The Marine Biodiversity Observation Network (MBON) Implementation Plan

Executive Summary

Governments and scientists around the world have recognized the need for information to evaluate changes in biodiversity. For example, to evaluate progress toward the U.N. Sustainable Development Goals (including SDG 14), Aichi Targets of the Convention on Biological Diversity (CBD), global assessments such as those by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), and the UN World Ocean Assessment. These include changes in the abundance of living resources, species' of ecological and conservation importance, and invasive species, from the coast to deep-sea.

To address this need for information, the Marine Biodiversity Observation Network (MBON) was established within the Group on Earth Observations (GEO) Biodiversity Observation Network (GEO BON). The goal of MBON is to develop a global community of practice for the collection, curation, analysis and communication of marine biodiversity data. This requires coordination and collaboration between countries, organisations and individuals involved in the Group on Earth Observations (GEO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, and many other organisations.

In 2016, an MBON interim Steering Committee is drafting this Implementation Plan, building membership and opportunities to develop international and thematic (e.g. coral reef) marine observation networks. It is collaborating with the Global Ocean Observing System (GOOS) of IOC to develop standardised minimum metrics of marine biodiversity as part of the Essential Biodiversity Variables (EBVs) of GEO BON and Essential Ocean Variables (EOVs) proposed by GOOS. MBON emphasizes objective knowledge of changes in marine life and ecology, and promotes the integration of regional datasets through systems such as the Ocean Biogeographic Information System (OBIS). Thus MBON is working with OBIS which is developing standards for data management and publication that enable integration and analysis of marine biodiversity data.

During 2017, MBON will have sufficient membership to formalise its governance and establish an International Secretariat by 2018. The MBON vision and strategy, and proposals on marine EBV and EOV, will be published for independent peer-review and community engagement.

During 2017 and 2018, examples of international and thematic MBON will be demonstrated, including applications of EBV to show spatial and temporal trends in marine biodiversity. These will continue to be supported by research and development of field and laboratory methods, data management protocols, and products useful in marine biodiversity research, education and policy.

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Scope

In accordance with the Convention on Biological Diversity (CBD), biodiversity is here defined as the variety of life at the within species, between species, and ecosystem levels. It includes the number of species, the abundance and biomass of organisms, the diverse interactions between organisms and the environment, and the variability and change of the habitat. Geographically, MBON will focus on international collaboration to achieve worldwide activity.

Vision

The vision of MBON is a community of practice that strengthens understanding of marine biodiversity and coordinates monitoring of associated changes over time through scientific observations, thereby facilitating ecosystem conservation, sustainability, and good management practices.

Background

A growing human population depends on healthy ocean ecosystems for a number of important economic and social benefits, including high quality food, pharmaceuticals and other materials, coastal protection, recreation, transportation, and renewable energy. Changes in ocean biodiversity threaten these benefits. These changes are driven both by natural variability and direct and indirect human impacts on the ocean. Governments and researchers worldwide have recognized the need for information to evaluate, respond and adapt to these changes in national plans and in a number of international treaties including the CBD, the U.N. Sustainable Development Goals (especially SDG 14 on oceans), the United Nations Law of the Sea (UNCLOS), and Ramsar Convention on wetlands. For example, SDG 14 provides 10 Targets, 6 of which are tied to biodiversity and ecosystems. Despite this recognition of its importance, sampling of marine biodiversity has been largely neglected in regular ocean observing programs due the complexity of its measurement. To address this need, the marine ecosystem Working Group 5 of GEO BON established an MBON task group in 2015, and formally proposed establishment of MBON to GEO BON in 2016.

MBON will build a community of practice by linking existing national and international research and monitoring efforts. It provides the marine biodiversity component of GEO (through GEO BON). MBON will work with the international community to promote the operational collection of biodiversity observations, working with the Global Ocean Observing System (GOOS) and other field sampling programmes ensure that biodiversity observations are complemented with physical and biogeochemical observations of the ocean and vice-versa.

