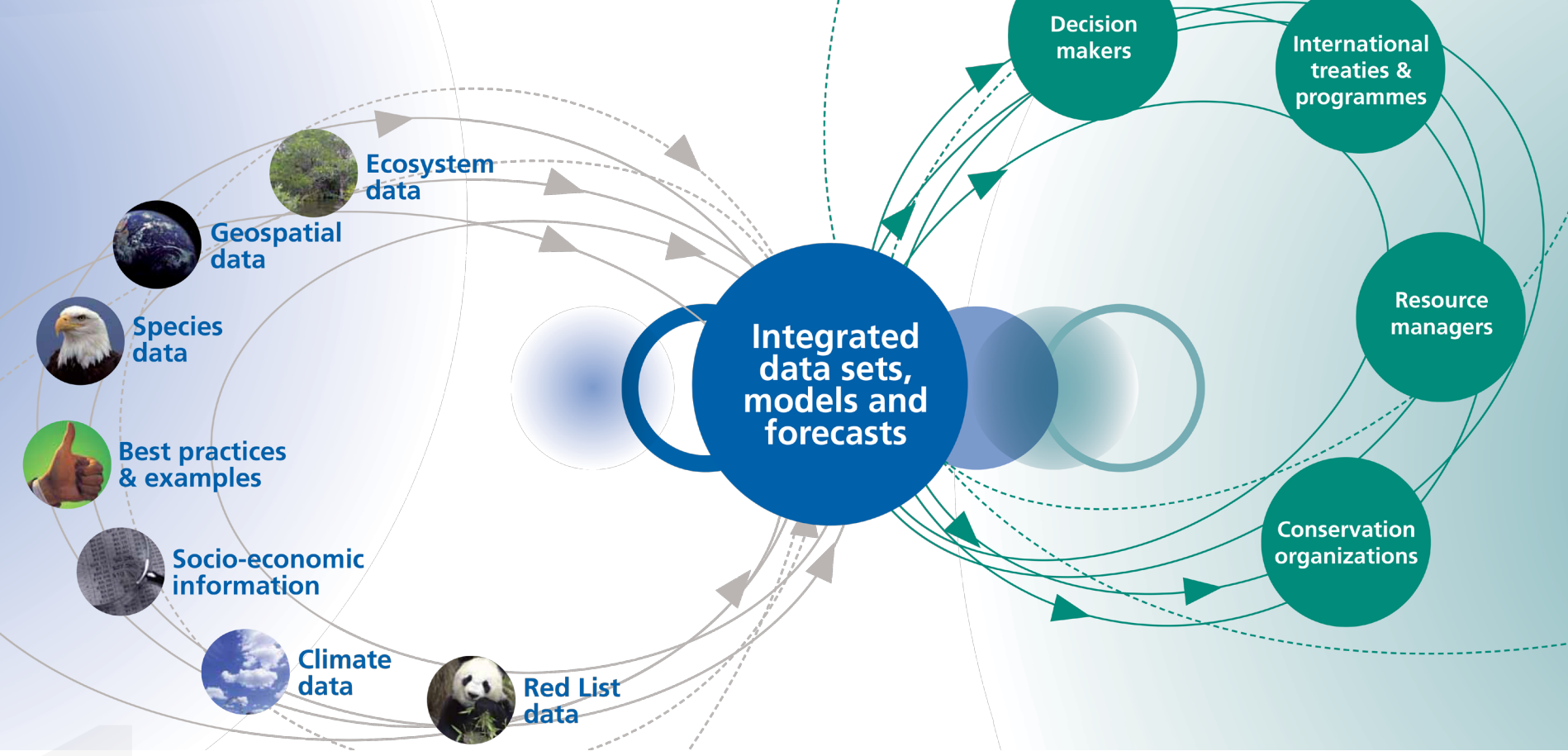


1 What is GEO BON?

Context

The Group on Earth Observations Biodiversity Observation Network (GEO BON) is focused on developing an interoperable observation system that delivers enhanced and harmonised biodiversity information to facilitate better decision making from local to global scales. GEO BON is focusing its efforts on the adoption and implementation of the Essential Biodiversity Variables (EBVs) and related monitoring guidelines. Through targeted capacity building efforts at the national and regional level (e.g. development of a "BON in a Box" toolkit), GEO BON focuses on improved acquisition, coordination and delivery of biodiversity information and services to users, particularly decision makers. This approach reflects the need to provide a top-down framework for a global observation system (e.g. EBVs, monitoring guidelines, interoperable data systems) with the pragmatism of a bottom-up construction process (e.g. through national and regional capacity building).

To achieve an interoperable global biodiversity observation network is an ambitious task. It requires a targeted and iterative approach that builds upon successes and lessons learned; focuses on understanding and responding to user needs; and facilitates the development of national and regional biodiversity observing networks that meet those needs.

GEO BON has developed a global social network and community of practice for biodiversity observations. This open network includes world-renowned leaders in biodiversity observations as well as major partner organisations working in biodiversity monitoring (see below how to join us). GEO BON moved into its second phase in 2014 by refocusing on its core goals, and it is now strategically investing in the decisions that will help us achieve these goals.

Governments require scientifically sound information and knowledge on biodiversity change so they can meet their national as well as international obligations. For example, parties are required to report on their progress towards meeting the CBD Aichi Targets; however, this remains a challenge for most countries as shown by the 4th National CBD reports where only 36% contained evidenced-based indicators[1].

The Ramsar reports on water and wetlands, IPBES and their on-going regional and thematic assessments, and the UN Sustainable Development Goals are tangible examples of the increasing need for scientifically sound information on biodiversity change, yet this information is still largely unavailable. GEO BON is designed with these needs in mind, focusing on filling gaps, building capacity, making data more accessible, and coordinating existing efforts.

Mission and Vision

GEO BON's mission is to improve the acquisition, coordination and delivery of biodiversity information and services to users, particularly decision makers. GEO BON is a network of more than 400 biodiversity observation experts and organisations worldwide. It includes working groups dedicated to specific challenges and several regional and thematic biodiversity observation networks. NASA and ESA are key partners of GEO BON supporting the integration of remotely sensed information with in-situ measurements as part of our mission.

GEO BON is committed to become, by 2025, a solid and interoperable global biodiversity observation network. The observations derived from this network contribute to the development of effective conservation actions, mitigation and adaptation strategies. The observations also contribute to the implementation of sustainable management practices and policies regarding the world's biodiversity and the ecosystem services it provides.

Some of the key GEO BON goals for 2025 include:

- Facilitate the development or enhancement of at least 25 national biodiversity observation systems that contribute to regional and global biodiversity assessments;
- Develop at least 10 regularly updated, fully operational products, based on in-situ or Earth observing systems that provide high quality information to scientists and decision makers at various scales;
- Actively contribute to models that support improved policy assessments and scenarios at multiple scales;
- Promote a highly interconnected and fully functional, geographically balanced self-sustained biodiversity observation community.

User Engagement and policy relevance

We consider three large groups of users to target GEO BON activities: governments, international multilateral agreements and scientists. We describe below how user communities are linked to GEO BON, how stakeholders benefit from GEO BON activities (in particular in developing countries) and how GEO BON products will feed into decision making processes.

Governments

GEO BON's most important group of users are national governments. Governments need scientifically sound biodiversity data, information and knowledge to meet their national mandates (e.g. national biodiversity plans, recovering species at risk, sustaining ecosystem services) and fulfil their international obligations (e.g. the Convention on Biological Diversity, the Ramsar Convention on Wetlands, the Convention on Migratory Species, etc.). The Essential Biodiversity Variables (EBVs), and BON in a Box toolbox (see page 19) provide the guiding framework and the tools required to set up or enhance observation systems at national level. Facilitating the development of new country level biodiversity observation systems and the enhancement of current systems are two key GEO BON focus areas. With this user group in mind, GEO BON has developed a set of flexible criteria for endorsement of national initiatives (www.geobon.org/become-a-bon/become-a-bon).

CBD, Ramsar & IPBES

GEO BON has been repeatedly endorsed as a key partner for collaboration by the CBD since the 9th session of the Conference of the Parties held in May 2008 in Bonn, Germany. Also GEO BON's role in promoting coherent biodiversity observations with regards to data architecture, scales and standards, and observation network planning, is highlighted repeatedly by the CBD protocols and programs. In addition, the Environmental Affairs Officer of the CBD is an active member of the GEO BON Advisory Board guaranteeing a strong institutional connection.

- In decision XI/3 (paragraph 13) the CBD COP invited GEO–BON to continue its work on the identification of Essential Biodiversity Variables and the development of associated data sets (UNEP/CBD/SBSTTA/15/INF/8).
- In decision XII/1 the CBD COP invited parties, indigenous and local communities and other relevant stakeholders to collaborate with GEO BON and other relevant organizations that contribute to building observing systems and to biodiversity monitoring, to address the priority needs identified by Parties related to biodiversity observations and monitoring.

GEO BON is an observer organisation to the Scientific and Technical Review Panel (STRP) of the Ramsar Convention. The GEO BON freshwater working group and the EU project SWOS contribute to the development of the Global Wetlands Observing System (GWOS), a key request from Ramsar (see below for details).
GEO BON is recognised by the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) as a key partner organisation. Many GEO BON members are or have been participating in the IPBES assessments at different capacities. Also, IPBES user needs are triggering the research agenda of many GEO BON partners, as IPBES needs knowledge, scientific data and information for its reports. GEO BON is especially engaged in the "IPBES Task Force on Knowledge and Data". The Executive Secretary of IPBES is an active member of the GEO BON Advisory Board. Furthermore, GEO BON regularly represents GEO as an accredited observer at both CBD and IPBES plenaries.

1 Bubb et al. 2015, UNEP WCMC

Scientists

The third key user group of GEO BON is the global scientific community that needs sound and reliable data to: develop and validate models, study the drivers of biodiversity change, identify new and emerging threats to biodiversity along with effective responses, and create scenarios and conduct assessments that inform policy and facilitate decision making . The two key user groups mentioned above depend on the work of scientists, who collect, analyse and publish biodiversity information. Scientists are responsible for developing protocols, guidelines and best practices taking advantage of the most up to date scientific knowledge. GEO BON includes a global network of scientists developing cutting-edge methods to observe biodiversity change, developing data standards and technologies for data interoperability and establishing new interoperable networks, which deliver information and knowledge to users.

Governance structure

GEO BON is a "community of practice". As such, it is a network of networks, with minimal parts of its own, designed to help strengthen and coordinate the activities of a diverse set of partners towards a common goal—improved biodiversity information for a wide range of users. The GEO BON standing bodies are its Chair and Vice-Chair, its Working Groups, BONs, its Advisory Board, and its Management and Implementation Committees. Every 2-4 years the General Assembly of GEO BON takes place at "All Hands Meetings" addressing all topics of the work plan, the Working Groups and the general structure of GEO BON.

Management Committee

The Management Committee is responsible for GEO BON planning and operations. It is composed of six members; four of them physically located at the Secretariat in Leipzig, Germany, the others located in Switzerland and Canada.

- Chair: **Henrique M Pereira** provides overall leadership, coordination and oversight; represents GEO BON at key meetings; is responsible for the coordination of a particular set of tasks (EBVs, Working Groups)
- Vice-Chair: **Mike Gill** provides leadership; represents GEO BON at key meetings; is responsible for a the coordination of a set of tasks (Bon-in-a-Box, BONs)
- Executive Director: **Jörg Freyhof** engages with WGs and activity leads and oversees product delivery; coordinates technical development (website, etc.), fundraising, representing GEO BON at key meetings
- GEO Science Officer: **Gary Geller** manages links between GEO BON activities and the GEO secretariat
- IT Officer: **Christian Langer** coordinates Web Page and IT infrastructure
- Administrative Assistants: **Ariane Korn & Helen Matthey** provide assistance with all administrative and management tasks

Implementation Committee

The Implementation Committee is composed of 28 members and meets physically once a year. During the year, it communicates via electronic means and quarterly virtual meetings. It has an executive function, although much of the daily operation tasks are delegated to the Management Committee. Members of the Implementation Committee are Working Group leads and co-leads and other engaged persons.

Advisory Board

GEO BON's Advisory Board consists of 16 members, representing global key biodiversity organisations, governments, and experts, in a geographically balanced composition as well as other influential individuals with good ties to funding. The Advisory Board meets once a year, together with the Implementation Committee, to evaluate the status of GEO BON and its progress. The Advisory board provides strategic direction and feedback on GEO BON and helps to find funding. Members of the Advisory Board are invited by GEO BON's Implementation Committee to serve a three year term, renewable once.

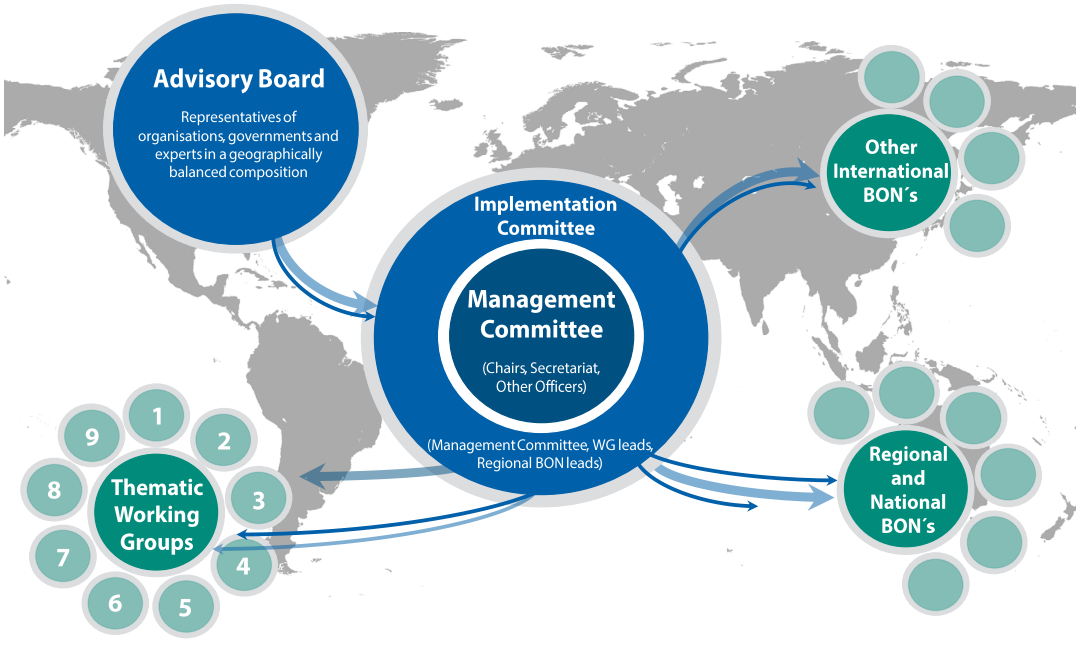


Figure 1: *GEO BON Governance structure*

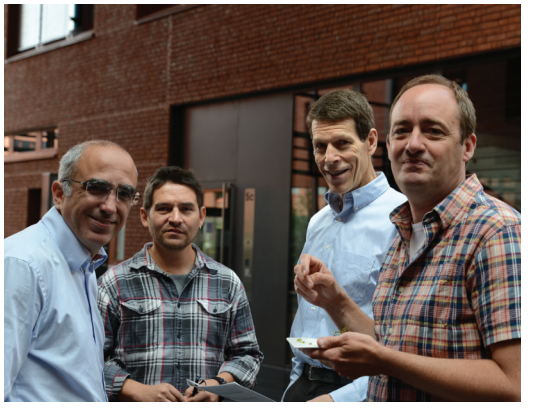
Members of the Implementation Committee

Name	Institution
Patty Balnanera	Universidad Nacional Autónoma de México
Neil Brummitt	Natural History Museum London
Mark Costello	University of Auckland
Dan Faith	The Australian Museum
Miguel A. Fernández	German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig
Simon Ferrier	Centre for Biodiversity Analysis, Australian National University
Jörg Freyhof	German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig
Gary Geller	US National Aeronautics and Space Administration (NASA)
Mike Gill	The Circumpolar Biodiversity Monitoring Programme (CBMP)
Richard Gregory	Royal Society for the Protection of Birds
Matthew C. Hansen	University of Maryland
Ian Harrison	Center for Environment and Peace, Conservation International
Christoph Haeuser	Naturkundemuseum Berlin
Wim Hugo	South African Environmental Observation Network
Walter Jetz	Yale University
Norbert Jürgens	University of Hamburg
Terry Parr	International Long Term Ecological Research (ILTER)
Henrique M. Pereira	German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig
Isabel Sousa Pinto	University of Porto
Eugenie Regan	United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)
Hannu Saarenmaa	University of Eastern Finland
Roger Sayre	US Geological Survey (USGS)
Dirk Schmeller	Helmholtz-Zentrum für Umweltforschung – UFZ
Andrew Skidmore	University of Twente
Eren Turak	Office of Environment & Heritage
Michele Walters	Council for Scientific and Industrial Research (CSIR)
Martin Wegmann	University of Wuerzburg
Tetsukazu Yahara	Kyushu University

"Members of the Implementation Committee are Working Group leads and co-leads and other engaged persons."

Henrique M. Pereira, Harold Mooney and Anne Larigauderie, (left to right) during the GEO BON IC AB meeting 2015

Eugenie Regan from UNEP-WCMC giving a presentation at the GEO BON IC AB meeting 2015



GEO BON MC group: Henrique M. Pereira, Miquel A. Fernandez, Gary Geller and Mike Gill

Members of the Advisory Board

Name	Institution
Juan C. Bello	Instituto de Investigación de Recursos Biológicos Alexander von Humboldt
Stuart Buchart	United Nations Environment Programme and BirdLife International
Donald Hobern	Global Biodiversity Information Facility (GBIF)
Robert Höft	Convention on Biological Diversity (CBD) Secretariat
Eun-Shik Kim	Environmental Institute of Scientific Networks, EISN-Institute
Dora Ann Lange Canhos	Centro de Referência em Informação Ambiental (CRIA)
Anne Larigauderie	Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)
Eugenia Montezuma	Sistema Nacional de Areas de Conservacion
Harold Mooney	Stanford Woods Institute for the Environment
Marc Paganini	European Space Agency (ESA)
Anne-Hélène Prieur-Richard	Future Earth, ICSU
Bob Scholes	Council for Scientific and Industrial Research (CSIR)
Woody Turner	US National Aeronautics and Space Administration (NASA)
Sheila Vergara	ASEAN Centre for Biodiversity
Matt Walpole	United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)
Haigen Xu	Nanjing Institute of Environmental Sciences (NIES), Ministry of Environmental Protection

Building the global network

GEO BON invites everybody active in biodiversity observation to add value to their biodiversity observation activities and maximize their efforts by becoming part of GEO BON. Various BONs have already become part of GEO BON.

In addition, GEO BON can help to:

- Gain global visibility and discoverability of initiatives, products and results;
- Enhance the credibility, and legitimacy of biodiversity data at the global scale;
- Meet the data needs of decision makers, researchers and other user groups;
- Access a global network of scientific excellence where expertise and experience in biodiversity monitoring efforts is constantly updated and shared;
- Access GEO BON's network, expert knowledge, and capacity building initiatives;
- Access information on funding calls and other opportunities;
- Access best practices, protocols, and workflows for biodiversity observations, data management, analysis and reporting;
- Provide context to local and regional initiatives.

Getting involved with GEO BON

GEO BON is continuously building up its network. GEO BON has more than 400 individual members from 45 different countries, including scientists, managers and practitioners active in biodiversity observation. Approximately 700 people around the world receive our newsletter that is published four times a year and this number has been increasing at a rate of 300 people a year. GEO BON invites all parties to be part of the GEO BON community shaping the future biodiversity observation. GEO BON fully depend on the active collaboration of members as well as the entire biodiversity community.

There are five ways getting engaged with GEO BON:

- **Becoming an individual member**
  Individuals can sign up to the GEO BON email list to receive regular updates and news from the GEO BON Secretariat. Just contact the GEO BON secretariat.

- **Becoming a member of a Working Group**
  The nine Working Groups (WGs) are the core of GEO BON and new members are warmly welcomed. WG chairs should be contacted to join; see their contact details later in this document or at www.geobon.org.

