EMODnet

European Marine Observation and Data Network

EMODnet Biology

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EMODnet Phase IV

D4.4: “Launch” of the European MBON node

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1 Introduction

1.1 Background

More than 36,000 known species of marine plants and animals are found in Europe. Understanding their geographic distribution, abundance and seasonal, annual, or decadal variation is key to detecting changes in marine ecosystems and for assessing ecosystem health. It has been long acknowledged amongst the scientific community that long term monitoring (or time series data) of individual species populations is essential for observing and understanding trends over time that may be due to natural causes or human activities. For example, monitoring allows for determining whether a species is in decline, whether management action or new policies are needed, and whether specific actions have or have not resulted in the restoration and recovery of biodiversity.

The Group on Earth Observations Biodiversity Observation Network (GEO BON) is a global initiative that was established to improve the acquisition, coordination and delivery of biodiversity observations and related services to users at international, regional, national, and local levels. The Marine Biodiversity Observation Network (MBON) is the marine thematic component of GEO BON dedicated to standardising and linking existing national and international efforts on marine biodiversity research, monitoring, and data management. Its overall aim is to facilitate the development of a common framework to monitor and understand how and why life in the ocean is changing.

Members of MBON 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. They are committed to developing, implementing, and sharing information on Essential Ocean Variables (EOVs) of the Global Ocean Observing System (GOOS) to facilitate formulation and production of the Essential Biodiversity Variables (EBVs) of GEO BON. EOVs help measure and interpret the connection between the ocean and elements such as the atmosphere, biosphere, hydrosphere, cryosphere, and anthroposphere. For example, they allow for delivery of ocean forecasts, early warnings, and climate projections. EBVs are a more recent concept that are still under development and were introduced to advance the collection, sharing, and use of biodiversity information.

At the regional level, MBON has so far established nodes in the USA (US MBON) and Asia-Pacific (AP MBON). With a gap in Europe to be filled, the Biology component of European Marine Observation and Data Network (EMODnet Biology), established in 2009 by Directorate-General for Maritime Affairs and Fisheries (DG MARE), was well positioned to take a lead role in establishing a European level MBON. EMODnet Biology is a network of organisations across Europe that is dedicated to providing free access to interoperable data on temporal and spatial distribution of marine species (angiosperms, benthos, birds, fish, macroalgae, mammals, phytoplankton, reptiles, zooplankton) and species traits from European regional seas, as defined by the European Environment Agency (EEA) Europe's Seas' dataset (Arctic Ocean, (North) Atlantic Ocean, Baltic Sea, Black Sea, Mediterranean Sea and North Sea). EMODnet Biology is supported by the EU's integrated maritime policy that works together to observe the sea, process the data according to international standards and make that information freely available as interoperable data layers and data products.

During its fourth phase, EMODnet Biology was tasked with laying out initial plans for the "Launch" of a European MBON node (D4.4). However, EuroMarine, another EU based network of marine organisations and research

institutes, launched a parallel initiative during this time. EuroMarine is currently at an advanced stage of early planning the development of an MBON in Europe (Table 1).

Table 1: EuroMarine's timeline and expected outcomes for the establishment of an MBON in Europe

Expected Date	Expected Outcome
2023 March	Formal recognition of MBON Europe as representative of MBON in Europe by the GEO BON MBON Steering Committee
2023 June	20 MoU signed (17 co-proposers plus new members)
2023 June	MBON Europe is recognised as an Action within the Ocean Decade programme MarineLife2030
2023 December	Online map indicating marine biodiversity monitoring in European seas
2024 March	Paper synthesising marine biodiversity monitoring in European seas by EuroMarine members
2024 March	Increase in number of marine biodiversity time-series data published online from EuroMarine members (e.g., in EMODnet, EurOBIS, OBIS, GBIF)

With this recent development and to avoid duplication of effort, EMODnet Biology is no longer pursuing the "Launch" of a European MBON node (D4.4). In lieu of this, EMODnet Biology has prepared this scoping report to offer a general overview of biodiversity monitoring in Europe and explore ways in which it could pivot its role and support the development, coordination, and implementation of an MBON in Europe, for example, in terms of data management, data publication and adoption of appropriate field sampling and laboratory analysis standards.

1.2 Value of establishing a regional MBON in Europe

Marine data collection, storage and sharing in Europe has been carried out in a fragmented way for many years. Data is often collected for a specific purpose, to meet the needs of single private and/or public organisations, often working in isolation from each other. Collection often consists of single short-term efforts that are not continued, therefore losing the possibility to monitor long term trends over time. Although effort has been targeted at mainstreaming biodiversity monitoring across Europe, the current landscape is still largely disconnected.

An MBON in Europe would serve as a permanent framework to support a more coordinated biodiversity monitoring activity in Europe and hereby contribute to a sustained, coordinated, global ocean system of marine biological and ecosystem observations as part of a comprehensive global ocean observing system. Adopting such a framework would help ensure that monitoring is a standardised regular activity of organisations across Europe.