Membership

MBON is a network rather than a legally-incorporated structure or organization. As a community of practice and collaboration, groups can engage in relatively informal or formal agreements. MBON is a "coalition of the willing" who agree to share knowledge and know-how to evaluate changes of biodiversity in the ocean, including data, products, protocols and methods, data systems and software.

MBON members are anticipated to include government agencies, academic institutions, researchers, research and non-governmental organizations, and commercial organisations. During its initial phase its membership will be grown and a governance structure established. Membership will be recognized on public documents such as websites.

Role of GEO BON

GEO BON is committed to reviewing and endorsing the work to implement and sustain the MBON, helping with dissemination of products, and facilitating collaboration and cooperation with relevant

initiatives and with other GEO groups. The process of coordinating membership and reporting on the activities of the members of MBON will be a key aspect of the MBON leadership, through networking, communication efforts, and other facilitation services.

Approach

Implementation of MBON will be achieved by:

1. establishing a steering group and identifying leadership for specific activities; including networking with the biodiversity and marine science communities, including within GEO, GEO BON, IOC, IABO, marine station networks, and national organizations;
2. developing a common framework for Essential Biodiversity Variables (EBVs) within GEO BON and GOOS Essential Ocean Variables (EOVs, developed jointly with the GOOS Bio-Eco panel);
3. Fostering the development of international and thematic MBON.
4. promoting best practice in data management, including development of standards that aid interoperability and data integration, and publication of data through OBIS; including contributing to the GEO BON "BON in a Box" compendium of methodologies for biodiversity observations;
5. Supporting research that supports the development of MBON.

1. Management

The Steering Committee (SC) (Table 1) will develop and update this Plan. Once sufficient membership has been established a more formal governance structure will be established. The initial SC is supported by people participating in GEO BON Working Groups, Task forces and related GEO initiatives (Table 2). The SC will continue to find people willing to communicate between MBON and related initiatives in GEO BON (Table 2), regional MBON such as in the America's (Appendix Table A1 and externally (Table 3, Appendix Table A2).

In addition to expanding the MBON membership through personal contacts and networking, the SC will communicate its plans through the GEO BON website, MBON email list, presentations at meetings, and publications. For example, the 4th World Conference on Marine Biodiversity (Montreal, 21-24 May 2018) is a key opportunity to network with the world marine biodiversity science community. The SC will report progress to GEO BON. A timetable is outlined in Table 4.

2. Developing EBVs

MBON will follow guidelines of the Framework for Ocean Observing (FOO), working with GOOS to develop a common framework for biodiversity and biological EOVs. The GOOS Bio-Eco panel has identified EOVs for ocean biology based on a Drivers-Pressures-State-Impact-Response process that include the societal and scientific requirements of national programs, international treaties, and the scientific community. MBON facilitates the development of a common framework for EBV and EOV, informing GOOS on the integration of marine biodiversity observations within environmental variables.

Working within this framework facilitates adoption of the biodiversity EOVs in existing international ocean observing systems and regional alliances that constitute GOOS. In developing the network, MBON also recognizes the important linkages between coastal habitats and the deep ocean as an environmental continuum within which many different species live, migrate, and reproduce. Therefore, the MBON network will link communities, including for example the GEO-Wetlands initiative, with the marine community.

3. International and thematic MBON

MBON has initiated the development of an America's Pole to Pole BON. Participants represent geographic regions (south, central, north, Caribbean) and functional roles (governance of GEO, observation systems, data analysis, data curation, capacity building, outreach, etc.) (Table A1). The

expansion of marineGEO internationally is underway, and options for the development of a European MBON, perhaps including Africa, are being explored. MBON is engaged with the Global Coral Reef Monitoring Network (GCRMN) which aims to become a coral reef MBON.

4. Data management

OBIS is the world's premier open access, online data system on the diversity, distribution and abundance of marine species. At present, more than 20 OBIS nodes around the world connect 600 institutions from 56 countries. Collectively, they have provided over 47 million observations of nearly 120,000 marine species, from bacteria to whales, from the surface to 10,900 m depth, and from the tropics to the poles. The datasets are integrated and allow search and mapping by species name or any higher taxonomic level, geographic area, depth, time and environmental parameters. OBIS provides a powerful platform through which to share and archive relevant historical observations. MBON will encourage publication of data through OBIS and its continued development.