- **Joining a Biodiversity Observation Network (BON)**
  The national, regional and topical BONs are very active parts of the GEO BON network. To join a particular BON, contact the GEO BON secretariat and express your interest in our activities, or see the BONs at www.geobon.org.

- **Becoming a national, regional or thematic BON**
  GEO BON actively facilitates the development of BONs by engaging stakeholders (particularly national governments, institutes, scientists and practitioners) and building capacity. The focus here is on the development of national BONs. These act as national units

closely connected to governments and national networks bringing biodiversity change data and information together. The development of the national BONs is directly facilitated through the application of the BON in a Box toolkit for biodiversity observations (see below). China, Japan and Korea have already formed their national BONs and several others are active to do so (e.g. Bolivia, Colombia, Madagascar, Nepal, Indonesia, France, Germany, USA). The Asia Pacific BON (AP-BON), the Circumpolar Biodiversity Monitoring Program (Arctic BON), the Global System of Ecosystem Observatories (GSEO), the Global Wetland Observing System (GWOS) and the Marine Biodiversity Observation Network (MBON) are existing or developing regional or thematic BONs under the GEO BON umbrella. GEO BON is ready to engage and build capacity with more countries especially in biodiversity-rich areas of the world.
This year, GEO BON has been working directly with the Alexander von Humboldt Institute to design the Colombian national BON. The Colombian test case on how to design this national BON will be presented to the CBD SBSTTA in 2016.

See more details at:
www.geobon.org/Downloads/PDF/Criteria.pdf

- **Becoming an Associated Partner**
  Large or small organisation active in the field of biodiversity observation are invited to become Associated Partners to GEO BON. Governmental bodies, university institutes, research stations, protected areas, local or global NGOs and local to global initiatives active in any kind of biodiversity change observation are specially encouraged to become partners of the GEO BON network. While some associated partners might engage through BONs or working groups, others might seek individual endorsement and recognition by GEO BON. Please contact the GEO BON secretariat if you are interested to become an Associated Partner.

GETTING INVOLVED

The five ways getting engaged with GEO BON

2 Building the Biodiversity Observation Network

Essential Biodiversity Variables (EBVs)

The fundamental question that GEO BON is seeking to answer is whether biodiversity is improving or worsening. This complex question, once disentangled into simpler terms, asks: What are the magnitude, velocity and direction of change across multiple spatial scales for the essential dimensions of biodiversity? These three parameters, once integrated, constitute and define the framework concept of the Essential Biodiversity Variables (EBVs)[1].

These essential quantities, based on in-situ and Earth-observation measurements, provide the guiding framework that can be applied by anyone to develop and implement cost-effective biodiversity observation systems that can be easily integrated into a global biodiversity monitoring network. Therefore, one of the main goals of the EBV framework is to support countries and organisations to fulfil their national and international commitments and obligations.

Although EBVs align well with general needs of policy and decision making , offering robust computations that can populate indicators (e.g., 2020 Aichi Targets) and feed assessments with information (e.g., IPBES Assessments), the degree of abstraction that separates them from indicators provides them with a strategic advantage by: (1) shielding them from changes in policy, (2) making them valuable over longer periods of time and (3) making them flexible enough

1 Pereira et al., 2013

to populate future potential indicators and decision support tools operating at various scales. The framework concept of the EBVs (cited already more than 150 times) has been recognised as urgently needed by the biodiversity community and has been swiftly adopted by major global initiatives including the CBD, Future Earth, and IPBES. Now that this concept has matured, GEO BON is moving from planning to implementation, where multiple EBV candidates will likely reach this stage by 2016.
GEO BON has co-funded five projects dedicated to develop EBVs in 2014 and 2015, including the development of EBVs that can feed into an indicator that help us evaluate Aichi Target 15 on land restoration and carbon sequestration. The European Commission funded four projects (GLOBIS-B, EU-BON, ECOPOTENTIAL and SWOS) that will help develop EBVs in Europe, and other regions will follow.

Currently GEO BON is developing an online platform to track the development of EBVs by the biodiversity observation community. This dynamic virtual environment in the form of a dashboard will promote creativity and broad community involvement. Also it will result in streamlined discussions that will naturally lead to community consensus, collaboration, interoperability, initial implementation and further development of urgently needed Essential Biodiversity Variables.
GEO BON has a global vision but it is acting at the national level. Currently GEO BON is working in close collaboration with Instituto Alexander von Humboldt to develop the Colombian national biodiversity observation system using the EBV framework. Also in close collaboration with the Instituto de Ecologia, GEO BON is working to develop the first biodiversity observation baseline in Bolivia using EBVs as a reference.

At the same time in collaboration with the Map of Life (MoL) project and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), GEO BON recently presented a new generation of global biodiversity indicators based on a small subset of EBVs at the CBD Ad hoc Technical Expert Group meeting this last September in Geneva (please see: www.geobon. org/Downloads/brochures/2015/GBCI_Version1.1_low.pdf).

These examples not only illustrate the power of EBVs as a modeled layer between direct observations and indicators but also their potential to generate spatially explicit and scalable products. These novel indicators include: the Species Habitat Index (for Targets 5 and 12), the Biodiversity Habitat Index (Target 5), the Species Protection Index (Target 11), the Protected Area Representativeness and Connectedness Indices (Target 11), the Global Ecosystem Restoration Index (Target 15), and the Species Status Information Index (Target 19). These are based on global datasets for four EBVs: Species Distributions, Taxonomic Diversity (gamma diversity), Ecosystem Extent, and Primary Productivity. These examples illustrate the power of EBVs as a modeled layer between direct observations and indicators and also demonstrate their potential to generate spatially explicit and scalable products.

"Currently GEO BON is developing an online platform to track the development of EBVs by the biodiversity observation community."

EBV classes and candidates

EBV class	EBV candidate
Genetic composition	Co-ancestry
	Allelic diversity
	Population genetic differentiation
	Breed and variety diversity
Species populations	Species distribution
	Population abundance
	Population structure by age/size class
Species traits	Phenology
	Body mass
	Natal dispersion distance
	Migratory behavior
	Demographic traits
	Physiological traits
Community composition	Taxonomic diversity
	Species interactions
Ecosystem function	Net primary productivity
	Secondary productivity
	Nutrient retention
	Disturbance regime
Ecosystem structure	Habitat structure
	Ecosystem extent and fragmentation
	Ecosystem composition by functional type

BON in a Box: Improving Capacity for Biodiversity Observation

There are many excellent tools, protocols and software in use that facilitate effective biodiversity monitoring, but these are not easily discoverable or available to all regions of the planet. As well, current efforts to monitor biodiversity are not interoperable, thereby limiting our ability to detect change and the underlying mechanisms driving change in biodiversity.

BON in a Box (Biodiversity Observation Network in a Box) is a regionally customisable and continually updated online toolkit. BON in a Box facilitates the start-up and enhancement of biodiversity observation networks, with a particular focus on national and regional networks. BON in a Box lowers the threshold for developing a biodiversity observing network by facilitating simple discovery and access to state-of-the-art tools. The classification of the tools also allows for guidance on the appropriate use of the tool. It is through this process that we will see greater harmonisation of observation design and data collection, management, analysis and reporting amongst and between nations, regions and other observation systems. BON in a Box is continually updated as the tools advance and new tools are developed. As well, the system allows for the connection between tool users and developers in order to promote continual improvements.

BON in a Box serves as a technology transfer mechanism that allows countries access to the most advanced and effective monitoring protocols, tools and software thereby, lowering the threshold for a country to set up, enhance or harmonize a national biodiversity observing system.

BON in a Box is a regionally customisable and continually updated online toolkit for facilitating the start-up or enhancement of national or regional biodiversity observation systems.

BON in a Box give nations, regions and others a common and scientifically sound set of biodiversity variables, monitoring methods and guidelines, mapping software, and data management, analysis, discovery and reporting tools and platforms, thereby increasing the power at not only a national but also a regional and global scale to detect important biodiversity trends and their underlying mechanisms.

BON in a Box improves national and regional observation systems so that governments can assess and report on their progress towards meeting both domestic (e.g., regulatory commitments) and international environmental obligations (e.g., the CBD Aichi Targets, support of IPBES assessments) regarding biodiversity conservation and sustainable use.

"BON in a Box is a regionally customisable and continually updated online toolkit."

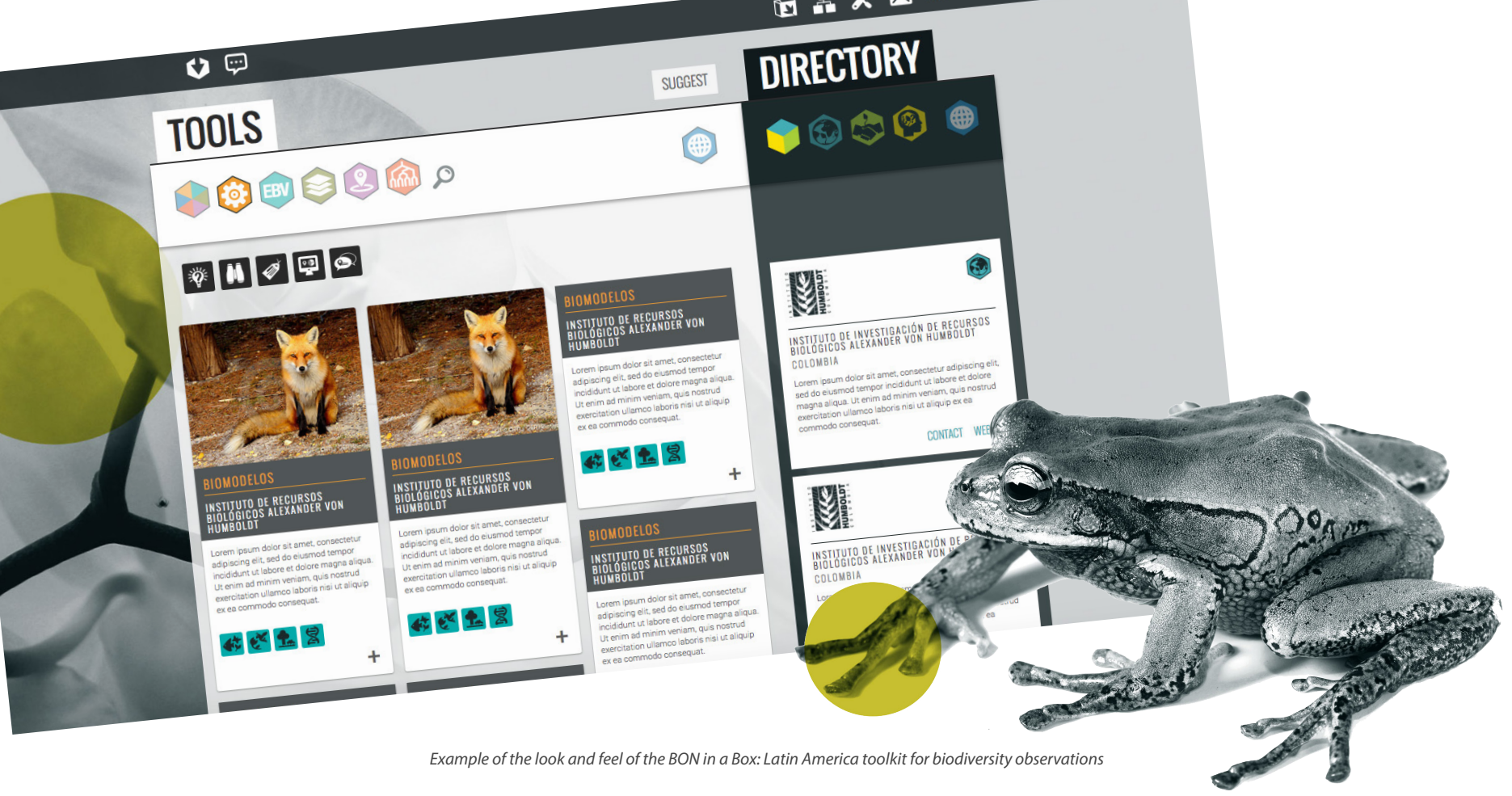
BON in a Box focuses on national governments because they are perhaps the most important set of users in regards to biodiversity data. National governments are responsible for reporting on the status and trends in ecosystems and the biodiversity they support to meet their national mandates (e.g. national biodiversity plans, recovering species at risk, sustaining ecosystem services) and international obligations (e.g. Convention on Biological Diversity, Ramsar Convention, Convention on Migratory Species, etc.).

These users are important because, more than any other group, they have the ability to enact and change policy and then implement it; both of which are dependent upon better observations, products, and tools than are currently available. Collectively, they have the greatest access to resources to support implementation. GEO BON is concerned with the development of more integrated, efficient and interoperable biodiversity observation networks that can produce more reliable, accessible and timely observations to serve these needs.

Latin American Regional Pilot

The development of BON in a Box is being piloted in Latin America, led by the Alexander von Humboldt Institute of Colombia on behalf of GEO BON. In support of its development, a survey was sent to over 1000 people in the Latin American region in an effort to refine our understanding regarding the generation and use of biodiversity data in this region and a workshop was held in April 2015 in Colombia with over

50 participants from 8 Latin American countries (Mexico, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia and Brazil). The workshop was focused on specifically designing the structure, content and functionality of the Latin American pilot. The first version (beta version) of BON in a Box: Latin America will be released in November 2015 (pre-launch at the CBD SBSTTA19 and full launch at GEO Plenary and Ministerial). The full version, in Spanish, English and Portuguese and with full functionality, will be ready in late 2016. The toolkit is comprised of two major elements – a web-based, searchable and customisable user interface, and a database of tools that are characterised based on a series of tags (31 in total including, for example, EBV class, observation component, scale of use). The development of BON in a Box also includes contributions from the GEO BON working groups and key partners (e.g. Map of Life, EarthWatch Institute, etc.).



Example of the look and feel of the BON in a Box: Latin America toolkit for biodiversity observations

Global Implementation

Beginning in early 2016, the process for establishing BON in a Box in other regions will continue. The next region planned for implementation is in sub-Saharan Africa using Ghana, Uganda and Mozambique as pilots (in collaboration with a UNEP World Conservation Monitoring Centre-led project on mainstreaming biodiversity in decision making in these countries). The development of an African version using the Latin American version as a base represents a south-south collaboration which can serve to promote interoperable and harmonised approaches for biodiversity observation in tropical regions.

Marine BON in a Box

It is envisioned that the online BON in a Box system can be easily customised and re-purposed for a number of themes and applications. Considering the expanse and diversity of marine ecosystems and the lack of capacity and coordination of current marine biodiversity observation efforts, it is believed that developing a specific-Marine BON in a Box will provide an opportunity to both harmonise existing observation efforts and facilitate the development of new, sustained observation efforts. Building on the many complementary existing efforts (e.g. GOOS, OBIS, the Marine Pole to Pole MBON in the Americas, etc.). The Marine BON in a Box shall extend the impact of these efforts by serving as a technology transfer and capacity building mechanism, promoting shared technologies, methodologies and standards to facilitate the uptake and development of harmonised marine biodiversity observation efforts. Discussions are currently underway with representatives of GEO BON's Marine Working Group, the Ocean Biogeographic Infor- mation System and the U.S. Marine BON leads on initiating development.

Direct Engagement and Conceptual Development

The development and use of the BON in a Box toolkit via a workshop process and collaborations that result in regional customisation, custodianship and ownership of the toolkit is intended to result in not only increased capacity for biodiversity observations but also to act as a catalyst for the development of national and regionally coordinated biodiversity observation networks. For instance, the Latin American regional pilot has already established a community of biodiversity practitioners in Latin America by which discussions are underway for more regional harmonised approaches to biodiversity observation. Having access to a common set of biodiversity observation tools will only help to further this regional harmonisation.

3 National, Regional and Thematic BONs

The GEO BON network is structured as working groups (WGs) as well as national, regional and thematic Biodiversity Observation Networks (BONs). GEO BON actively facilitates the development of BONs by building capacity and engaging stakeholders (particularly national governments, institutes, scientists and practitioner). The focus here is on the development of national BONs, which can act as national units and networks bringing biodiversity change data and information together. The development of national BONs is also directly facilitated through the application of the BON in a Box (see above). China, Colombia, Japan and Korea are national BONs already functioning or in development. The Asia Pacific BON (AP-BON), the Circumpolar Biodiversity Monitoring Program (Arctic BON), the Global System of Ecosystem Observatories (GSEO), the Global Wetland Observing System (GWOS) and the Marine Biodiversity Observation Network (MBON) are existing or developing regional or thematic BONs under the GEO BON umbrella.

"GEO BON actively facilitates the development of BONs by building capacity and engaging stakeholders."

National BONs

Colombia BON

Lead:
Instituto de Investigación de Recursos Biológicos Alexander von Humboldt

Network partners:
The Colombian BON is envisioning to be part of the actual National Environmental Information System (SINA) were all the research and administrative institutions related to the Ministry of Environment of Colombia are represented.

Personnel and financial resources:
Currently the personnel working on the establishment of the Colombian BON are part of the Biodiversity Evaluation and Monitoring programme in the Humboldt Institute. This program has a team of 52 professionals including biologist, ecologist, engineers and graphic designers. Of this team four people have been working directly with the GEO BON secretariat to progress towards the consolidation of the National BON. In 2015 we will have invest approximately 44.000 Euros.

Topics, activities and products:
In 2015 we have been developing a conceptual framework for the Colombian BON, identifying key questions and information needs. We also have been working in the identification of Biodiversity Indicators at national and subnational level. We have done this by participating and hosting a series of meetings and workshops internal to the Humboldt Institute and with other Institutions part of the National Environmental System (SINA). Finally with cooperation of the GIZ we are developing a national capacity assessment using the BON in a Box components, in order to have an inventory and evaluate the tools produces and used by SINA institutions in collection, management, analysis and reporting of biodiversity observations. We hope that this assessment can guide an implementation plan in capacity building and capacity transfer between GEO BON expert groups and the Colombian BON. Colombia, as part of its application to join the Organisation for Economic Cooperation and Development (OECD), is beginning development of a National Framework for Biodiversity Observations. Colombia's Alexander von Humboldt Institute has been tasked with developing this and has asked for GEO BON's assistance. This represents an opportunity for GEO BON to directly engage with the development of a national biodiversity observation network. This demonstrates the applied value of GEO BON. Since 2015, GEO BON directly works with Colombia's Alexander von Humboldt Institute to design a Colombian national BON, in part, through the application of the BON in a Box: Latin American toolkit. This can be seen as a test case for CBD Parties as a whole. The overall process and approach for designing this national BON will be communicated as a CBD Technical Publication, which will be presented at COP12 in Mexico in 2016. The intention is for GEO BON to serve as an applied provider of biodiversity observation expertise to the Parties of the CBD.

Regional BONs

Asia Pacific BON (AP-BON)

AP-BON is a regional network including three national BONs (Japan, Korea and China) from which China (Sino-BON) is featured below. AP-BON was organised in 2009 as a regional network of GEO BON, covering most countries of the Asia-Pacific region and covering all levels of biodiversity and ecosystems. The vision of AP-BON is (1) to establish a coordinated Asia-Pacific network that gathers and shares information on biodiversity and ecosystem services, (2) to develop regional BON in a Box applications, and (3) to contribute to improving ecosystem management, sustainable use of biodiversity, and human well-being. Since 2009, AP-BON has had six workshops and published two books on biodiversity and ecosystems in the Asia-Pacific region. Further, AP-BON has contributed to the annual GEOSS-AP symposia to tighten linkage with GEO activities in other social benefit areas. AP-BON consists of a Steering Committee and five working groups. Moreover, as a national biodiversity observation network (BON), J-BON is organised in Japan, Sino-BON in China and K-BON in Korea. Several other countries in Asia are on their way to form their own national BONs.

AP BON leads Tetsukazu Yahara, Keping Ma, Sheila Vergara and Eun-Shik Kim (left to right) at the GEOSS AP Symposium 2015 in Beijing

Chinas Biodiversity Observation Network (Sino-BON)

Lead:
Chinese Academy of Sciences (CAS)
Sino BON was established by the CAS following the basic principle of "sound planning and unified layout for biodiversity observation at national scale". It is a priority project supported by the CAS as an observation platform at the academy level. It formally became a member of AP BON on October 11, 2014.