Some of the common challenges in monitoring that an MBON in Europe would help address include:

- ✔ Lack of institutional commitment
- ✔ Short term efforts
- ✔ Limited comparability of results
- ✔ Differences in field and laboratory methodologies

- ✔ Limited interoperability of data
- ✔ Lack of common standards
- ✔ Old data sets not yet converted to digital format
- ✔ Culture of not publishing data

At the European level, a European MBON aligns with and contributes to many different regional priorities:

- ✔ Horizon Europe and Biodiversa+ Programmes
- ✔ EU Biodiversity Strategy for 2030 target of protecting 30% of EU land and sea by 2030
- ✔ Mission Ocean, Restore our Ocean and Waters by 2030, Objective 1: Protect and Restore Ecosystems and Biodiversity
- ✔ European Atlas of the Seas
- ✔ European Digital Twin of the Ocean (European DTO)
- ✔ EU Policies: Marine Strategy Framework Directive (MSFD), The Habitats Directive, Nature Restoration Law
- ✔ EU Green Deal

At the global level, a European MBON aligns with and contributes to:

- ✔ Group on Earth Observations Biodiversity Observation Network (GEO BON) and its global Marine Biodiversity Observation Network (MBON).
- ✔ MarineLife 2030 vision to "Transform observation and forecasting of marine life for the benefit of all people".
- ✔ OBIS 2030 vision to provide the biodiversity data hub made up of standardised, quality controlled and managed data to create information tailored for decision makers to help them protect and restore marine ecosystems and protect life in the ocean.
- ✔ Monitoring progress towards global environmental frameworks (targets and indicators) like the UN Sustainable Development Goals (especially SDG 14) and Global Biodiversity Framework of the Convention on Biological Diversity.
- ✔ UN Decade of Ocean Science for Sustainable Development (Ocean Decade)
- ✔ UN Decade on Ecosystem Restoration
- ✔ Assessments of the Intergovernmental Platform in Biodiversity and Ecosystems Services (IPBES) and Intergovernmental Panel on Climate change (IPCC)
- ✔ Activities related to the conservation and sustainable use of biological diversity in areas beyond national jurisdiction (BBNJ)
- ✔ Relevant national and private sector requirements.

1.3 General overview of the EuroMarine led MBON in Europe

MBON Europe is constituted as a Long-Term Scientific Working Group in EuroMarine, chaired by Prof Mark Costello, Nord University for three years. As it grows, its governance would accordingly evolve, for example, with a Steering Committee (SC) and perhaps sub-groups dealing with particular methods in field sampling or laboratory analysis. As a permanent, legally established, marine science association established to provide continuity between research projects in Europe, EuroMarine provides a natural home for networking activities such as MBON.

The global MBON implementation plan indicates that MBON globally is a community of practice that is open, and welcomes and serves members of the scientific community, policymakers, civil society, NGOs, and other stakeholders. While the current MBON Europe MoU appears to be limited to organisations that are EuroMarine members (Annex 1), i.e., academic or research institutes, companies or societies, that are active in marine sciences (Full members), this is not a requirement and non EuroMarine members are welcome (Costello, pers. comm.). Signatories may modify the text of the MoU as long as the three pillars, or following three expected tasks that signatories must agree with to join and contribute data to MBON Europe, are retained (Costello, pers. comm.), namely:

1. Our organisation will collect data on marine biodiversity on at least an annual basis;
2. Our sampling or observation methods will be standardised to aid comparability of data over the years, and may be adjusted to aid comparability with datasets internationally; and,
3. Our data will be published into the Ocean Biodiversity Information System (OBIS) as one or more datasets each year.

1.4 Key Objectives of the EuroMarine led MBON in Europe

The following are some of the key objectives of the EuroMarine led MBON in Europe:

- ✔ Establish long-term institutional commitment to monitoring biodiversity through signing Memoranda of Understanding (MoU).
- ✔ Link existing national and international efforts on marine biodiversity research, monitoring, and data management.
- ✔ Increase awareness and promote capacity around standardised and interoperable metrics of marine biodiversity.
- ✔ Facilitate the development of a common framework for EBV and EOV, informing GOOS on the integration of marine biodiversity observations within environmental variables.
- ✔ Emphasise objective knowledge of changes in marine life and ecology and promote the integration of regional datasets using databases and toolboxes such as the Ocean Biodiversity Information System (OBIS) and the Ocean Best Practices System (OBPS).
- ✔ Adoption and evolution of data formatting standards (e.g., Darwin Core) and other interoperable approaches for data curation, archival, and distribution, and emphasises adherence to open, FAIR, and CARE observing and data management principles.
- ✔ Disseminate products and facilitate collaboration and cooperation with relevant initiatives and with other GEO groups.
- ✔ Foster an open, diverse, and inclusive network that offers opportunities for members to share experiences, observations, and resources.

2 Potential contribution of EMODnet Biology to a European level MBON

EMODnet is prepared to support and contribute to the development, coordination, and implementation of European level MBON. This section provides some insight on how EMODnet Biology works and explores some of the potential roles and contributions it could offer to an MBON in Europe.