5. Research to support MBON

MBON participants are engaged in research and product development that supports the implementation of MBON. This includes development of EBV, EOV, field and laboratory methods, and delivery of data, publications and related products. The GEO BON 'BON in a Box' will be used to disseminate such material and facilitate the integration of regional knowledge and observations.

The SC will provide endorsement of research funding proposals that will contribute and commit to report progress to MBON. This will support researchers' applications for national funding in countries that are GEO members.

Challenges

The following challenges have been identified.

1. Commitment from individual scientists to drive MBON forward.
2. Funding for coordination through a secretariat:
   (a) The secretariat will need to be a flexible entity, but the MBON activities and the various related GEO BON efforts will require engagement of many people.
   (b) At least one executive secretary and one program assistant are needed to coordinate the MBON and to facilitate organizing teleconferences, reporting, and communications in general, other tasks listed in this document, and coordinate among partners and members. MBON will invite people and institutions to support this.
   (c) In addition, preferably as part of OBIS, a full-time data coordinator will be needed to support the implementation of data management practices, provide training and help-desk functions and also support the end-users in the acquisition of data and information from OBIS. A part-time IT developer is needed to develop and maintain the MBON data portal.
3. Sponsorship for international meetings for network coordination and collaboration, especially for developing countries and when national funding limits international travel.
4. Commitment from organisations and institutes to build MBON. These will include long-term funding commitments for staff time or secondments, observations, computational infrastructure, and development of existing or new MBON elements. This will require careful and energetic coordination.
5. Resources to generate useful products: It is envisaged that MBON members, as did its predecessor 'marine ecosystems Working Group 5' of GEO BON, will deliver products demonstrating methods, applications and policy implications of an international MBON.

Table 1. MBON Steering Committee.

Individual	Affiliation	Representation (role)
Frank Muller-Karger	University of South Florida, USA	Americas (Co-chair)
Mark Costello	University of Auckland, New Zealand	Asia and Pacific (Co-chair)
Isabel Souza Pinto	University of Porto, Portugal	Europe and Africa (Co-chair)
David Obura	CORDIO East Africa, Kenya	Global Coral Reef Monitoring Network (GCRMN)
Emmett Duffy	Smithsonian Institution, USA	marineGEO (Tennebaum Marine Observatories)
Amanda Bates	University of Southampton, UK	Time series data
Gabrielle Canonico	NOAA, Silver Springs, USA	US IOOS
Ward Appeltans	Intergovernmental Oceanographic Commission	OBIS
Patricia Miloslavich	?????	GOOS Bio-Eco
Enrique Montes	University of South Florida, USA	Pole to Pole in Americas?
Catherine (CJ) Reynolds	International Ocean Institute, Florida, USA	MBON webpages

Table 2. Roles of individual members of MBON within GEO BON.

	Notes	Representatives
Working Groups		
Species Populations	Species distribution, population abundance, and population structure candidate EBVs.	Brian Helmuth
Ecosystem Structure	Habitat and biodiversity mapping, including remote sensing	Zeenatul Basher Frank Muller-Karger Roger Sayre?
Ecosystem Functioning	Ecosystem function and processes including primary productivity, disturbance regime	Corinne Martin Maria Kavanaugh
Ecosystem Services	Monitoring of ecosystem services	Pat Halpin, Isabel Sousa Pinto
Task forces		
EBV framework	conceptual framework for EBV development and a strategy for refinement	Mark Costello
Data portal & standards		Ward Appeltans Zeenatul Basher
Policy & Indicators		Lauren Weatherdon
Funding		?
BON Development	Development national, regional and thematic BON	Frank Muller-Karger
	Asia Pacific (AP)	Mark Costello
	Arctic BON	?
	Colombia	Diana Gomez
	Freshwater BON (FBON)	?
	Europe, France BON– ECOSCOPE	Isabel Sousa Pinto
GEO-Wetlands		Adrian Strauch
Blue Planet	POGO	Sophie Seeyave
BON in a Box		?