Network partners:
All members of Sino BON are institutions related to the CAS. It has established 10 thematic networks and one synthesis and data management center. At present it includes a zoological diversity center, a botanical diversity center,

a microbiological diversity center and a synthesis center. There are six thematic networks in the zoological diversity center: the mammal diversity observation network, the bird diversity observation network, the amphibian & reptile diversity observation network, the freshwater fish diversity observation network, the insect diversity observation network and the soil invertebrate diversity observation network. There are three thematic networks in the botanical diversity center: CForBio, the steppe & desert biodiversity observation network, and the forest canopy biodiversity observation network. The soil microbial observation network belongs to the microbiological diversity center. The synthesis center is in charge of standards & criteria formulation, data management & sharing, and remote sensing with LiDAR.

Personnel and financial resources:
Currently there are 378 biologists, ecologists, engineers, and 523 graduate students from 17 institutions, 10 state key laboratories associated with this program. In 2013-2015, 48 million RMB (approximately 6.7 million EUR) grants were supported by the CAS. In 2016-2020, a budget about 100 million RMB (approximately 14 million EUR) from the CAS was approved.

Topics, activities and products:
Sino-BON research based on mapping biodiversity data includes community assembly, biogeography, conservation planning, phenology, climate change and others. Sino-BON not only demonstrates monitoring methodologies with general equipment, but also develops new approaches to speed up biodiversity discovery and monitoring, for example, satellite tracking-based bird monitoring, camera trapping based animal observation, forest crane-based research on canopy biology, mapping 3D vegetation structure for biodiversity, and habitat with LiDAR.

Activities in 2015:
- January 20-21, the 1st National Workshop on Biodiversity Monitoring was held in Beijing;
- June 19-21, the 1st Laser Radar Forest Ecology Training Course was held in Beijing;
- September 9-11, the Asia-Pacific Biodiversity Observation Network Symposium was held in Beijing;
- September 21-23, the 1st Symposium of Insect Diversity Monitoring network was held in Harbin;
- October 8, Workshop on New Methods of Bird Monitoring Network will be held in Beijing;
- October 27-29, the International Symposium of Forest Ecology and Biodiversity will be held in Xishuangbanna;
- Training workshop on red listing of ecosystems is scheduled on October 29-31 in Beijing;
- On November 5-6, the 4th National Symposium on Biodiversity Informatics will be held in Nanning;
- On November 21-26, the 9th Cross Strait Annual Meeting on Forest Dynamics Plots will be held in Taiwan.

The Circumpolar Biodiversity Monitoring Program (Arctic BON)

The Circumpolar Biodiversity Monitoring Program (CBMP) is an international network of scientists, government agencies, Indigenous organisations and conservation groups working together to harmonise and integrate efforts to monitor the Arctic's living resources. The CBMP has over 100 organisational partners and 1000 members and involves all eight Arctic countries of the Arctic Council (U.S., Canada, Kingdom of Denmark, Iceland, Norway, Sweden, Finland and the Russian Federation).

"The CBMP has over 100 organisational partners and 1000 members and involves all eight Arctic countries."

CBMP experts are developing and implementing four coordinated and integrated Arctic Biodiversity Monitoring Plans (marine, coastal, terrestrial and freshwater) to help guide circumpolar monitoring efforts. Results are being channelled into effective conservation, mitigation and adaptation policies supporting the Arctic.

Thematic BONs

Global System of Ecosystem Observatories (GSEO)

GSEO is a developing thematic BON, an emerging network of field site networks focused on harmonisation and coordination. The aim of the system is to provide access through GEOSS (e.g. through the GEOSS Access Broker) to a significant set of biodiversity observations from in situ sources (sites), which alone or in combination with models and other components of GEO BON, will 1) quantify and map the drivers of environmental change and their impacts on biodiversity and ecosystem processes; 2) quantify and map the consequences of biodiversity loss on the services and goods provided by ecosystems and the benefits that would be derived from remediation and restoration of degraded ecosystems; and 3) deliver products to end users to support decision making at local, national and global levels related to the sustainable use of biodiversity and ecosystems.

The GSEO will also contribute to several other GEO BON deliverables under development in GEO BON Working Groups on Genetics, Species, Ecosystem, Freshwater, and Remote Sensing. The main GSEO stakeholders will be the data providers and science community who operate sites and networks and deliver products from them. The main users of the system will be national and international agencies and organisations that need to make broad-scale assessments of the risks posed by global environmental change to ecosystems and the social and economic benefits they derive from them.

The Global Wetland Observing System (GWOS)

GWOS is a thematic BON, a collaborative development and capacity building effort lead by Wetlands International and several GEO BON members to bring together available information on the status and values of wetlands and water in a way that can support policy processes and decision making at various geographic scales. It

will, once fully developed, describe extent and condition as well as change and trends over time of a variety of wetland types. Amongst others it will feed into the Ramsar Convention's "State of the Worlds Wetlands and their Services" flagship publication and their "Global Wetland Outlook". Funding through the EU H2020 project SWOS allows development of an operational element of GWOS with a geographic focus on Europe but following a global approach. The activities in SWOS will lead GWOS from the planning phase into the first (European) implementation phase 2015-2018. Other projects like the ESA Globwetland Africa Project (starting in late 2015) will also provide funding for development and capacity building activities contributing to the GWOS over the next years.

Marine Biodiversity Observation Network (MBON)

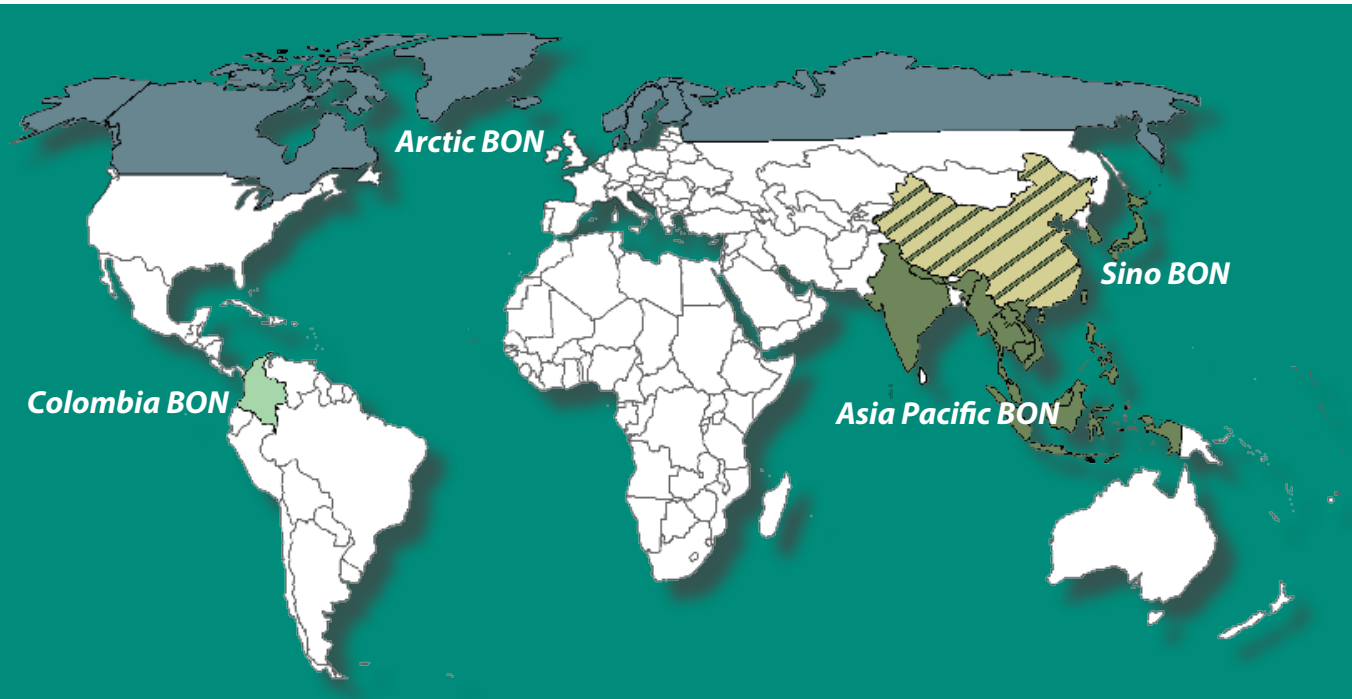
MBON is a thematic BON in development. Marine biodiversity is a key indicator of ocean health and provides a multitude of essential ecosystem services, yet no global network for organised biodiversity observations is in place. The GEO BON Marine Biodiversity Observation Network (MBON) is envisioned as GEO BON's key pillar for the marine realm. It is a crosscutting activity linking GEO BON with Blue Planet (GEO's overarching marine task), GOOS's Biodiversity and Ecosystems Panel, and other marine and biodiversity initiatives and data sharing strategies. It will help coordinate many individual programs that monitor various aspects of marine biology and biodiversity and provide the ability to share data, experiences, and protocols to understand species and the status and trends of ecosystem and their services. Thus it will build on existing data infrastructures such as the World Register of Marine Species and the Ocean Biogeographic Information System (OBIS). A Pole-to-Pole MBON in the Americas concept is being planned as the first major phase of MBON. Several countries in the Americas have initiated a dialogue to understand the connection between ecosystems along this latitudinal gradient, and it is anticipated that initiatives in other regions will follow. Tools developed under MBON efforts will be available to include in a marine BON in a Box.

The MBON Task within the Marine Ecosystem Change Working Group is led by Frank Muller-Karger, in partnership with Gabrielle Canonico of the NOAA Integrated Ocean Observing System (IOOS) program office, and Woody Turner of the NASA Applied Sciences and Biodiversity and Ecological Forecasting programs. At present, the GEO BON Marine Ecosystems Change WG is helping to facilitate a conversation between countries in the Americas. The leadership of the Antares ocean observation network (www.antares.ws), Eduardo Santamaria del Angel (Mexico) is working on developing a consensus among groups developed in Antares to participate. The Antares network is a consortium of organisations in different countries, some with support from the local government or university, but also with some support from the Inter-American Institute for Global Change Research (IAI).

The US is sponsoring various academic, private, and government groups to develop pilot MBON programs focused on National Marine Sanctuaries (Florida Keys, Monterey Bay), the broader Santa Barbara Channel, and the Chukchi Sea. The U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM), the National Oceanic and Atmospheric Administration (NOAA), and NASA are funding three projects to demonstrate how a national operational marine biodiversity observation network could be developed. Additional sites are sponsored under the MarineGEO program coordinated by the Smithsonian Institution's Tennenbaum Marine Biodiversity Observation Network (TMON, www.marinegeo.si.edu), which includes partners in the Americas, Pacific, and Asia.

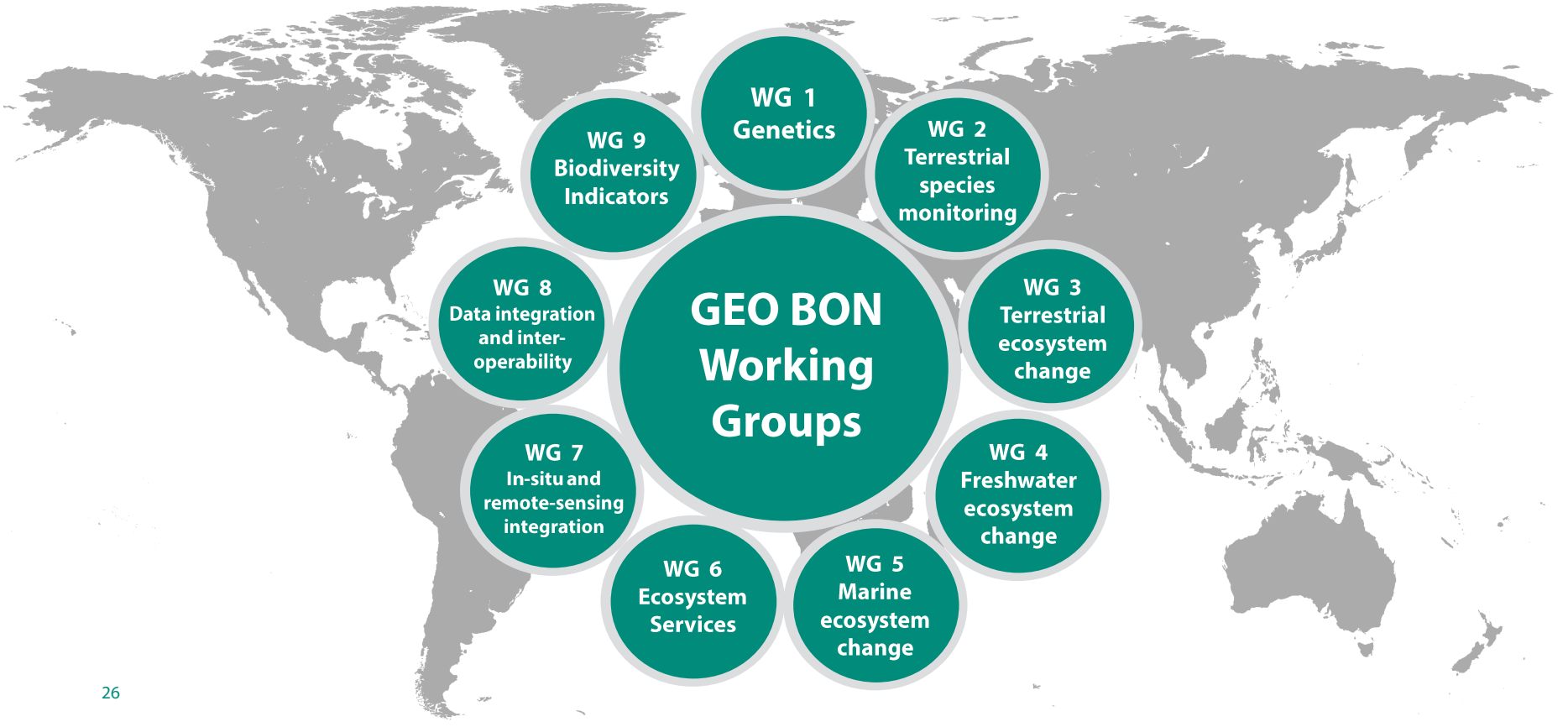
NETWORKS

National and Regional BONs



4 Status and progress reports of Working Groups

The coordination actions of GEO BON are conducted by nine working groups, each having a defined purpose for a limited period. The members of the working groups are experts, acting on a voluntary basis and in their personal capacities, selected to provide the necessary skills, experience and connections to achieve their tasks. In these working groups, a major part of the globe's biodiversity observation experts are linked together forming a huge pool of excellence. With GEO BON's first implementation plan in 2010, its working groups agreed to produce a set of deliverables. Since then, 41 products have been delivered. The responsibilities of the Working Groups are to develop and implement specific thematic aspects of GEO BON. An assessment of performance and revision of the current working structure is planned for 2016.



Genetics

Aims and visions

The most fundamental unit of biological diversity is variation in the nucleic acid sequences that make up the genetic code of life. This is the basis for variation between species, but also of variation among individuals and populations within species. It is important in three main ways: 1) as the source and record of evolutionary potential that provides useful new features, some of which help support human well-being now and in the future; 2) as a necessary condition for the viability of species, especially when their populations are reduced to low numbers; and 3) as the basis of functional traits that ultimately determine ecosystem function and ecosystem services. The focus in genetic diversity observations to date has been disproportionately on genetic variation in economically important species, for instance crop plants, domesticated animals and disease organisms. GEO BON covers those issues, but also genetic variation in wild organisms.

The concepts to be implemented by the observation system at the gene level include:

- Repeated measurements, over time, of specific genetic components of interest, in selected target species and clades;
- Linking (in both directions) genetic diversity to the species and ecosystem levels of biodiversity;
- Model-based inferences on change in genetic diversity and its consequences, based on observations of patterns of biodiversity.

WG 1 Leaders

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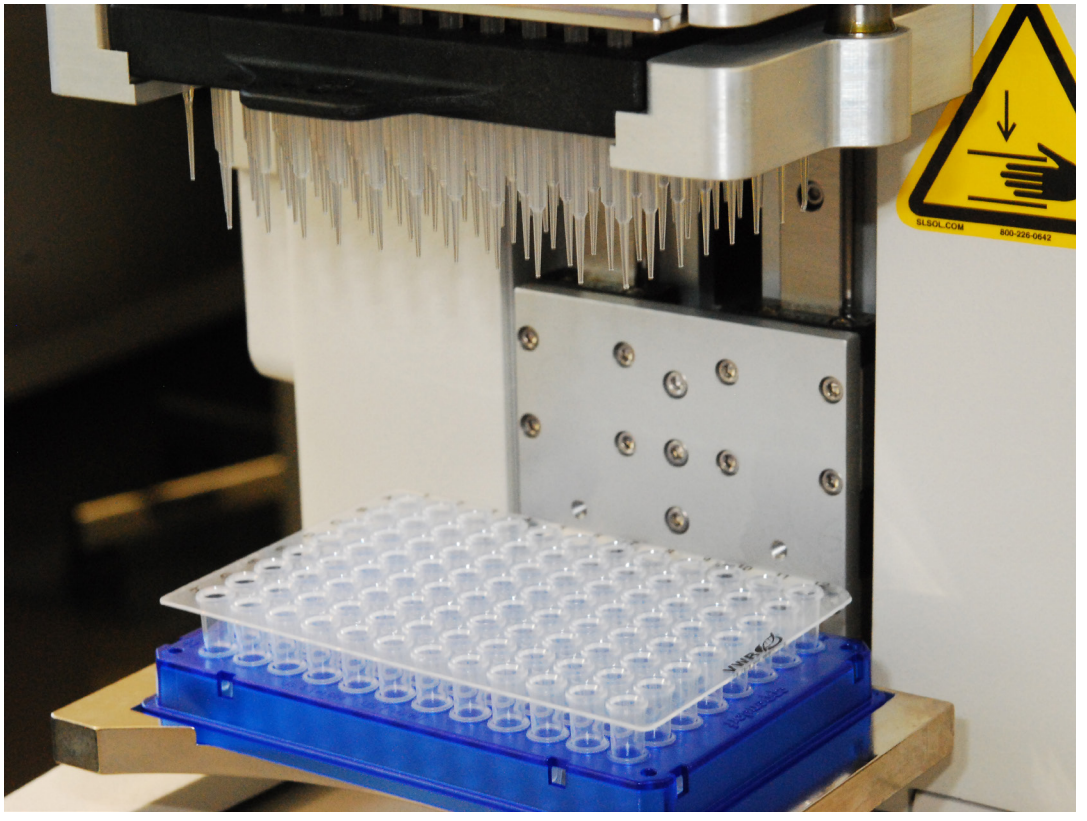

Although the technology for observing genetic diversity is rapidly becoming cheaper and more powerful, it will be some time before it is feasible to observe genetic diversity change in all species.

GEO BON focus on three main species groups:

1) Rapidly declining species, e.g., IUCN "red list" species and Evolutionarily Distinct Globally Endangered (EDGE) species—those with few close relatives on the tree of life, and whose loss would thus prune entire branches;

2) Rapidly increasing species, such as invasive alien species and novel pests and diseases;

3) Species selected for largely scientific reasons, as reference groups ("controls") ecological keystone, economically important or flagship species; wild model organisms (e.g., Arabidopsis, Mus and Drosophila), or species with good historical records.

Initially, while the protocols are under development, the collection of new genetic observations will be associated with core sites, often co-located with Long Term Ecological Research (LTER) sites. A novel GEO BON product will be maps of phylogenetic diversity. These are a fundamental basis for conservation planning, which will complement the currently used species richness maps in helping to identify areas to prioritise for protection. Genetic diversity provides a good tool for understanding patterns and changes in microbial biodiversity, where many species are either undescribed or poorly defined. Specifically, a set of ribosomal sequences known as 16S will be used to map the distribution and turnover of microbial diversity and relate it to macro-ecological features, through a procedure known as metagenomics. Metagenomics will be an important platform in the marine environment, both in sediments and for phytoplankton diversity. The embedding of sequence data in a spatial, temporal, taxonomic and ecosystem context is an important step that will be championed by GEO BON. This will be achieved by advocating that sequence data entering the several large databases created for their storage and exchange (e.g., GENEBANK) be associated with the appropriate metadata regarding the organism from which the sequence was obtained and the time and place where it was collected. A metadata standard called MIENS (Minimum Information about an Environmental Sequence) will be adopted.

Partners

Currently Working Group 1 comprises 14 members from seven countries including a large range of institutions.
Australian Museum Sidney, Kyushu University, Nigerian Ministry of Environment, University of Montana, University of Colorado, Zoological Society of London, Biota/FAPESP Campinas, Brazil, Kew Botanical Gardens, Adelaide University, UNEP-WCMC and USDA.

Terrestrial species monitoring

Aims and visions

Working Group 2 sees its role as a facilitator to implement terrestrial species monitoring on a global scale. It derives its vision from contributions to the Convention on Biological Diversity's strategic plan, which lays out five goals: "(A) address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society; (B) reduce the direct pressures on biodiversity and promote sustainable use; (C) improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity; (D) enhance the benefits to all from biodiversity and ecosystem services; (E) enhance implementation through participatory planning, knowledge management and capacity building." To meet and inform on the progress towards these goals, a globally coordinated approach is needed for biodiversity monitoring that is linked to environmental data and covers all biogeographic regions.

Working Group 2 has identified nine requirements believed to be necessary for developing and implementing such a global terrestrial species monitoring program. The program needs to design and implement an integrated information chain from monitoring to policy reporting, to create and implement minimal data standards and common monitoring protocols to be able to inform Essential Biodiversity Variables (EBVs), and to develop and optimise semantics and ontologies for data interoperability and modelling. To achieve this, the program needs to coordinate diverse but complementary local nodes and part-

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nerships. In addition, capacities need to be built for technical tasks, and new monitoring technologies need to be integrated. Finally, a global monitoring program needs to facilitate and secure funding for the collection of long-term data and to detect and fill gaps in under-observed regions and taxa. Working group 2 will now pursue their implementation and accomplishment on a global scale via involvement in processes at UN level.

Key activities and products

Plot-based monitoring

There is generally growing awareness that we need to harmonise, coordinate and synthesise long-term data to enable comparisons within and between networks, ecosystems, and scales. Currently, we see parallel developments of data harmonisation and integration mechanisms driven by different scientific communities (e.g., GEO BON, NEON, LTER). A step that has been lacking so far is to link the different initiatives to ensure the interoperability of data that is being collected, as well as creation of linkages/interfaces between the different concepts embraced by different communities.

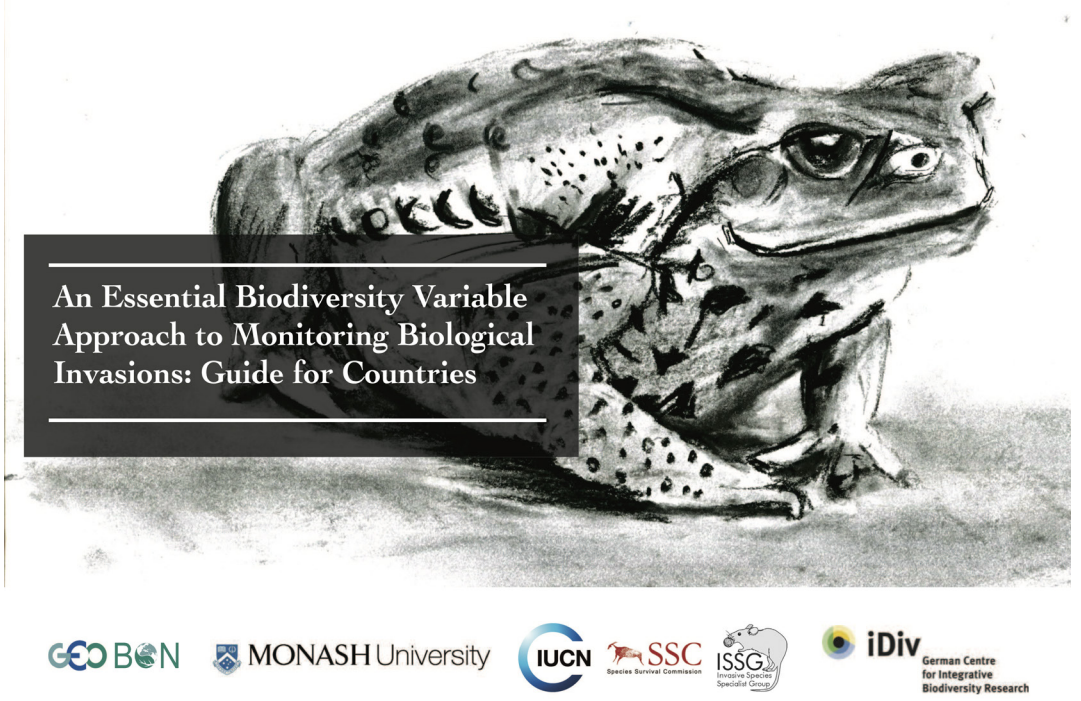
The long-term data generated by LTER sites are not only important for investigating changes in ecosystem integrity but can potentially also provide crucial and valuable data to feed into other global initiatives dealing with wider political issues as well as forming a basis to contribute to Essential Biodiversity Variable. In this respect, future data generation at LTER-sites need to consider the demands of these other initiatives by incorporating appropriate measurements at their sites. There are many such in situ sites or field stations distributed around the globe but there is currently no global system to link and co-ordinate their activities to provide consistent in situ data and products on biodiversity and ecosystems spanning terrestrial, freshwater, coastal and marine domains. This system would establish a global network of sites and develop a set of principles and processes to deliver coherent data and data products that quantify change in biodiversity, its causes and its consequences for ecosystem services. The system would also contribute to other societal benefits prioritised by the Group on Earth Observations (GEO) including those related to health, disaster, energy, climate, water and agriculture issues. It will also complement actions in the Global Climate Observation System that aim "to establish a global network of long-term observation sites and encourage co-location of physical, biological and ecological measurements". WG 2 will work on solutions together with other partners.

Blacklisting of invasive alien species

Lead:
Melodie McGeoch

The project has produced the prototype for an EBV-based observation and monitoring scheme for invasive species, along with an online visualisation product. The scheme integrates existing relevant approaches for invasive species and recent developments in species distribution modelling to provide robust, readily implementable guidance for countries and other relevant organisations involved in monitoring biological invasions. Current information with complete global coverage is central to managing biological invasions. International and cross-border policy and co-operation is particularly essential; trans-boundary and trading partnership risks cannot be evaluated without adequate information on alien species distributions. However, systematic monitoring of alien species remains lacking, and a standardised approach for tracking biological invasion has until now not been developed.

This project has delivered a series of products and a vision for global observation and monitoring of biological invasions, based on the concept of Essential Biodiversity Variables. We show how the architecture for tracking biological invasions is provided by a minimum information set of essential variables, global collaboration on data sharing and infrastructure, and staged, strategic contributions by countries.



Cover of the brochure "An Essential Biodiversity Variable Approach to Monitoring Biological Invasions: Guide for Countries"

The product draws on substantive recent progress across multiple fronts that jointly place such a system within reach. This novel, synthetic approach to an observation system for alien and invasive species provides a tangible solution to delivering the information needed to slow the rate of new incursions and reduce the impacts of the worst invaders.

Applying the concept of Essential Biodiversity Variables, we identified three essential variables for invasion monitoring; alien species occurrence, status and impact. We outlined how delivery of this minimum information set by joint, complementary contributions from countries and global community initiatives is possible. Country contributions are then made feasible using a modular approach where all countries are able to participate and strategically build their contributions over time. Current developments in best-practice data infrastructure and biodiversity informatics, including for alien species, are ready to support the system.

Recent progress that makes this vision realisable includes the current focus on identifying essential biodiversity metrics. The recent development, and support by the IUCN, of a standard scheme for quantifying invasive species impacts form a key part of the approach we reveal. Finally, significant developments in digital infrastructure and delivery of information on alien species are well advanced in their capacity to support a global observation system for alien species.

"We identified three essential variables for invasion monitoring"

The approach this project has developed provides clear direction for national and international efforts to collect the data most essential to enable actions to reduce the negative consequences of biological invasions. It is also flexible enough to accommodate data with a range of precision and accuracy for multiple taxa, ecosystems and countries.

The various outputs (publications, guideline brochure and online tool) jointly provide the scientific basis, variables and monitoring needs for observing, monitoring and assessing alien species based on EBVs, and an interface to aid communication and adoption of the product. This includes background information and context, operational definitions of key terms and concepts, presentation and explanation of the essential variable approach to invasion monitoring, and details of the quantitative approach to developing a global observation system for invasion monitoring from the country level.

Manual for butterfly monitoring

Lead:
Eugenie Regan, Chris van Swaay

Monitoring butterflies is one of the oldest examples of citizen science. The success of Butterfly Monitoring Schemes (BMS's) is due to many factors, not least that the techniques are easy to learn and the field work fun to do. The results of such schemes have proven invaluable in providing robust data on changes in butterfly populations in nature reserves, local areas, countries and even whole regions, such as Europe. Therefore, each individual recorder becomes part of a joint effort to track butterfly fauna and biodiversity in their local area, country, region, and even the whole world as we plan to move towards a Global Butterfly Index. Currently butterfly monitoring is well established in temperate regions such as Europe and North America. The focus of these guidelines is to outline generic field protocols for monitoring butterfly populations (as opposed to species inventories or distributions) that can be applied in any part of the world. Thereby, these guidelines will enable the growth of butterfly monitoring around the world and the creation of a Global Butterfly Index. The proposed Global Butterfly Index will be similar to the Living Planet Index, one of the most well-known biodiversity indicators, that measures trends in thousands of vertebrate species populations over large regions of the world. In order to compare population abundance data from different locations and bring these data together to create national and international indicators, it is essential

to ensure that data collected nationally and internationally are based on sound methodology and standards.

These guidelines, therefore, propose a standard set of field protocols that measure butterfly population change over specific spatial and temporal scales. These guidelines arise from a workshop led by the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) and Dutch Butterfly Conservation (De Vlinderstichting) with the support of The Group on Earth Observations Biodiversity Observation Network (GEO BON) and the EC FP7 project 'EU BON – Building the European Biodiversity Observation Network', and involving a wide range of collaborating partners from around the world. These guidelines were developed for those who want to organise butterfly monitoring in any part of the world (either undertaken by professional or citizen scientists). It explains how to set up butterfly monitoring that can provide consistent and comparable results between sites and between years, consistent with international standards. The target audience are those concerned with the development of butterfly monitoring, including NGOs, representatives of government agencies, academia, and research institutes, as well as individuals or groups of butterfly enthusiasts who want to start up butterfly monitoring.

The aim is to enable the expansion of butterfly monitoring from a temperate context as originally developed, to a global context and in consideration of: a) all possible habitats; b) climatic differences; c) knowledge gaps in hyper-diverse regions; and, d) a range of audiences from professionals to interested naturalists. The information in these guidelines is not meant to be exhaustive, as each situation will vary according to country or region and over time. However, it should serve as a useful starting point.

Partners

Currently Working Group 2 comprises about 30 members from a large range of institutions, including research centers, museums, and NGOs from all continents (except Antarctica).

Helmholtz Centre for Environmental Research – UFZ, Royal Society for the Protection of Birds, Institute of Zoology London, Natural History Museum, London, Earthwatch Institute, Nanjing Institute of Environmental Sciences, Amphibian Survival Alliance, Institut Méditerranéen de Biodiversité et d'Ecologie marine et continentale (IMBE), Canadian High Arctic Research Station, Senckenberg Research Institute and Natural History Museum, United Nations Environment Programme World Conservation Monitoring Centre, Muséum National d'Histoire Naturelle, Instituto Nacional de Pesquisas da Amazônia, Monash University, University of Hamburg, U.S. Geological Survey and Vlinderstichling.

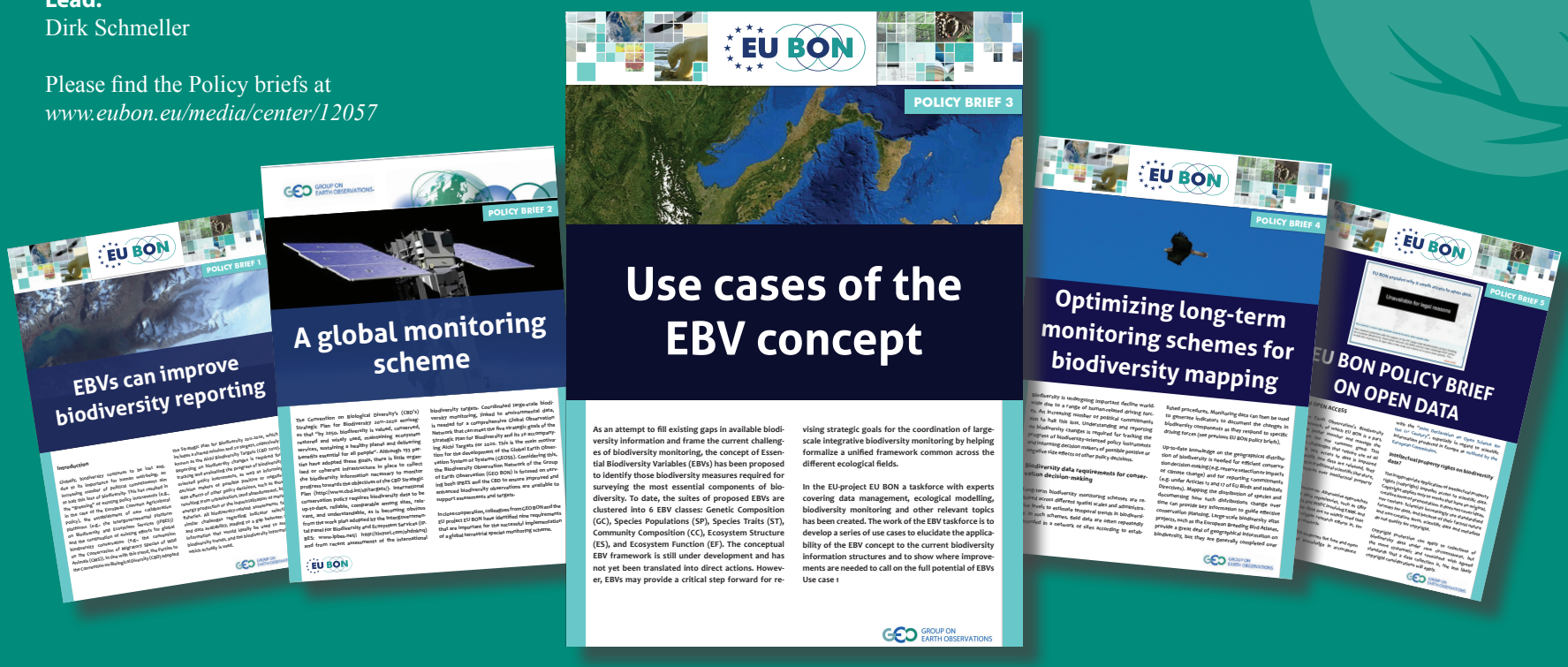
WORKING GROUP 2 PRODUCTS:

Policy briefs

"Together with the project EU BON, GEO BON WG 2 has produced five policy briefs relevant to the work of GEO BON on EBVs, open data and requirements for a global monitoring scheme."

Lead:
Dirk Schmeller

Please find the Policy briefs at
www.eubon.eu/media/center/12057



Terrestrial ecosystem change

Aims and visions

Working Group 3 focuses on an ecosystem approach for terrestrial ecosystems. For this to be effective, consistent and accurate information about ecosystem location, composition and status needs to be generated. WG3's goal is to harmonise the mapping and monitoring of terrestrial ecosystems worldwide, with a special emphasis on in situ and EO derived data. Ecosystem change metrics include for example, extent (e.g. size, connectivity, scale of fragments etc.), as well as the condition and change in the mechanisms that maintain the structure (traits), function and services provided by ecosystems. WG3 cooperates to create a biodiversity monitoring network needed for tracking individual species and populations, monitoring trends in forests, rangelands and other ecosystems, and integrating this mass of biodiversity information with data and forecasts on climate change, landscape fragmentation, pollution and other threats to biodiversity. WG3 develops new techniques and algorithms for EO and ancillary geographical data for handling biodiversity data.

Key activities and products

The activities of WG3 are incorporated around the following themes:

- Building the network of field sites
- Remote Sensing of essential biodiversity variables
- Global ecosystem mapping and stratification

WG 3 Leaders

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Matthew C Hansen
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(co-activity with GEO ENV)
- Ecosystem restoration and degradation
- Intact and hinterland land forest landscapes
- Contribution to books on "Sourcebook for biodiversity monitoring in tropical forests with remote sensing"

Some examples of key products from these themes include global ecosystem map series, scientific output, ecosystem restoration and degradation maps, and forest cover and loss maps. Some of these will now be summarized.

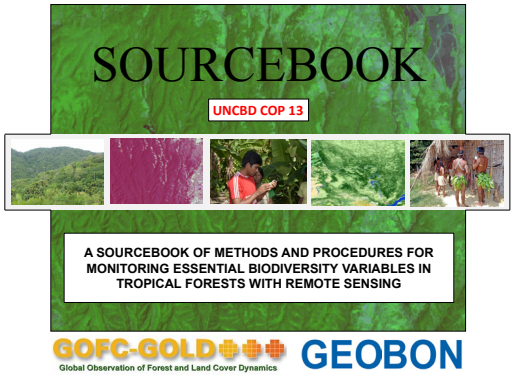
Sourcebook for Biodiversity Monitoring in Tropical Forests with Remote Sensing Data and Methods

A joint initiative by GOFC-GOLD and GEO BON

Lead:
Brice Mora

User surveys have identified the need for guidance on how remote sensing (RS) data and methods can be used for biodiversity monitoring in tropical forests, in link with international policy discussions and efforts (UNCBD Aichi targets, Essential Biodiversity Variables, REDD+ mechanism). The purpose of the sourcebook is to present techniques based on RS and field data for biodiversity monitoring in tropical forests. These methods are aimed to deliver products that can inform national and sub-national policy, and support convention commitments and targets.

The sourcebook will focus on RS techniques that have been proven operational for the integration of RS and in situ observations, present and discuss sampling approaches, in relation with the development of the relevant Essential Biodiversity Variables of the GEO BON. Depending on the chapters, the target audience is formed of project managers, technical level practitioners, academic institutions, and NGOs. The developers have adopted a bottom-up approach developing the sourcebook in the frame of the BON-in-a-box concept from GEO BON.
The sourcebook will be a living document updated every year, made available on the internet, and translated from English into French and Spanish. The development of training materials and a R&D plan will be considered on a midterm perspective. This new sourcebook is being developed in complementarity with other existing guidance documents such as the CBD Technical Reports, the ZSL-GIZ Sourcebook, and the GEO Handbook. The first version is expected to be released during the UNCBD COP-13 (fall 2016).



SOURCEBOOK - A joint initiative by GOFC-GOLD and GEO BON

Agree on biodiversity metrics to track from space *(see right page)*

Track Biodiversity

In a move that previously proved successful in helping to monitor climate change on a global scale, GEO BON believes that space technology could help track biodiversity across the planet. Satellite images can quickly reveal where to reverse the loss of biological diversity. Vegetation productivity or leaf cover can, for example, be measured across continents from space while providing information about biodiversity level on the ground. Publicly-funded space agencies, including ESA and NASA, already collect and regularly provide open-access to satellite data.

However, a lack of agreement between conservation biologists and space agencies on a definitive set of variables to track, as well as how to translate such information into useful data for conservation, has meant that so far this game-changing resource has remained untapped. Today, satellite imagery from major space agencies is becoming more freely available, and images are of much higher resolution than 10 years ago. Our ambition to monitor biodiversity from space is now being matched by actual technical capacity. As conservation and remote sensing communities join forces, biodiversity can be monitored on a global scale. High tech satellites can assist in conserving biological diversity by tracking the impact of environmental policies worldwide.