Table 3. Additional MBON participants and their role in MBON networking and reporting.

Individual	Affiliation	Role
Amanda Bates	University of Southampton, UK	Time series data, deep-sea vents
Lauren Weatherdon	WCMC, Cambridge, UK	Conservation Policy
Brian Helmuth	Northeastern University, USA	Intertidal monitoring
Corinne Martin	WCMC, Cambridge, UK	Indicators for conservation
Healy Hamilton	NatureServe, USA	?
Gray Williams	University of Hong Kong	INSHORE www.rockyinshore.org
Yunwei Dong	Xiamen University, China	INSHORE network
Francisco Chavez	MBARI, Monterray, Ca, USA	USA MBON project
Nicholas Hoepffner	JRC Italy	?
Willie Wilson	Sir Alistar Hardy Foundation of Ocean Sciences (SAHFOS), Plymouth, UK	Continuous Plankton Recorder Global Ecological Assessment
Simon Claus	VLIZ, Belgium	Marineregions.org
Peter Miller	Plymouth Marine Laboratory, UK	Remote sensing for modelling marine species distributions'
Maria Baker	University of Southampton	Deep-sea community
Katsu Fujikura	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Time-series studies in Japan

Table 4. Timetable for MBON. WCMB = World Conference Marine Biodiversity (Montreal).

Activities	2016	2017	2018	2019	2020+
Management	Finalise MBON implementation plan Form MBON Steering Committee	Publish MBON vision paper Establish MBON Secretariat	Formalise MBON network (membership, governance)		Operational network of observatories monitoring trends in marine biodiversity from local to global scales
Networking	Pilot MBON in USA	Build MBON network	EuroMBON WCMB IV		
Demonstrations		Pole to Pole in Americas Smithsonian's MarineGEO	MBON portal operational, providing the first products	GOOS conference OceanObs2019	
EBV and EOV development	GOOS BioEco propose EOV	Publication comprehensive marine EBV as part of EOV	Demonstration of EBV and EOV	Continued development methods and EBV with new research and technologies	

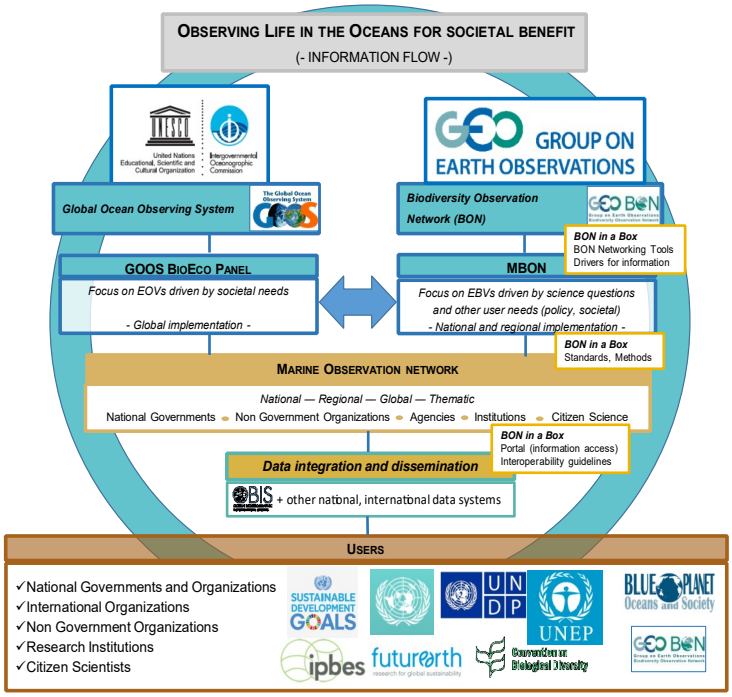

Figure 1. The marine Biodiversity Observation Network (MBON) is an international collaboration to collect and publish data on marine life for use in national and international research and policy. This diagram illustrates the roles of two intergovernmental organisations, the Intergovernmental Oceanographic Commission (IOC) and Group on Earth Observations (GEO) in planning MBON. MBON membership is open to a wide range of science organisations and will deliver information to a wide range of national and international organisations, including conventions.