Urgency and Vision

With global wildlife populations halved in just 40 years, there is a real urgency to identify variables that both capture key aspects of biodiversity change and can be monitored consistently and globally. Satellites can help deliver such information, and in 10 years' time, global biodiversity monitoring from space could be a reality, but only if ecologists and Space Agencies agreed on a priority list of satellite-based data that is essential for tracking changes in biodiversity. So far biodiversity monitoring has been mostly species-based, and this means that some of the changes happening on a global-scale may be missed. Being able to look at the planet as a whole could literally provide a new perspective on how we conserve biological diversity.

"GEO BON believes that space technology could help track biodiversity across the planet."

Associated Project

Remote Sensing for Essential Biodiversity Variables (RS4EBV): An Innovator III project of the European Space Agency (ESA)

Project background

The world's declining plant diversity is degrading nature's ability to provide goods and services. Terrestrial ecosystem productivity is driven by plants and the most plant diverse ecosystems are generally the most productive,

WORKING GROUP 3 PRODUCTS:

A New Map of Global Ecological Land Units

AN ECOPHYSIOGRAPHIC STRATIFICATION APPROACH

Lead: Roger Sayre

This special publication describes the concepts and methods for delineating ecological land units (ELUs) as distinct physical environments and associated land cover. The ELUs were developed in response to the need for a high resolution, standardised, and data-derived map of global ecosystems. Users aim to analyse climate change impacts, assess economic and non-economic value of ecosystem goods and services, biodiversity conservation planning, and natural resource management. Detailed and accurate maps of ELUs are presented for the Earth and the continents, as well as regional examples. The work has been associated with GEO BON from the beginning in recognition that Ecosystem Extent is one of the Essential Biodiversity Variables (EBVs). The work was undertaken in a model public/private partnership between the U.S. Geological Survey and Esri with a number of international ecosystems and vegetation experts contributing. The ELUs represent distinct combinations of four Earth surface features: bioclimate, landforms, geology, and vegetation. Global datalayers for each of these four input layers were obtained or created and then spatially combined to produce the ELUs. The base resolution for the ELU product is 250 m. The ELUs represent the most current, finest thematic and spatial resolution delineations of terrestrial ecosystems produced to date. Approximately 4000 unique ELUs were delineated.

For more information contact Dr. Roger Sayre, Senior Scientist for Ecosystems, Land Change Science Program, U. S. Geological Survey (*rsayre@usgs.gov*), or Charlie Frye, Chief Cartographer, Esri (*cfrye@esri.com*).

Agree on biodiversity metrics to track from space

JOURNAL PUBLICATION

Lead: Andrew Skidmore

One of the major aims of GEO BON is to enable better cooperation of Conservation scientists with space agencies, such as NASA and the European Space Agency (ESA), on identifying measures to help track biodiversity change around the world. That topic has been strongly addressed by Andrew K. Skidmore of the ITC Faculty of the University of Twente and other GEO BON colleagues around the world, including scientists from the Zoological Society of London (ZSL). In a comment published in the world-renowned scientific journal Nature, the scientists state more has to be done to make the use of satellite data valuable to fight global biodiversity loss.

See the original paper:

Skidmore, A. K., Pettorelli, N., Coops, N. C., Geller, G. N., Hansen, M., Lucas, R., Mücher, C.A., O'Connor, B., Paganini, M., Pereira, H.M., Schaepman, M.E., Turner, W., Wang, T., Wegmann, M., (2015) Environmental science: Agree on biodiversity metrics to track from space. Nature 523: 403–405

doi:10.1038/523403a


COMMENT

Agree on biodiversity metrics to track from space

Ecologists and space agencies must forge a global monitoring strategy, say **Andrew K. Skidmore**, **Nathalie Pettorelli** and colleagues.

in terms of creation of biomass and the provision of ecosystem goods and services to society. However human pressures on the world's plant diversity is increasing causing alarming losses in plant species worldwide. The Global Strategy for Plant Conservation was ratified in 2002 by the parties to the United Nations Convention on Biological Diversity (CBD). It aims to halt these losses, conserve plant diversity and mitigate human pressures on plant life. The RS4EBV project is developing a methodology for consistent mapping and monitoring of a suite of variables which describe plant status and health, paving the way for a global plant functional diversity index. Functional Diversity (FD) is the value, range, and relative abundance of plant traits in a given ecosystem. Developing this index will be the first step in helping conservationist to focus their efforts on the world's most productive and functionally diverse ecosystems and ultimately to halt plant species decline. Repeated and systematic observations of FD globally could also help policy makers assess progress towards the Aichi Biodiversity Targets by building an indicator based on trends in FD.

Project team

The RS4EBV team consists of a core partnership between the UNEP World Conservation Monitoring Centre (UNEP-WCMC) and the University of Twente – Faculty of Geo-Information Science and Earth Observation (UT-ITC) with financial and technical support from the European Space Agency (ESA) Innovators III initiative. The project kicked off in March 2015 and will run until early 2017.

Contact points for further information

Marc Paganini, ESA/ESRIN,
marc.paganini@esa.int

Partners

There are approximately 50 members of WG3 representing a diverse range of national and international organisations from research, academic, government, NGO and industry.

Freshwater ecosystem change

Aims and visions

No other major element of the globes biodiversity has experienced such a massive loss and modification as freshwater ecosystems and species. Many human activities strongly depend on the availability of freshwater as a resource and this has lead to widespread competitive situations. The large-scale loss of wetlands, the extinction of many freshwater species and the drastic modification of many habitats, especially marshes and large rivers are the result. WG 4 focuses on change in all dimensions of freshwater biodiversity, especially on ecosystem extend as well as on species occurrence, abundance and on freshwater biodiversity related ecosystem services.
WG 4 develops products of high policy relevance for national governments and major GEO BON user groups as CBD and IPBES, including Red Lists and other products. WG 4 is a network of the globes major freshwater biodiversity scientists and conservation practitioners concerned about freshwater biodiversity loss and engaged in conservation issues.

Key activities and products

- Development Essential Biodiversity Variables for freshwaters
- Building a global partnership towards a Census of Freshwater Life
- Partnering with Ramsar to develop the Global Wetlands Observing System (GWOS)
- Development of freshwater-specific indicators

WG 4 Leaders

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of species distributions and species abundance;
- Development of citizen science protocols for monitoring in freshwater ecosystems;
- Mobilisation and management of freshwater biodiversity data (e.g. Global Freshwater Biodiversity Atlas and Freshwater Platform);
- Ecosystem diversity/meta-ecosystems, Global classification and mapping of freshwater ecosystems;
- Global modelling of species richness and turnover in freshwater freshwater biodiversity;
- Freshwater conservation planning, establishment and management of freshwater protected areas;
- Linking freshwater biodiversity to food security, inland fisheries, climate change adaptation, terrestrial ecosystems (especially tropical rainforests).

Associated Project

Satellite-based Wetland Observation Service (SWOS)

SWOS
Satellite-based Wetland Observation Service

Project background

Globally, wetlands are amongst the ecosystems with the highest rate of loss during the last several decades. At the same time, wetland conservation and management is emphasised because of their significance as biodiversity hotspots and as ecosystems that provide many ecosystem services. SWOS is a European pilot project of GWOS, the Global Wetland Observation System. The objectives of the SWOS project are to (1) promote and underpin the consideration of wetlands in the implementation of key policy areas, (2) develop an operational, standardised monitoring service and service portal for wetlands and their ecosystem services, (3) provide a unique entry point to easily locate, access and connect wetland information via the service portal, (4) use the new possibilities offered by the Sentinel satellites and (5) further develop existing approaches, in particular the GlobWetland II approach. SWOS is a wetland monitoring service that will be demonstrated for selected wetlands in Europe, Africa and Asia.

It follows a multi-level user approach: Ecosystem and wetland management bodies (national park and protected area managers, scientists, local administrations) are addressed on the local level. National authorities shall benefit from and contribute to SWOS regarding the reporting on the status and trends of wetland ecosystems (national administrations, Natura2000, WFD, EU member states). At the global scale SWOS aims to support the implementation action of the Ramsar Convention on Wetlands, the Global Earth Observation System of Systems (GEOSS), EU Natura2000, CBD, the EU Copernicus program and others.

To provide a service for data acquisition, thematic mapping, and long-term accessibility of key wetland map products and indicators are the main goals of the SWOS project. The planned SWOS data middleware system operated by a geoportal will be designed for full access to satellite data, derived products, and in-situ databases and other existing EO data related to wetlands. SWOS will contribute to reducing existing deficits in human-machine interaction for a better and faster performance, linking users with different sources of environmental data.

Recent web-based approaches in environmental monitoring will be integrated via mobile appli-

cations on smartphones, such as crowdsourcing based delineation of wetlands and biodiversity mapping and mobile visualisation and analysis for spatial time-series data. The integration of citizens as sensors for collaborative mapping will enhance the public awareness and visibility of the project and the environmental challenges addressed and is in line with current and planned activities within GEO.

Contact point for further information

http://swos-service.eu

Partners

WG4 has 20 members from 13 countries, from universities (e.g Hong Kong University, Kyoto University, University of Bonn), government conservation and environmental agencies (e.g. Office of Envrionment and Heritage, Australia, EMBRAPA, Brazil) research organisations (e.g CSIR, South Africa, Australian Museum, Royal Belgian Institute of Natural Sciences) , NGOs (The Nature Conservancy, Wetlands International, The RSPB) International non-profit organisations (IUCN, Earthwatch). WG4 works closely with Ramsar and the IUCN WCPA Freshwater Protected Areas Task Force and the IUCN Species Survival Commission Freshwater Species Programme.

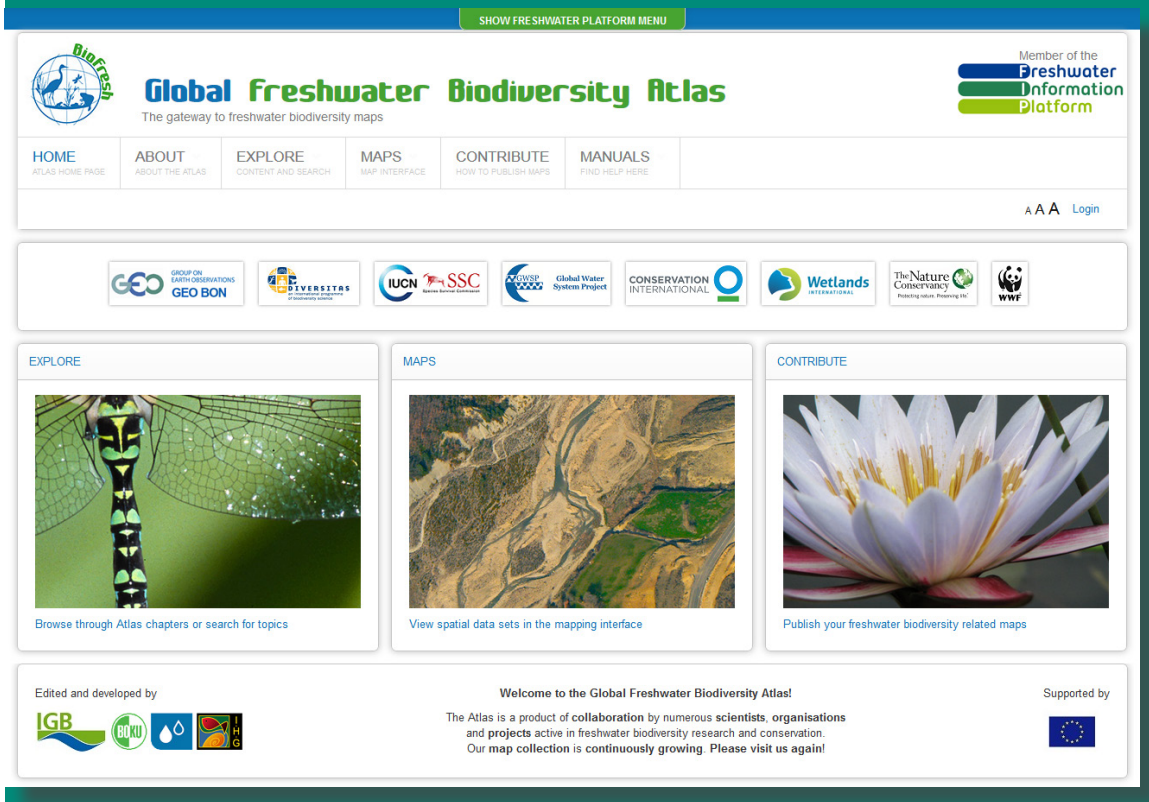
"WG 4 develops products of high policy relevance for national governments and major GEO BON user groups as CBD and IPBES, including Red Lists and other products. "

WORKING GROUP 4 PRODUCT:

Global Freshwater Biodiversity Atlas

Lead:
Jörg Freyhof

Many stakeholders and policy makers concerned about biodiversity ask for better availability of biodiversity data and information. GEO BON, including its partners in the IUCN/SSC, the GWSP, Wetlands International, Conservation International, the Nature Conservancy, WWF and the European FP7 project BioFresh, has developed an online atlas of freshwater biodiversity to fill this gap. The Global Freshwater Biodiversity Atlas provides an open-access and interactive gateway to species distribution patterns and key geographical background information on freshwater biodiversity, resources and ecosystems, pressures and conservation measures across a range of scales.
The Global Freshwater Biodiversity Atlas is seen as a key resource for evidence-based decision making relating to water policy and management and an important visualisation tool, facilitating the discovery and increasing the accessibility of scientific research results. Content and functionality will be constantly expanded and scientists are invited to contribute their research results to this open and collaborative initiative.
Find the Global Freshwater Biodiversity Atlas at *http://atlas.freshwaterbiodiversity.eu*



Marine ecosystem change

Aims and visions

Working Group 5 focuses on the distribution, extent, and condition of marine ecosystems and how they are changing over time. Deliverables include a compilation of ready to use Global Marine Environmental Datasets (http://gmed.auckland.ac.nz), identification of gaps in marine biodiversity data, annual global ecological status report based on the Continuous Plankton Recorder surveys, a compendium of maps of 'Marine Regions'. A new marine BON task group is fostering global scale collaboration in approaches to monitoring trends in biodiversity over time.

Key activities and products

The activities of WG5 are so far:

- **Annual Global Ocean Ecological Status Report**
  Report on status of oceans based on annual Continuous Plankton Recorder surveys.
- **Compendium of global environmental data layers**
  Downloadable set of global marine environmental data layers at standard spatial resolution from http://gmed.auckland.ac.nz.
- **Ocean biodiversity monitoring plan towards mBON**
  A global marine Biodiversity Observation Network (mBON). Locations where marine biodiversity is being monitored. This will require standard methods and variables to en-

WG 5 Leaders

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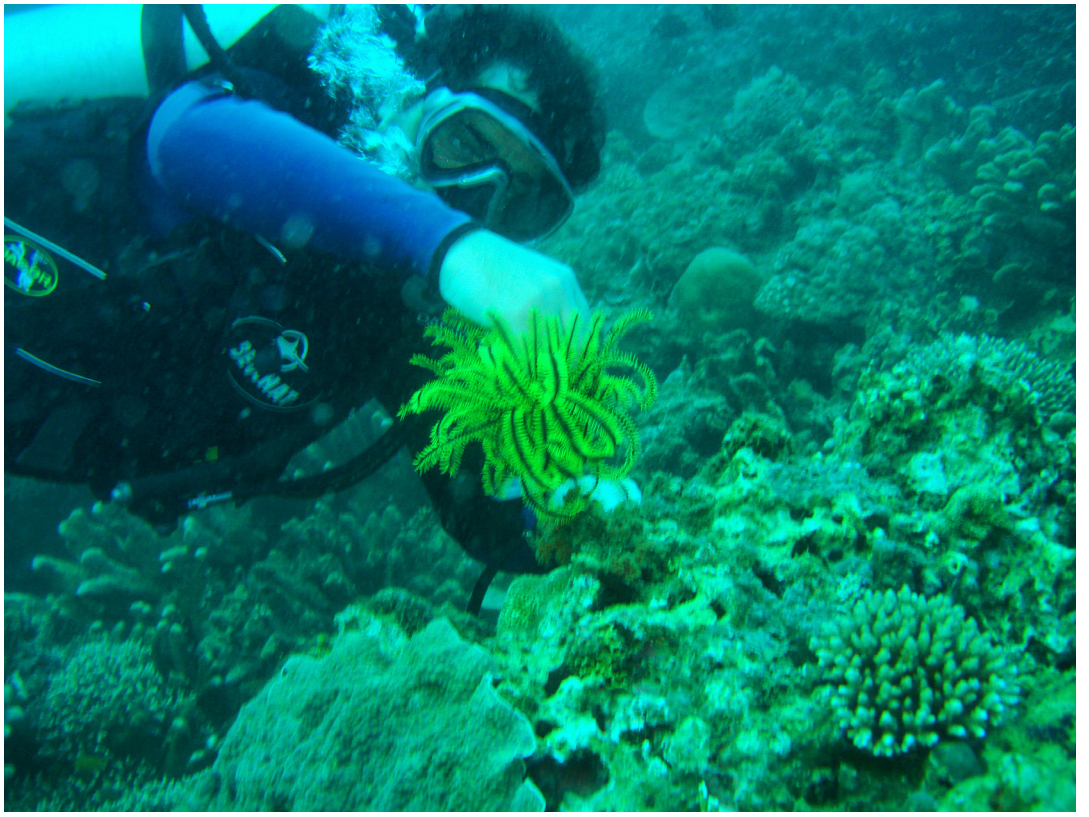


able integration of data and trends globally.

- **Ocean environmental and species data for EBSAs**
  Document with maps and descriptions of data used to identify EBSAs (Ecologically or Biologically Significant Areas).
- **Permanent ocean pelagic habitat features map**
  Map of areas that may be considered permanent distinctive pelagic habitats.
- **Future marine benthic biodiversity**
  Paper that maps benthic biomass globally.
- **Global bacterial richness assessment map**
  Paper with map of bacterial biomass related to ecosystem function.
- **Global marine ecosystems map**
  Map of marine ecosystems using same approach as terrestrial ecosystems so both are comparable.
- **Marine Regions compendium**
  Downloadable set of global marine regions as GIS files, including seas and oceans; Exclusive Economic Zones; topography statistics; and expert defined regions.
- **World Register of Marine Introduced Species (WRIMS)**
  Permanent, continually updated, taxonomically validated, free-access online database on all marine introduced and invasive species. It was launched recently and integrated within the World Register of Marine Species (WoRMS), being taxonomically managed by experts and continually updated. Presently integrates 1,553 species (origin 68 uncertain, 129 unknown).
- **Spatial and temporal gaps in marine biodiversity data**
  Gaps maps: where there is and is not ground-truth data for marine biodiversity over time; by country and/or sea or region.
- **Compendium of biodiversity time-series datasets**
  Assessment of population time-series datasets and monitoring stations.

Associated Project

Marine Biodiversity Observation Network (MBON)

In 2014, WG5 started to engage in building the global Marine Biodiversity Observation Network (MBON), which is a cooperative effort of the US pilot MBONs, the Tennenbaum Marine Observatory Network (TMON), GOOS and other initiatives. Please see details in chapter 3.
For further information please see
www.geobon.org/working-groups/working-group-5-marine-ecosystem-change

Partners

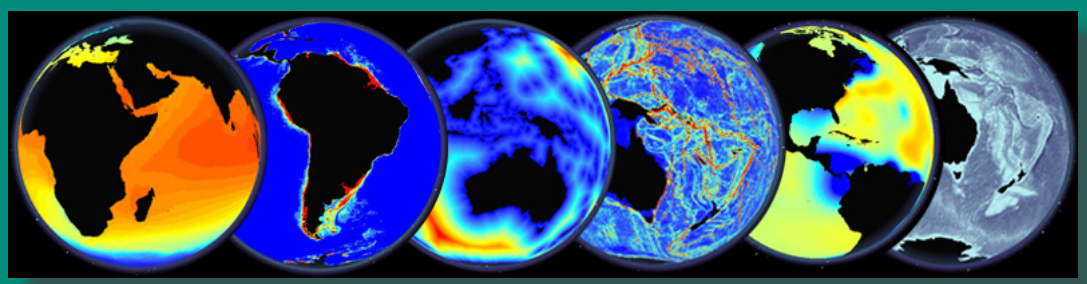
There are 25 members of WG5 from 11 countries and representing a diverse range of national and international organisations from research, academic, government and NGOs.

WORKING GROUP 5 PRODUCTS:

Global marine dataset compendium for species distribution modelling and environment visualisation

The Global Marine Environment Dataset (GMED) publishes a compilation of global climatic, biological, and geophysical environmental layers featuring present day, past and future conditions. Marine ecologists and biologists map and use modelling algorithms to predict and visualise species distributions at a global scale.

However, the environmental datasets have varying spatial resolutions and are frequently provided in different file formats, making the data assembly time-consuming part of any study. Thus, GMED provides ready to use standardised dataset with uniform spatial extent and a land mask to eliminate land areas at high spatial resolution.



The compilation covers the widest range of environmental layers available, including depth from the surface to the deepest part of the ocean. The free online availability of GMED enables rapid mapping of species against past, present and future environmental conditions, such as to visualise the potential distribution of vulnerable, endangered or invasive species by Species Distribution Modeling (SDM) algorithms (e.g. Random Forest, GARP, MaxEnt).

Find the dataset compendium at
http://gmed.auckland.ac.nz

The Marine Global Earth Observatory

http://marinegeo.si.edu

MarineGEO is a network of worldwide coastal observation and research sites that focus on understanding changes at the land-sea interface, where marine life is most abundant and human effects and demands on that life are highest. The Smithsonian's Tennenbaum Marine Observatories Network (TMON) directs and coordinates the research efforts of these sites and is also responsible for establishing new partner sites around the world. Since most existing ocean observation efforts tend to focus on the open ocean or on physical and chemical characteristics, the Marine GEO initiative fills a critical void with its focus on:

- The coastal zone, where people and marine life are concentrated;
- Biodiversity and the factors that create resilience to stressors;
- Systematic data collection over a long time span;
- Integration of multiple scientific disciplines to understand biodiversity and ecosystem function;
- Experiments to help us truly understand the drivers of change.

The initiative is employing long-term standardized observations and experiments to build the first comprehensive database on the coastal ocean's physical characteristics and biodiversity, making new scientific discoveries possible. With new data and increased understanding of ocean health, TMON aims at providing policy makers and resource managers with the most current scientific information to support innovative sustainability solutions and advance ocean management and protection.

This network is expanding through partnerships. Partners will collaborate to sustain the long-term network with in-kind contributions of field access, students, facilities, and local expertise. A flexible, adaptive research program encourages initiation of locally relevant research built around standard measurements conducted at all sites.

Ecosystem Services

Aims and visions

Ecosystem services are the benefits societies obtain from ecosystems. These benefits include the tangible resources we can consume such as water, food from agriculture, fisheries or hunting, wood or fuel wood. These are called provisioning services. They also include the processes that regulate the average conditions suitable for human enterprise but also those that regulate the variations around this average, such as regulation of climate (from global to local), of floods, of human diseases or the presence of pollinators for crops. The non-tangible benefits that arise from interactions between people and societies, including experiences such as recreation or artistic inspiration, identity and other characteristics important to people's livelihoods are another category of benefits. Monitoring change in ecosystem services is critical to inform on the capacity of ecosystems to sustain and fulfil human life through time. Changes in ecosystem services can result from management decisions to increase them or from unintended deterioration of ecosystem. These in turn are critical to assess changes in human well-being.

Working Group 6 is focused on developing protocols, proofs of concepts and an encompassing strategy to monitor ecosystem services at different spatial scales. These tools can be used to assess how the supply, delivery, value and links to human well-being of ecosystem services changes vary across space and time and how these can be projected into the future. The data generated by these tools is critical to inform global, national and sub-national policy design and inform

WG 6 Leader

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decisions on how to manage social-ecological systems to best reconcile current and future societal needs as well as the maintenance of life on Earth and the systems that support it. Users of products from Working Group 6 include national governments that need to assess progress towards Aichi Targets or sustainable development goals, as well as to including them into national accounting systems.

Key activities and products

The activities of WG 6 gather around the following themes:

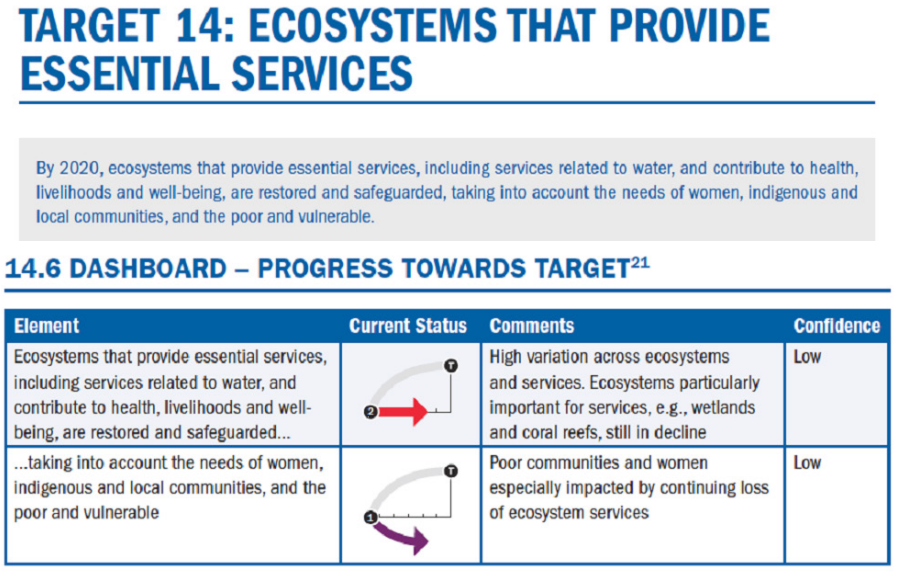
- A framework for observing ecosystem services change
- Standards for in situ observations of ecosystem services and human well-being
- Enhancing household surveys to measure the value of ecosystem services to people
- Producing regularly updated global maps of ecosystem services
- Assessing multi-ecosystem service tradeoffs
- Assessing current knowledge on ecosystems that provide key ecosystem services
- National statistics and indicators of ecosystem services to assess progress towards conservation and sustainability targets
- The development of Essential Ecosystem Service Variables
- The incorporation of tools to assess ecosystem services into Bon in a Box.

We developed a conceptual framework for the GEO BON Ecosystem Services Working Group that will allow monitoring ecosystem services change and informing decisions made at any scale. We showed how the integration of national statistics, numerical models, remote sensing, and in situ measurements can contribute to regularly tracking changes in ecosystem services across the globe. We showed how different data sources could contribute to this endeavour at different spatial scales. We found that although many ecosystem services are not currently measured, others are ripe for reporting. We assessed what data is available or missing to allow assessing the contribution of the environment to social conditions. The emphasis was on how this data could inform indicators relevant to major conventions such as CBD (the Convention for Biological Diversity) or the Sustainable Development Goals (SDGS). We revised and discussed what new indicators could be created and reported from existing data streams such as national statistics, household surveys and in-situ observations. We developed a guideline in partnership with the World Conservation Monitoring Services WCMC on such indicators. We then ran a pilot application of this approach for the case of South Africa, where we assessed what data was available to measure progress towards Aichi Target 14, aimed at restoring and safeguarding by 2020 the ecosystems that provide essential ecosystem services.
This target emphasises those ecosystem services related to water and health, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable. We compiled all the published information available to date on this topic to assess how close we are to date towards meeting this target. We found that there are critical ecosystems that provide key services that are declining while others are not, but that more systematic assessment across ecosystems and services are needed. We found that the most vulnerable sectors of society are at risk in the face of the current loss of ecosystems and their services.

For further information please see
www.geobon.org/working-groups/working-group-6-ecosystem-services

Target 14: Ecosystems that provide essential services

In 2010 the Parties of the Convention on Biological Diversity (CBD) adopted the Strategic Plan for Biodiversity 2011-2020 including 20 ambitious yet achievable targets, the Aichi Targets. Target 14 is aimed at restoring and save guarding by 2020 the ecosystems that provide essential ecosystem services. Target 14 has an emphasis on water and health and the needs of women, indigenous and local communities, as well as the poor and vulnerable. We compiled all the published information available on this topic to assess how close we are towards meet
ing Target 14. In this study, we explain in detail, which critical ecosystems, providing key services, are declining and which are more stable. This study finds, that the sectors of the global society already being most vulnerable also face the highest risk to loose ecosystems and their services crucial for their livelihoods.



TARGET 14: ECOSYSTEMS THAT PROVIDE ESSENTIAL SERVICES

By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

14.6 DASHBOARD – PROGRESS TOWARDS TARGET[21]

Element	Current Status	Comments	Confidence
Ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded...		High variation across ecosystems and services. Ecosystems particularly important for services, e.g., wetlands and coral reefs, still in decline	Low
...taking into account the needs of women, indigenous and local communities, and the poor and vulnerable		Poor communities and women especially impacted by continuing loss of ecosystem services	Low

Figure 2: *Target 14: Ecosystems that provide essential services*

WORKING GROUP 6 PRODUCTS:

Measuring Ecosystem Services

GUIDANCE ON DEVELOPING ECOSYSTEM SERVICE INDICATORS

What are the contributions of ecosystems to societal conditions?
While this is a simple question, current data available does not allow assessing this link. The lack of data has important consequences on policy design. We assessed what data is available or missing to better understand the consequences of change in environmental contributions to social conditions. The emphasis was on how this data could inform indicators relevant to major conventions such as the Convention for Biological Diversity (CBD) or the Sustainable Development Goals (SDGS). We revised and discussed which new indicators could be developed from existing data streams such as national statistics, household surveys and in-situ observations.

Assessing ecosystem service change & its impacts on human wellbeing

A national pilot of indicator approaches and data

South Africa has a long history of ecosystem services research and policy, a close connection between the science and policy communities, as well as good national datasets. These conditions have allowed the country to develop and test indicators and metrics of ecosystem services in various policy contexts. This document describes several of these indicators and their policy uses. It also contributes to global efforts to enhance the development, utility and uptake of ecosystem service measures and indicators. This allows for a better assessment of the wider consequences of change in ecosystem services and their implications for society, human wellbeing and poverty alleviation at sub-global scales.

In-situ and remote-sensing integration

Aims and visions

Effective detection and monitoring of biodiversity change across large spatial extents has the potential to benefit substantially from combining field observations with remote-sensing data. This working group focuses on the development and application of approaches to using modelling to achieve such integration at regional to global scales. The work of the group links directly with that of a number of other working groups, as the approaches being pursued are of broad relevance to multiple levels of biodiversity (genetic, species, ecosystem) across multiple environments (terrestrial, freshwater, marine). The group's recent activities have addressed species-distribution and taxonomic-diversity EBVs in terrestrial environments. A particular recent focus has been the development of indicators for the Convention on Biological Diversity addressing progress toward the 2020 Aichi Biodiversity Targets (see below).

Key activities and products

Towards a new generation of biodiversity indicators

GEO BON with its scientific partners introduces a new generation of global indicators integrating biodiversity observations, remote sensing data, and models for assessing progress towards the CBD Strategic Plan 2011-2020 and Aichi Targets 5, 11, 12, 15 and 19. A GEO BON con-

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sortium involving researchers and organisations around the world has developed a novel set of global indicators to address important gaps in our understanding of biodiversity change across scales, from national to global. These indicators are embedded in open online analysis platforms following GEO data sharing principles and have the long-term commitment of established research institutions. The new set of indicators is characterised by the rigorous use of large global datasets, state of the art remote-sensing based information, model-based integration of multiple data sources and types, including in situ (ground based) observations, and online infrastructure enabling inexpensive and dynamic updates, with full transparency. This has become possible through direct collaboration with technical and research support partners such as Google and NASA, the development of a dedicated infrastructure such as Map of Life, and the engagement of the larger GEO BON community.

"A GEO BON consortium has developed a novel set of global indicators to address important gaps in our understanding of biodiversity change across scales, from national to global."

Five new indicators for assessing and reporting progress against Aichi Targets 5, 11, 12, 15 and 19 have been derived by integrating data from three Essential Biodiversity Variables: species distributions, taxonomic diversity and ecosystem extent. By integrating the complementary strengths of different types of data, the resulting indicators offer some important benefits. For example, they help to fill geographical and taxonomic gaps in the coverage of measures based purely on in situ biological data and are able to translate measures based purely on remote sensing, for example of habitat loss and degradation, into biologically-scaled indicators of likely impacts on biodiversity. One key advantage of these new indicators is that they cover the entire terrestrial surface of the planet at 1km grid resolution. By operating at this spatial resolution the indicators can effectively account for important relationships between species distributions and patterns of habitat loss and protection that play out at scales much finer than those typically addressed by previous global indicators. This fine resolution of analysis then underpins reporting of the indicators at any desired level of spatial aggregation, including the national level. Such automated national reporting is being integrated into the BON-in-a-Box toolkit of GEO BON. Developing robust global indicators is a component of a larger GEO BON effort to improve our understanding of the biotic response to global change, by integrating previously disconnected dimensions of biodiversity and also by connecting local trends to regional and global trends, offering tests of the predictive capacity of models in response to global change, a critical step in making ecological forecast more rigorous.

Find the proposed indicators at:
www.geobon.org/Downloads/brochures/2015/GBCI_Version1.1_low.pdf

Associated Projects

Projecting Responses of Ecological Diversity In Changing Terrestrial Systems: the PREDICTS project

Project background

The PREDICTS project (www.predicts.org.uk) aims to build global models of how local terrestrial biodiversity responds to land use and related impacts, and to use them to map and project current and future states of biodiversity. Our models are supported by a compilation of spatial comparisons of sites facing different human pressures: currently, this database has over 3 million records, relating to a taxonomically representative set of over 45,000 species at a geographically widespread set of 27,000 sites (95 countries).[1] The database will be made freely available within the next few months.

Results

Our first global models and projections[2] suggest that, on average, within-sample species-richness has been reduced by 13.6% worldwide, and rarefaction-based richness by 8.1%. Rapid further losses are predicted under a business-as-usual land-use scenario, with losses concentrated in biodiverse but economically poor countries; but strong mitigation can deliver much more positive and fairer biodiversity changes. Other analyses published so far take a species focus, considering vertebrates in tropical forests[3] and European bees[4].

Next steps

Several analyses are ongoing, including fine-scale global estimation of Scholes & Biggs'[5] Biodiversity Intactness Index and a test of the effect of protected areas on site-level diversity. We are also able to produce maps of our modeled response variables for any regions of policy interest. The next phase of PREDICTS will focus on data from temporal, rather than spatial, comparisons, allowing a test of space-for-time substitution.

Project team

PREDICTS is a partnership between the Natural History Museum (London), UNEP-WCMC and several British universities, with financial support mostly from the Natural Environment Research Council (NERC, U.K.). The project started in March 2012 and is currently funded until September 2018.

Contact points for further information

www.predicts.org.uk

Map of Life: A global resource for species distribution and trend information

Readily accessible information about the geographic distribution of species and the composition of animal or plant communities is usually taxonomically restricted, spatially uneven, or too coarse-grained to appropriately support research and effective resource management. Map of Life (http://mol.org) sets out to help address this shortcoming by providing a scientifically sound, interactive, and global resource for best-possible information on spatial biodiversity distributions and trends. The project provides visualisation and analysis infrastructure for GEO BON to support the quantification of species distribution EBVs and select community composition EBVs. The project uses detailed remote sensing data, novel statistical methods, and digital platforms for the integration of large biodiversity datasets to develop a new generation of spatial biodiversity information products that benefit from model-based integration. In close collaboration with research and technology partners, such as NASA and Google, Map of Life has developed a scalable web platform for large biodiversity data analysis and visualisation and has begun to work with data partners to help them publish and share information and address knowledge gaps.

In 2015 Map of Life worked with GEO BON to provide a new set of indicators addressing species distributions to the Convention on Biological Diversity. The project also published a new global field guide and citizen science mobile application (http://mol.org/mobile), downloaded by tens of thousands of users. It also launched a pre-release of interactive analysis tools for integrating remote sensing and species distributions (http://species.mol.org/pa) and is currently extending this to additional model-based approaches supporting species distribution and community composition EBVs.

Project team

The team consists of a collaboration of Yale University, the University of Florida, the Future Earth Cluster on 'Global Biodiversity Monitoring, Prediction and Reporting' (http://www.futureearth.org), the Global Mountain Biodiversity Assessment (http://gmba.unibas.ch), GEO BON Working Group 7, the National Center of Analysis and Synthesis (https://www.nceas.ucsb.edu), the African Conservation Centre (http://www.accafrica.org), and others.

Contact point for further information

http://mol.org

1 Hudson et al. 2014 Ecology & Evolution 4:4701-4735
2 Newbold et al. 2015, Nature 520:45-50
3 Newbold et al. 2014 Proc R Soc B 20141371
4 De Palma et al. 2015 J Appl Ecol DOI: 10.1111/1365-2664.12524
5 2005 Nature 434:45-49

Data integration and inter-operability; informatics and portals

Aims and visions

Interoperability and data integration are important for building GEOSS because solving global problems requires bringing together data from many sources. Interoperability means that systems can connect with each other and exchange information using standardised mechanisms. Data integration means building large pools of harmonised data from different sources. The GEOSS Common Infrastructure is the framework that defines and implements the interoperability and integration mechanisms for GEO. The "GEOSS Data Sharing Principles" require that all data in GEOSS are made openly accessible.

Key activities and products

Working Group 8 is focussed in defining the data standards and interoperability protocols to be used within GEO BON. These must be compatible with those in GEOSS and those from the whole biodiversity community. WG8 works to develop online guidance for systems, standards, and software to support the access to and dissemination of EBVs data. We are demonstrating their use in practice by addressing particular challenges through web-based processing of standardised data into EBVs and further to indicators.

The ongoing activities include:

- **Setting up web-based resources**, for each defined EBV to describe the applicable meta-data and data standards, showcase reference

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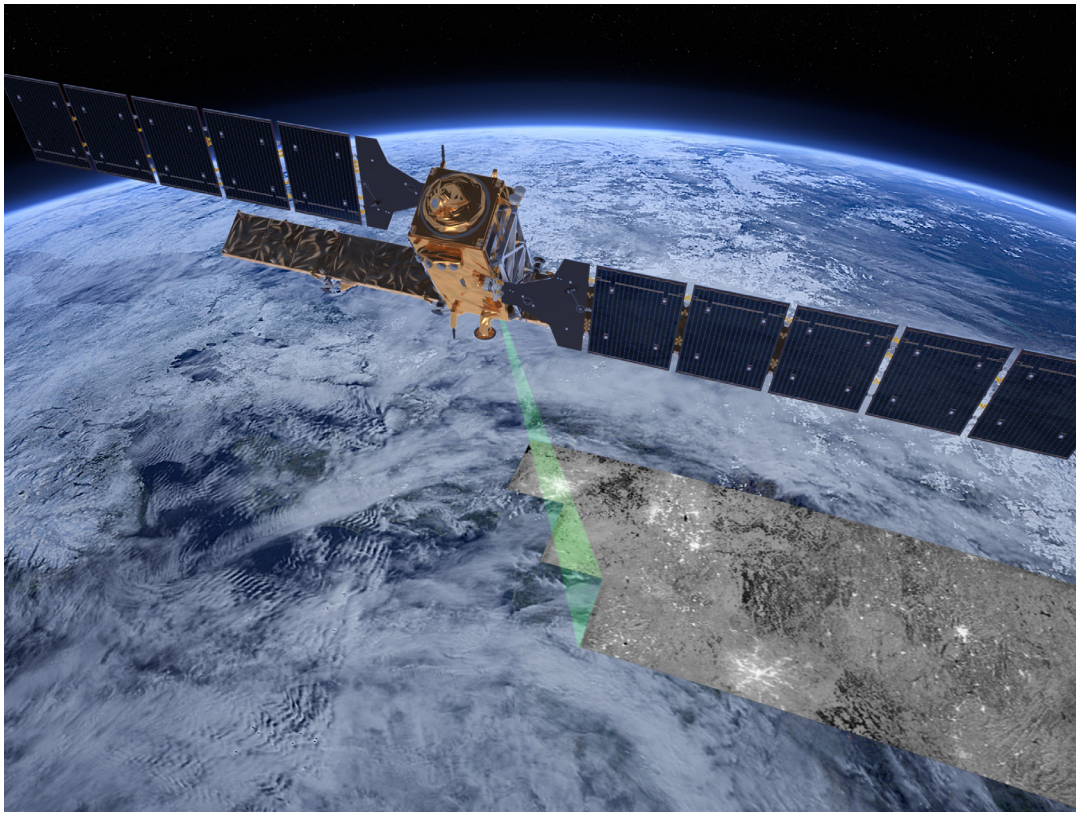


services and implementations for the EBV, catalogs of available software, and a registry of applicable services and vocabularies that support the EBV.