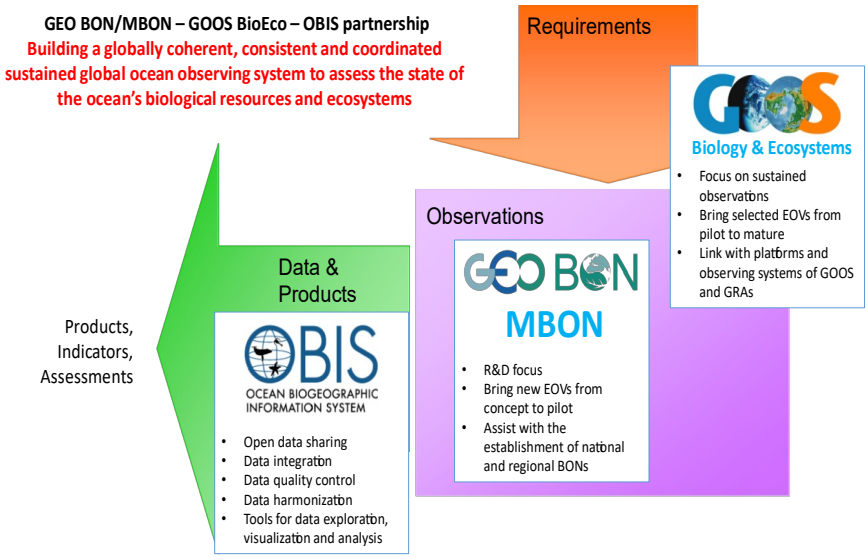

Figure 2. Illustration of how MBON, while established within GEO BON, includes activities of the Intergovernmental Oceanographic Commission (OBIS and GOOS), members of these groups, and contributors and users of ocean biodiversity information. Overlapping squares symbolize an intersection of activities. For example, MBON participates in the GOOS Bio-Eco Panel, helping to define Essential Biodiversity Variables (EBVs) which would be entrained in the definition of practical Essential Ocean Variables (EOVs).

Appendix

Table A1. Current members of the initiative for a Pole to Pole MBON in the Americas. Members of other MBON projects may also be listed on the MBON web pages in due course.
(NOTE: Need to complete affiliations and representation or role)

Individual	Affiliation	Representation	Role
Jorge Cortes	Universidad de Costa Rica	CARICOMP	Vice-chair
Arturo Izurieta	Charles Darwin Foundation, Galapagos, Ecuador		Vice-chair
Sergio Cerdeira	CONABIO, Mexico		Vice-chair
Marisol Rueda	Healthy Reefs Initiative, Mexico		
Peter Lawton	DFO, Canada		
Eduardo Klein	Venezuela	OBIS	
Maria Murray		marineGEO	
Antonio C. Marques	U Sao Paulo, Brazil	OBIS	
Pablo Penchaszadeh	Argentina		
Mark Schrader	Team Americas / Project Ocean Watch		Outreach
Enrique Montes	University of South Florida, USA	MBON USA	
Jorge Pierini	Centro Científico y Tecnológico de Bahía Blanca (IADO-Conicet-UNS, Argentina		

Table A2. Organizations of interest for collaboration or support for MBON. Suggestions of additional organisations are welcomed.