- Engage with working groups that have produced data or service deliverables and assist with standardised description and publication as required, and help **identify appropriate infrastructure** (GBIF, DataONE, EU-BON, Regional Repositories such as SAEON, etc.)
- **Implement the Model Web pilot** application to model abundance from occurrence data.
- **Implement end-to-end indicator calculation** and presentation from distributed data sources.
- Linkages and collaboration with **RDA Brokering Working Group** – define the services and tools available from infrastructures such as GBIF, EU-BON, GEO, and DataONE.
- **Support for BON-in-a-Box:** 1) assist in defining the most important EBVs GEO BON plans to target, 2) guide national parties on how they can mobilise relevant data in the most appropriate way to support these EBVs, and 3) set up pluggable mechanisms for visualisation and use of modeled versions of the EBVs.

Associated Project

EU BON - Building the European Biodiversity Observation Network

Project background

The main objective of EU BON (European Biodiversity Observation Network) is to build a substantial European contribution for GEO BON, also in light of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The global framework is set by GEO BON and GEOSS (Global Earth Observation System of Systems Group on Earth Observations). EU BON is building on existing biodiversity information systems and infrastructures (e.g. GBIF, DataOne, LifeWatch, LTER and national biodiversity data centres) thereby integrating access to multiple data sources. A European Biodiversity Portal will be developed by EU BON to become the main GEO BON information hub. It will link to relevant databases and information systems, policy contacts and recommendations, and to structured advice for assessing relevant distributed information/datasets for different user groups, including contributions from citizen science data gathering gateways.

"A European Biodiversity Portal will be developed by EU BON to become the main GEO BON information hub."

The EU BON project is an integration between social networks of science and policy and technological networks, resulting in a new open access platform for sharing biodiversity data and tools as well as results from state of the art analyses. Together with the latest modelling scenarios, a network of test sites will be used to verify the observed patterns, processes and trends. EU BON addresses the existing barriers to improve the biodiversity data landscape. There are a number of roles and contributions of Biodiversity Observation Networks (BONs) towards mobilising biodiversity information for use by policy development and decision makers. At the center of the EU BON's efforts is the promotion and adoption of existing standards of good practices and the data integration into a single biodiversity portal in order to make it discoverable, accessible and digestible.

Project team

EU BON's consortium includes 31 partners from 18 countries coordinated by the Museum für Naturkunde (MfN), Berlin. Project partners are members of networks of biodiversity data-holders, monitoring organisations, and leading scientific institutions. The project is open for collaboration with further parties that show interest in EU BON research. Up to now EU BON has signed Memoranda of Understanding with 28 institutions from around the world. The EU BON project is funded by the European Commission under the 7th Framework Programme; it started in December 2012 and it will last until May 2017.

Users

The European Biodiversity Portal will address various stakeholders and end users ranging from the local to the global level in the fields of research (ecology, taxonomy, genetics), practice (nature conservation, agriculture, NGO's), policy (local authorities, national governments) and policy-related processes (IPBES, CBD). Scientists are one of the main users, but finally the assembled information and knowledge will contribute to informed decision making as well. Thus, decision making authorities at the global, European and national scale will use knowledge products and tools provided by EU BON. In many cases, these products are summaries of multiple analyses done by multiple researchers.

Contact point for further information

www.eubon.eu

Partners

The working group has about 40 members from around the world. These involve, among others, GBIF, LTER, DataONE, NCEAS, SAEON, EU BON, BioVeL, CRIA and ALA.

WORKING GROUP 8 PRODUCTS:

European Biodiversity Portal

A GEOSS COMMUNITY PORTAL

Lead:
Hannu Saarenmaa & Antonio Garcia Camacho

The EU BON project, the European contribution to GEO BON, is developing a new portal to enable fast access to integrated data and products by researchers, decision makers, and other stakeholders. The portal will technically integrate the various data sources under one search facility and spatially/temporally oriented user interface. It will provide access to detailed data, geographic visualisation, and remotely sensed data.
EU BON pulls together fragmented data of various networks, and reduces heterogeneity of biodiversity information. This makes biodiversity observations openly available, following the GEOSS Data Sharing Principles. A registry of existing and available data sources is the key enabling mechanism underlying the portal. The EU BON registry integrates metadata of the registries of major projects, such as GBIF, LTER, KNB/DataONE, DEIMS, EuMon, etc., under one search facility, and links these to the GEOSS registry system using the GEOSS data access broker. Once the registry knows what data exists, but has not yet been openly shared, we have a mechanism to fill the gaps in data (spatial, temporal, taxonomic coverage, EBV classes) on-demand. This is a function no other organisation provides at the moment.
EU BON is building on the GBIF network for sharing the full, integrated data. Sample-based monitoring data has recently been featured in the GBIF network. The Darwin Core data standard was extended with new terms to cover sample-based data. The new terms have now been implemented in the latest version of GBIF Integrated Publishing Toolkit.

Other key products:

- Principles of information architecture for GEO BON.
- Darwin Core data standard, in particular the terms for quantitative data.
- GBIF Integrated Publishing Toolkit, version 2.3, supporting quantitative data.
- A portfolio of community-maintained web-based resources that provides guidance on data and meta-data standards, services, software, and registries for a growing number of EBVs.
- Web-based resources to assist with identification and use of regional and global infrastructure for biodiversity data.

"The EU BON project is developing a new portal to enable fast access to integrated data and products by researchers, decision makers, and other stakeholders."

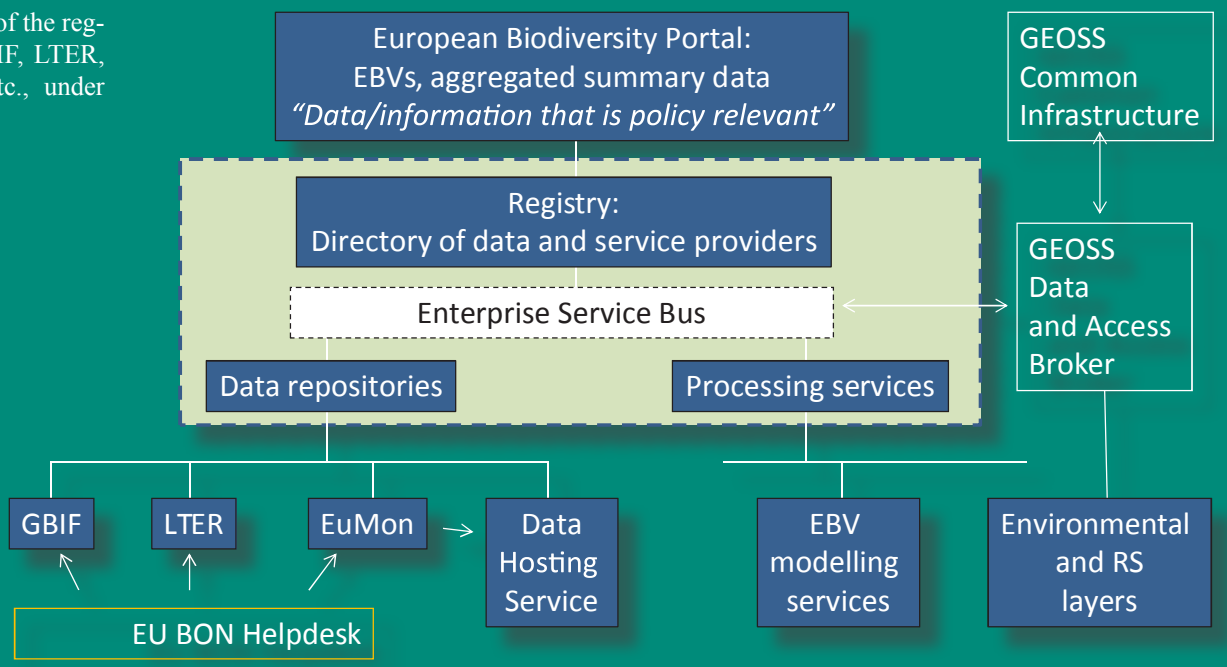
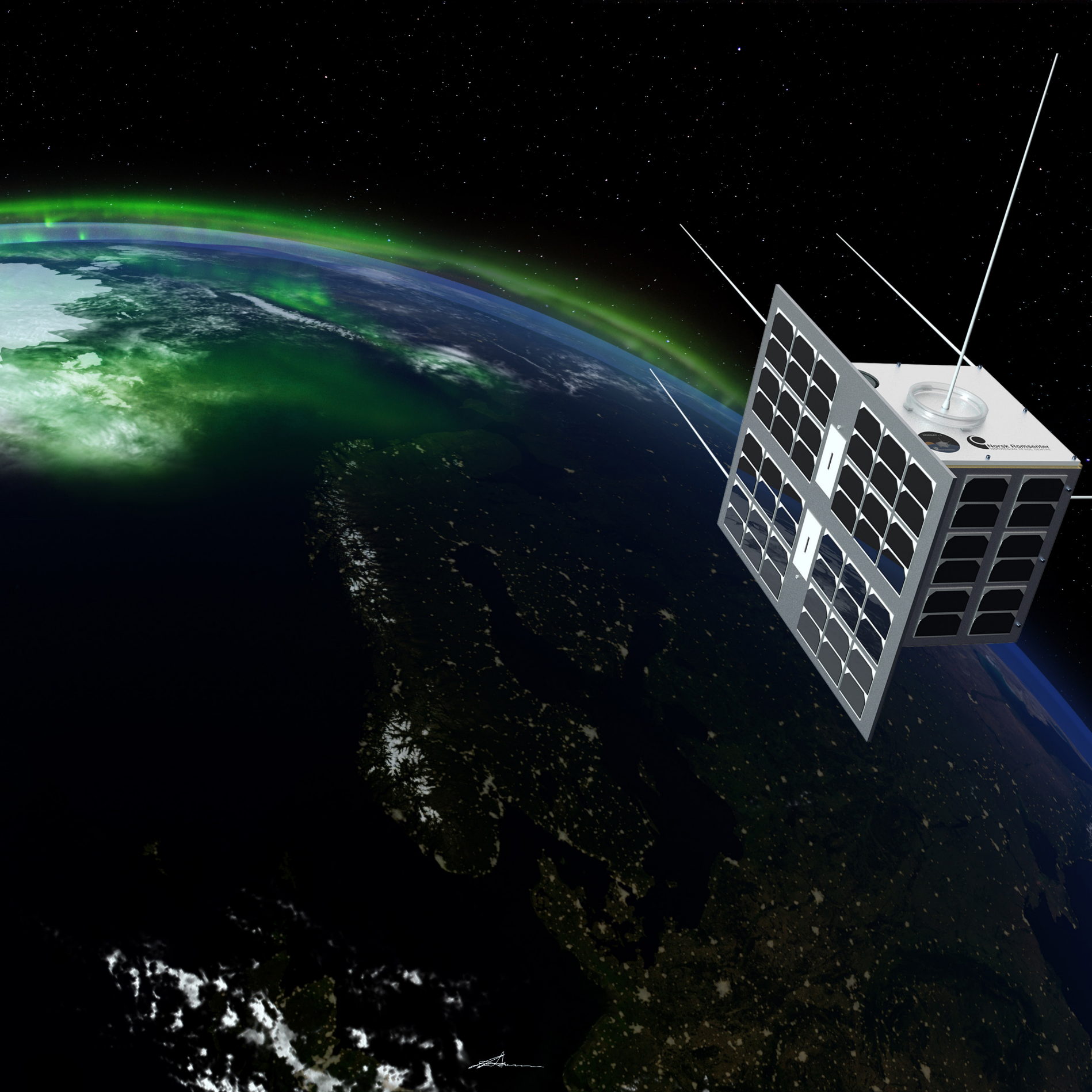


Figure 3: *Conceptual Framework of European Biodiversity Portal*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Biodiversity Indicators

Aims and visions

Working Group 9 creates and enhances linkages between the GEO BON core activities/community of practice and the end users of biodiversity observations/information catalysed by GEO BON. Working Group 9 specifically works with those decision makers who require biodiversity information in order to develop, implement and monitor progress towards biodiversity-related policy goals and targets.

Working Group 9 aims to:

- ensure that the GEO BON community is well aware of, and able to respond to, user needs, both in terms of information to support indicators and capacity to generate such information, at national, regional and global scales;
- incorporate biodiversity information and analyses from GEO BON into indicator-based policy products designed and delivered to meet user needs;
- link GEO BON to existing initiatives that improve information delivery to policy users, such as the Biodiversity Indicators Partnership (BIP);
- help to communicate the value of GEO BON to end-users.

Key activities and products

In doing so, WG9 directly contributes to four of the seven areas highlighted in the GEO BON self-assessment, namely (i) national

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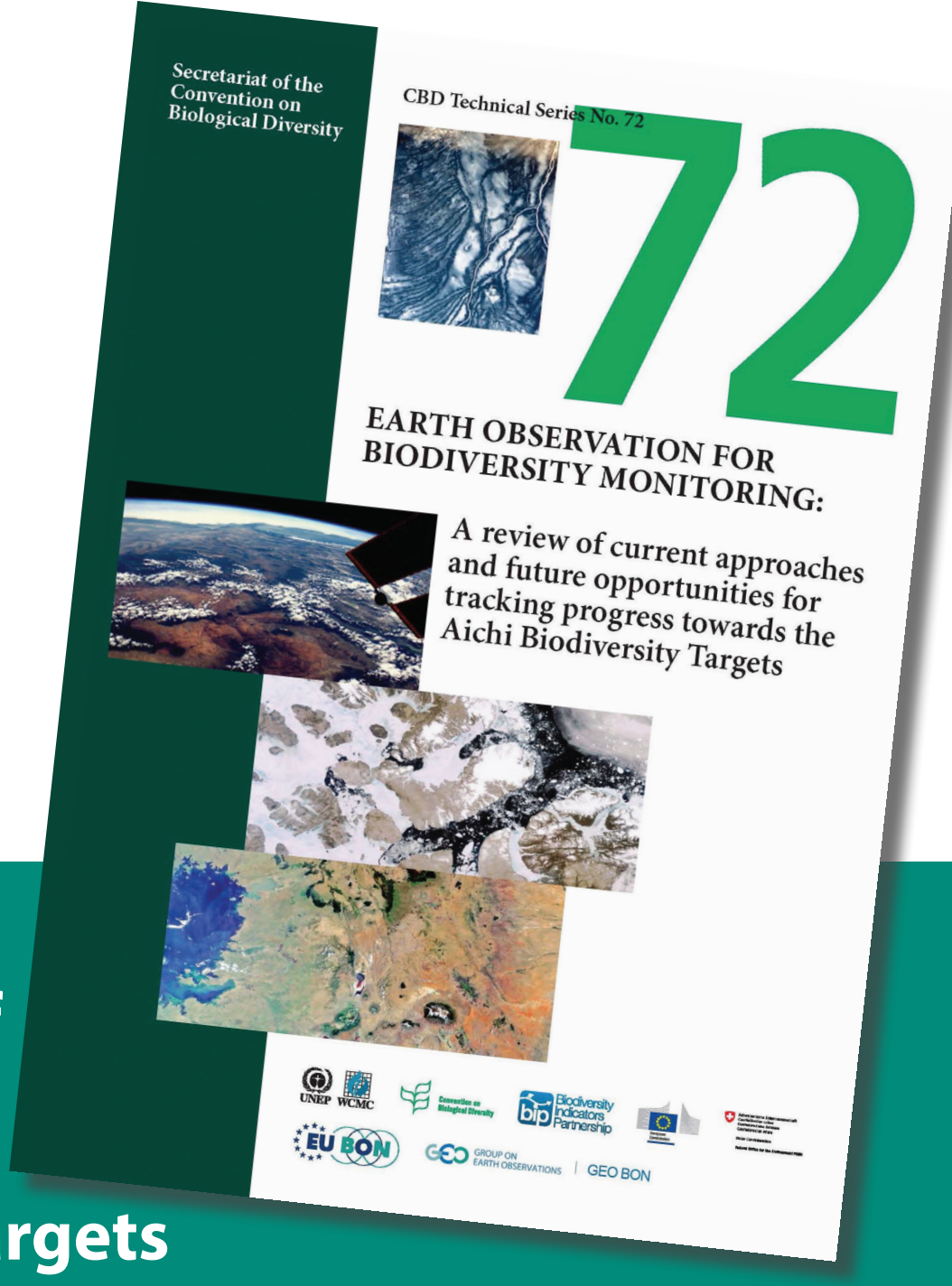
government engagement, (ii) user needs, (iii) product focus, and (iv) visibility and utility. WG9 is a cross-cutting working group within the GEO BON structure, and as such engages with, and draws representation from, each of the other working groups. WG9 also works with relevant organisations and individuals worldwide that are not currently associated with GEO BON. These are encouraged to provide data relevant to indicators or capacity to support improved indicator development at national and regional scales.

"WG 9 incorporates biodiversity information and analyses from GEO BON into indicator-based policy products designed and delivered to meet user needs."

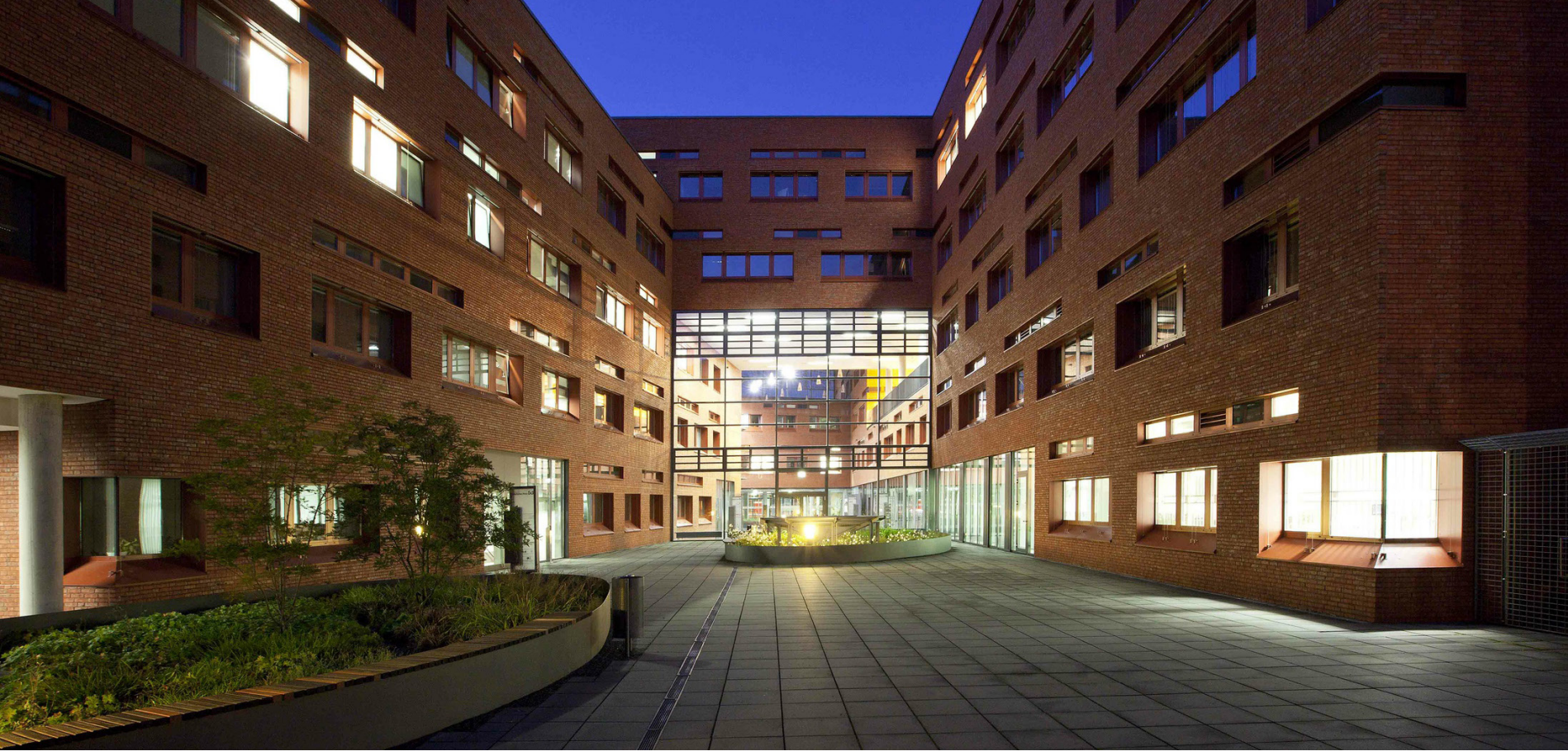


WORKING GROUP 9 PRODUCT:

Review of the use of remote sensing for tracking progress towards the Aichi Targets

The report explores how current and near future remotely sensed Earth observation products could be used to create indicators to track progress towards the Aichi Biodiversity Targets adopted by Parties to the Convention on Biodiversity (CBD). Led by UNEP-WCMC, under the auspices of GEO BON Working Group 9, EU BON and the CBD-mandated Biodiversity Indicators Partnership (BIP), and on the request of the Secretariat of the CBD, the review examined operational Earth observation products as well as those under development.

Find the report at
www.geobon.org/Downloads/reports/2014/cbd-ts-72-en.pdf



5 The GEO BON Secretariat

Thanks to the support GEO BON receives from the German Science Foundation and the German Centre for Integrative Biodiversity Research (iDiv), the GEO BON Secretariat moved from South Africa to Germany in late 2013 along with the selection of Henrique Pereira as the new GEO BON Chair. Starting in March 2014, the GEO BON Secretariat was staffed with Jörg Freyhof (Executive Director), Ariane Korn (Administrative Assistant) and Christian Langer (IT Officer). Miguel Fernandez, a postdoc at iDiv joined the GEO BON core group at iDiv with responsibilities on EBV development. In 2015, Helen Matthey replaced Ariane Korn and Alexandra Marques also joined, funded by the EU H2020 project ECOPOTENTIAL.

"The GEO BON Secretariat moved from South Africa to Germany in late 2013."

Communication and promotion

New Website

The new GEO BON website was launched in summer 2014 and is a big enhancement over the GEO-based site. With fewer constraints it is more up-to-date and complete, but, most importantly, it provides the base upon which the portal for the biodiversity community will grow. The GEO BON website already provides information such as an overview, actual news, an About tab, identification of partners, connections to working groups, news, etc, and to key activities like EBVs and BON in a Box, which are currently under development. It already nicely supports the social networking activities that facilitate interaction among various data providers and users. Already today, the website informs the outside world comprehensively about GEO BON and provides regular updates to the GEO BON community. As GEO BON matures additional information and functions and tools will be added. See the new GEO BON website at

www.geobon.org

Newsletter

GEO BON produces an online newsletter four times a year, starting in April 2014. Since then about 360 GEO BON members are reached by the newsletter and 92 news items have been produced so far. Since the first newsletter was set up, the number of contributions from the GEO BON community has steadily increased from 12 to 25. All newsletters can be found at

www.geobon.org/products/newsletter

Facebook

In October 2014, GEO BON set up a Facebook site to better disseminate its news. Since then almost each week actual news are posted on the site and 260 individuals regularly receive these news. Shared news contributions reach up to 900

New website was launched in April 2015

Visit GEO BON on facebook

www.facebook.com/BiodiversityObservationNetworkGEOBON

people and the audience of the GEO BON Facebook site is continuously growing.

Budget

iDiv supports the GEO BON Secretariat with an annual budget of €135k for personnel costs and €50k running budget. More specifically, iDiv provides the salaries for the Executive Director, the IT Officer and the Administrative Assistants as well as €50k annually for GEO BON's running costs. Furthermore, iDiv offers office space and associated infrastructure, and a considerable part of the working time of the GEO BON chair, Prof. Henrique Pereira.

Travelling and networking

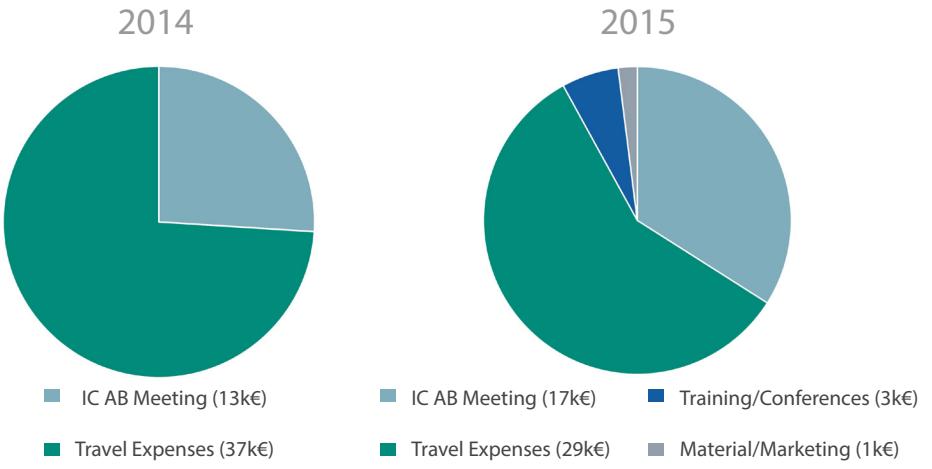
Being present and representing GEO BON at key events and meetings is a major obligation of the GEO BON Secretariat, especially the Executive Director. In 2014, 37k€ and in 2015 29k€ were spent for this activity, which includes representing GEO BON at GEO meetings as well as conferences and plenaries of the CBD and IPBES.

This expenses have been spent as shown in the following:

2014	
IC AB Meeting	13k€
Travel Expenses	37k€
Total	**50k€**

2015	
IC AB Meeting	17k€
Travel Expenses	29k€
Training/Conferences	3k€
Material/Marketing	1k€
Total	**50k€**

DISTRIBUTION OF EXPENSES

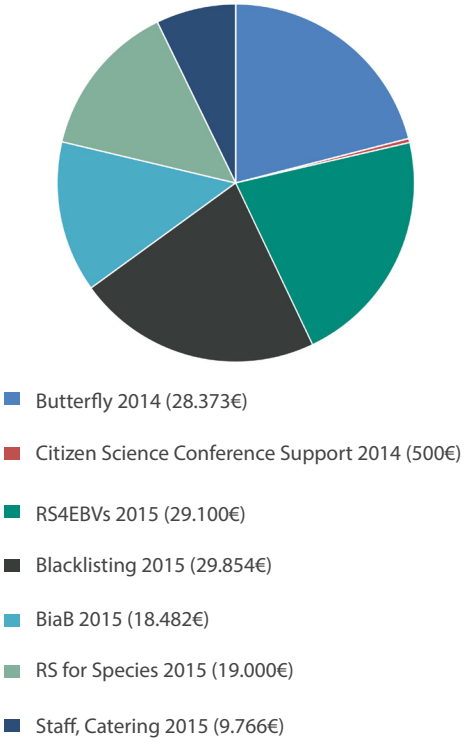


Overall expenses

In 2014 and 2015, GEO BON spent €235k on its activities, which include an amount of €135k that was spent from funds received from NASA through Diversitas. In April 2014, GEO BON announced an open call for small projects to support the developments of EBV's and monitoring guidelines. Twenty-four excellent proposals had been submitted from all over the world asking together for about €1.2 Million. Five proposals were selected:

- Black Listing Invasive Species for Monitoring and Reporting submitted by Monash University (29.854€);
- BON in a Box submitted by the Humboldt Institute (18.482€);
- Developing guidelines for standardised global butterfly monitoring, submitted by UNEP-WCMC and Dutch Butterfly Conservation (28.373€);
- Finalising, visualising and communicating global remote sensing supported species EBVs and change indicators submitted by Yale University (19.000€);
- Remote sensing of Essential Biodiversity Variables submitted by Twente University (29.100k€).

SHARE OF THE NASA BUDGET SPENT IN 2014 AND 2015



In kind support of partners and associated projects.

The annual in-kind contribution of GEO BON partners to progress in GEO BON activities is more than 15 M€ annually. NASA provides in-kind expertise to GEO and GEO BON, including a full time secondment to the GEO Secretariat responsible for GEO BON. NASA is also supporting the marine biodiversity observation network MBON with about 1.86 M USD annually. In addition, Polar Knowledge Canada supports the Vice-Chair position for GEO BON which is equivalent to 34k€ in 2016.

The Global Biodiversity Information Facility (GBIF) provides an in-kind contribution of 10k€ annually and Map of Life (MoL) provides 50k€ annually to GEO BON activities, with over 200k€ dedicated annually to EBV computations. It is difficult to fully estimate the in-kind contribution from all members and partners to GEO BON activities (for example the Berlin Natural History Museum (MfN) provides 2k€ annually, the Center of Ecology and Hydrology (CEH) 6k€ annually and members of GEO BON WG5 spent about 40k€ annually for WG activities). Furthermore, it should be mentioned that the European Space Agency supports the project RS4EBVs with 200 k€ for two years and the European Commission also supports GEO BON indirectly by funding projects which develop Essential Biodiversity Variables and/or contribute actively to GEO BON by a total of 32 M€ (Globis-B: 1 M€, SWOS: 5 M€, Ecopotential: 15 M€, EU-BON: 11 M€).

"In April 2014, GEO BON announced an open call for small projects to support the developments of EBV´s and monitoring guidelines."

6 Major Partner Organisations

Below, we list major GEO BON partner organisations that are deeply engaged in GEO BON activities. These partner organisations provide in-kind funding and support to individuals that represent their organisation in the GEO BON network, as members of the Working Groups or members of the GEO BON Implementation Committee or Advisory Board for details on the governance structure). Some of these organisations have also provided direct funding to GEO BON activities.

"Some of these organisations have also provided direct funding to GEO BON activities."

List of Partners

German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig

iDiv conducts top-level research and looks at major biodiversity questions as well as those of increasing social relevance such as environmental change caused by loss of species and habitat, sustainable development and bio-resource management. iDiv has hosted the GEO BON Secretariat since 2014 and supports GEO BON activities financially as well as by providing space, logistics and scientific support.

US National Aeronautics and Space Administration (NASA)

NASA conducts and sponsors research, collects observations , develops technologies, and extends science and technology education to learners of all ages. NASA has supported GEO BON from the beginning and has provided large amounts of direct funding to GEO BON in support of "All-Hands" meetings, including the GEO BON general assembly and other activities.

United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)

UNEP-WCMC evaluates and highlights the many values of biodiversity and puts authoritative biodiversity knowledge at the centre of decision making.
The UNEP-WCMC Species Database includes data on 75,720 animals and 88,763 plants of conservation interest, as well as 94,034 sub-species, stocks or synonyms, and the World Data Base on Protected Areas (WDPA), maintained by UNEP-WCMC, contains crucial information from governments and organisations intended for ecological gap analysis, environmental impact analysis and private sector decision making.
Two UNEP-WCMC members are present on the GEO BON Implementation Committee and Advisory Board, and UNEP-WCMC provides in-kind support on GEO BON's engagement with indicators, EBVs and remote sensing.

	**Global Biodiversity Information Facility (GBIF)**	GBIF is a global network of data providers that builds biodiversity information infrastructure and promotes the growth of biodiversity information content on the Internet by working with partner initiatives and coordinating activities worldwide. The GBIF Executive Director is a member of the GEO BON Advisory Board and GBIF provides in-kind funding and expertise on several topics, mostly but not limited to those related to data management.
	**ASEAN Centre for Biodiversity (ACB)**	ACB is an intergovernmental, regional centre of excellence that facilitates cooperation among the members of the Association of Southeast Asian Nations (ASEAN) and relevant national governments and regional and international organisations on the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising from the use of such biodiversity. ACB is an active member of the Asia-Pacific Biodiversity Observation Network (AP-BON) of GEO BON. The Director for Biodiversity Information Management of ACB is a member of GEO BON's Advisory Board.
	**United Nations Educational, Scientific and Cultural Organisation's Intergovernmental Oceanographic Commission (IOC-UNESCO)**	IOC-UNESCO is the only body within the UN system with a mandate for Ocean Science, Observations and Services, Data management and Capacity Building in all ocean basins. IOC-UNESCO coordinates the Global Ocean Observing System (GOOS) and runs the Ocean Biogeographic Information System (OBIS) database. OBIS is a global network of regional and thematic nodes integrating over 45 million marine species occurrences and related sampling event data from nearly 500 institutions over a wide range of marine themes, from the poles to the equator, and from microbes to whales. OBIS provides a clearinghouse and data sharing mechanism and provides services and tools for marine biodiversity indicator development and national reporting. The OBIS Project Manager is a member of the GEO BON Marine Ecosystem Change Working Group (WG5) and the GEO BON Data Working Group (WG8), and is provided as an in-kind contribution from the Intergovernmental Oceanographic Commission of UNESCO.
	**Map of Life (MOL)**	MOL is an online resource for mapping, monitoring and analyzing biodiversity worldwide, endorsed by GEO BON. The Map of Life lead is a member of the GEO BON Implementation Committee and Map of Life is assisting in the implementation of some EBVs.
	**Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL)**	SASSCAL is a joint initiative of Angola, Botswana, Namibia, South Africa, Zambia, and Germany, responding to the challenges of global change. SASSCAL is assisting GEO BON with is activities in Southern Africa, and its coordinator is a member of the GEO BON Implementation Committee.

Partnerships are key for us

"GEO BON in partnership with Colombia's Instituto von Humboldt held the first BON in a Box regional workshop in Colombia.

Over 50 participants from Mexico, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia, Brazil convened over 4 days to enthusiastically define the structure and content for this regional toolkit for biodiversity observations."

7 Publications and communication products in the period 2014-15

2014

Han, Xuemei, Regan L. Smyth, Bruce E. Young, Thomas M. Brooks, Alexandra Sanchez de Lozada, Philip Bubb, Stuart H. M. Butchart, et al. 2014. A Biodiversity Indicators Dashboard: Addressing Challenges to Monitoring Progress towards the Aichi Biodiversity Targets Using Disaggregated Global Data. PLoS ONE. 9 (11): e112046

Hoffmann A, Penner J, Vohland K, Cramer W, Doubleday R, Henle K, Kıljalg U, K¸hn I, Kunin WE, Negro JJ, Penev L, RodrÌguez C, Saarenmaa H, Schmeller DS, Stoev P, Sutherland WJ, Tuama EO, Wetzel F, Häuser CL (2014) Improved access to integrated biodiversity data for science, practice, and policy - the European Biodiversity Observation Network (EU BON). Nature Conservation 6: 49ñ65. doi: 10.3897/natureconservation.6.6498

Kissling, W. Daniel, Alex Hardisty, Enrique Alonso Garcia, Monica Santamaria, Francesca De Leo, Graziano Pesole, Jörg Freyhof, et al. 2015. Towards global interoperability for supporting biodiversity research on essential biodiversity variables (EBVs). Biodiversity. 1-9

Pettorelli N, K Safi, and W Turner. 2014. Satellite remote sensing, biodiversity research and conservation of the future. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences. 369 (1643)

Pettorelli, Nathalie, Harini Nagendra, Rob Williams, Duccio Rocchini, and Erica Fleishman. 2014. A new platform to support research at the interface of remote sensing, ecology and conservation. Remote Sensing in Ecology and Conservation

Pettorelli, Nathalie, William F. Laurance, Timothy G. O'Brien, Martin Wegmann, Harini Nagendra, Woody Turner, and E.J. Milner-Gulland. 2014. Satellite remote sensing for applied ecologists: opportunities and challenges. Journal of Applied Ecology. 51 (4): 839-848

Schmeller, D.S., R. Julliard, P.J. Bellingham, M. Bohm, N. Brummitt, A. Chiarucci, D. Couvet, et al. 2015. Towards a global terrestrial species monitoring program. Journal for Nature Conservation. 25: 51-57

2015

Geijzendorffer, Ilse R., Eugenie C. Regan, Henrique M. Pereira, Lluis Brotons, Neil Brummitt, Yoni Gavish, Peter Haase, et al. 2015. Bridging the gap between biodiversity data and policy reporting needs: An Essential Biodiversity Variables perspective. Journal of Applied Ecology

Laity, Tania, Shawn W. Laffan, Carlos E. Gonzalez-Orozco, Daniel P. Faith, Dan F. Rosauer, Margaret Byrne, Joseph T. Miller, et al. 2015. Phylodiversity to inform conservation policy: An Australian example. Science of The Total Environment. 534 (3): 131-143

Ma, Keping. 2015. Biodiversity monitoring in China: from CForBio to Sino BON. Biodiversity Science. 23 (1): 1-2

McGeoch,, Melodie A., Guillaume Latombe. 2015. Characterizing common and range expanding species. Journal of Biogeography, DOI: 10.1111/jbi.12642

O'Connor, Brian, Cristina Secades, Johannes Penner, Ruth Sonnenschein, Andrew Skidmore, Neil D. Burgess, and Jon M. Hutton. 2015. Earth observation as a tool for tracking progress towards the Aichi Biodiversity Targets. Remote Sensing in Ecology and Conservation

Skidmore, Andrew K., Nathalie Pettorelli, Nicholas C. Coops, Gary N. Geller, and Matthew Hansen. 2015. Environmental science: Agree on biodiversity metrics to track from space. Nature. 523 (7561): 403-405

Turner, Woody, Carlo Rondinini,; Nathalie Pettorelli,; Brice Mora,; Allison K. Leidner, Zoltan Szantoi,; Graeme Buchanan,; Stefan Dech,; John Dwyer,; Martin Herold,; Lian P. Koh, Peter Leimgruber,; Hannes Taubenboeck,; Martin Wegmann,; Martin Wikelski,; Curtis Woodcock. 2015. Free and open-access satellite data are key to biodiversity conservation. Biological Conservation. 182: 173-176

Vihervaara, Petteri, Laura Mononen, Ari-Pekka Auvinen, Raimo Virkkala, Yihe Lü, Inka Pippuri, Petteri Packalen, Ruben Valbuena, and Jari Valkama. 2015. How to integrate remotely sensed data and biodiversity for ecosystem assessments at landscape scale. Landscape Ecology. 30 (3): 501-516

Wetzel, Florian T., Hannu Saarenmaa, Eugenie Regan, Corinne S. Martin, Patricia Mergen, Larissa Smirnova, Eamonn Tuama, et al. 2015. The roles and contributions of Biodiversity Observation Networks (BONs) in better tracking progress to 2020 biodiversity targets: a European case study. Biodiversity. 1-13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2016 GEO BON OPEN SCIENCE CONFERENCE

Biodiversity and Ecosystem Services Monitoring for the 2020 Targets and beyond

Biodiversity Science is facing enormous challenges as the pressures upon Earth's biotic systems are rapidly intensifying, and we are unlikely to reach the CBD 2020 Aichi Targets. But how far or close are we to reach those targets?

The GEO BON Open Science Conference on "*Biodiversity and Ecosystem Services Monitoring for the 2020 Targets and beyond*" will address this question. The conference is open to the wide scientific public and is sponsored and co-organised by iDiv, UFZ, SASSCAL, OBIS and GOOS.

The conference will foster scientifically sound biodiversity monitoring by in-situ and remote sensing methodologies, monitoring of ecosystem services, modeling of biodiversity at all scales and in all dimensions and especially encourage interdisciplinary research. It will show ways forward in biodiversity observation and the development of Essential Biodiversity Variables. The conference will accept submissions of abstracts on any biodiversity monitoring topic, but will prioritise talks associated with the development of monitoring for Essential Biodiversity Variables.

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