Collaborator	Relationship
Arctic Council, SCAR	Support participation of their members in MBON
ATLANTOS	Facilitate the development of biodiversity observations integrated in Marine Observation Programs being developed at the Atlantic level by AtlantOS
European Commission, NOAA, NASA, CSIRO, DFO	Support local institutes to participate in MBON through endorsement, direct funding and in-kind support.
Future Earth	Communication to ensure synergy of effort regarding marine biodiversity science and policy
GCRMN	Strengthening development biodiversity EOV, data publication and data use within coral reef scientific community
GEO-Wetlands	GEO-Wetlands supports the Ramsar Convention, which includes coastal areas up to 6 m in depth. Cooperation with GEO-Wetlands can produce mutual benefits specifically in the production and exchange of mangrove and coral reef related information and knowledge.
Global CPR	Support expansion CPR and integration CPR observations with other biodiversity variables
Global Ocean Acidification Observing Network (GOA-ON)	A collaborative international approach to document the status and progress of ocean acidification in open-ocean, coastal, and estuarine environments, to understand the drivers and impacts of ocean acidification on marine ecosystems, and to provide spatially and temporally resolved biogeochemical data necessary to optimize modeling for ocean acidification.
GOOS BioEco	Incorporate biodiversity within EOV framework, and related GOOS regional and deep-sea programmes, including EurGOOS, EOOS, Deep-sea OOS,
ICES, PICES, CIESM, FAO, NEAFC, fisheries	Have fishery monitoring data include biodiversity EoV and publish data into OBIS.
IPBES	Communication the Intergovernmental Platform on Biodiversity and Ecosystem Services will aim to ensure synergy of effort regarding marine biodiversity science and policy
JPI Oceans	Support development MBON in Europe
MarineGEO	Coastal benthic ecosystem observations in accordance with EBVs and EOVs, coordination and promotion of MBON with MarineGEO partners, potentially outreach via Smithsonian's education avenues
OBIS	Facilitate publication of data through OBIS and advising how OBIS can be more ready-to-use for a wider range of non-specialist scientists
POGO, Blue Planet	Support capacity building and understanding of MBON internationally
SCOR and affiliated research programmes	Support capacity building in developing countries and understanding of MBON internationally, and communicating with programmes such as the Integrated Marine Biogeochemistry and Ecosystem Research program (IMBER)
WAMS, NAML, MARS and EUROMARINE	Facilitate the coordination of monitoring already on-going in many marine stations and filling the gaps in those observations, including starting new programs or in new stations.
INDEEP, DOSI, DOOS	Ensure deep-sea community is part of MBON and encourage development of long-term deep-sea observatories.

Table A1. Other GEO, GEO BON Working Group, Task Force, and BON leads.

Other GEO Initiatives		
Blue Planet	Sophie Seeyave	(ssve@pml.ac.uk)
GEO-Wetlands	Adrian Strauch	(astrauch@uni-bonn.de)
Other BON leads		
France BON – ECOSCOPE:	Aurélie Delavaud	(aurelie.delavaud@fondationbiodiversite.fr)
Colombia:	Maria Cecilia Londoño	(mlondono@humboldt.org.co)
Arctic BON:	Tom Christensen	(toch@bios.au.dk)
Asia Pacific (AP):	Tetsukazu Yahara	(tet.yahara@gmail.com)
Freshwater BON:	Eren Turak	(Eren.Turak@environment.nsw.gov.au)
Other GEO BON Working Group Leads		
Ecosystem Structure	Matt Hansen	(mhansen@umd.edu)
	and Andrew Skidmore	(a.k.skidmore@utwente.nl)
Ecosystem Functioning	Nathalie Pettorelli	(Nathalie.Pettorelli@IOZ.AC.UK)
Ecosystem Services	Patricia Balvanera	(pbalvanera@cieco.unam.mx)
	and Tuyeni Mwampamba	
Species populations	Walter Jetz	(walter.jetz@yale.edu)
	and Melodie McGeoch	(melodie.mcgeoch@monash.edu)
BON Development	Maria Cecilia Londoño	(mlondono@humboldt.org.co)
	and Mike Gill	(mike.gill@polar.gc.ca)
Taskforce leads:		
Data portal and standards	Miguel Fernandez	(miguel.fernandez@idiv.de)
EBV Development	Henrique Pereira	(hpereira@idiv.de)
Policy and Indicators	Laetitia Navarro	(laetitia.navarro@idiv.de)
Funding	Mike Gill	(mike.gill@polar.gc.ca)