2.1 EMODnet Biology

EMODnet is a fully centralised core data infrastructure and marine data service which, together with the Copernicus Marine Service and Copernicus Data and Information Access Service (DIAS), form the backbone of a future European Digital Twin Ocean (DTO). The DTO is a key contribution to the EU marine data space and regional best practices for the global ocean data ecosystem in situ marine data service in Europe that offers a wealth of in water ocean observations, data and data products, spanning the coast to the open ocean and the surface to the deep sea.

The following principles of EMODnet align with the vision of MBON and GEO BON:

- ✔ Collect data once and use it many times.
- ✔ Develop standards across disciplines as well as within them.
- ✔ Process and validate data at different levels. Structures are already developing at national level but infrastructure at sea-basin and European level is needed.
- ✔ Provide sustainable financing at an EU level to extract maximum value from the efforts of individual Member States.
- ✔ Build on existing efforts where data communities have already organised themselves.
- ✔ Develop a decision-making process for priorities that is user driven.
- ✔ Accompany data with comprehensive metadata to guide users in "fitness for purpose", as well as statements on ownership, accuracy, and precision.
- ✔ Recognise that marine data is a public good and discourage cost-recovery pricing from public bodies.

EMODnet Biology is built upon the World Register of Marine Species (WoRMS) and the European node of the Ocean Biodiversity Information System (EurOBIS), with tools and services developed in collaboration with Lifewatch ERIC and Lifewatch Marine. EMODnet Biology offers Open Geospatial Consortium (OGC) compliant services enabling users free and open access to INSPIRE compliant metadata descriptions of more than 1200 thematic biological datasets and harmonised, transboundary, multidisciplinary data layers that can support relevant stakeholders operating across different jurisdictions.

The key services of EMODnet Biology are:

- ✔ Data management
- ✔ Standardisation in observations
- ✔ Quality control and interoperability of marine data
- ✔ Open and free publication of marine biodiversity data

The main data contributors and formats of EMODnet Biology are:

- ✔ International biogeographic datasets from EurOBIS (European node of the Ocean Biodiversity Information System)

- ✔ National monitoring programmes
- ✔ International monitoring campaigns (databases storing data from multiples countries within the same regional European sea)
- ✔ International data aggregators
- ✔ Data rescue and archaeology
- ✔ Datasets recovered from ad hoc submissions from researchers
- ✔ Citizen science activities, NGOs, and industry data providers
- ✔ Excel spreadsheets
- ✔ Paper documents
- ✔ Museum collection data

2.2 Potential role/contribution of EMODnet Biology

As the gateway to in situ marine data, data products and services in Europe and beyond, EMODnet Biology is well positioned to provide an underpinning infrastructure role as the methods by which data are collected are an essential part of the metadata for the wider community and other aggregators like OBIS etc.

EMODnet Biology aims to actively support the development of MBON Europe in EuroMarine, as it aligns with the overall vision and workplan proposed for Phase IV. The support that can be offered is varied and includes for example: (1) providing feedback and/or input on the various activities organised/planned; (2) promoting and/or organising workshops that would build relationships to streamline processes from field data collection to data publication, (3) contributing to the documentation of data collection methods, including field sampling and laboratory analyses, so as to publish methods manuals and encourage standardisation of methods; (4) contributing to data synthesis and publication of scientific papers that demonstrate the value of biodiversity monitoring to scientists, science organisations, policy makers and the wider public; and (5) other activities that help achieve the need for the public availability of data in trends in marine biodiversity to inform society and policy.

The following provides more detailed information on EMODnet Biology's strengths and potential contributions it could make to a European level MBON.

i. Access to a well-established network of 20 partners operating in 13 EU countries

The reach and breadth of the EMODnet Biology consortium represents a high-level of connectivity at national, regional, and global scales. An overview and details of the Phase IV partnership can be found under Biology in the Partnership page.

Table 2. Current EMODnet Biology Partners

EMODnet Biology Partners	Acronym	Country
Lead Organisations		
Flanders Marine Institute	VLIZ	Belgium
Hellenic Centre for Marine Research	HCMR	Greece
Marine Biological Association	MBA	United Kingdom
University of Sheffield		United Kingdom
Other Organisations		
Centre for Environment, Fisheries and Aquaculture Science	CEFAS	United Kingdom
Danish Centre for Environment and Energy- Aarhus University	DCE	Denmark

EMODnet Biology Partners	Acronym	Country
Stichting Deltares	Deltares	Netherlands
French Research Institute for Exploitation of the Sea	Ifremer	France
Institute for Agricultural and Fisheries Research	ILVO	Belgium
Institute of Environmental Hydraulics of the Universidad de Cantabria	IH Cantabria	Spain
Institute of Marine Research	IMR	Norway
International Council for the Exploration of the Sea	ICES	Denmark
Marine Information Service	MARIS	Netherlands
National Institute for Marine Research and Development "Grigore Antipa"	NIMRD	Romania
National Institute of Oceanography and Applied Geophysics	OGS	Italy
Portuguese Institute of Ocean and Atmosphere	IPMA	Portugal
Royal Netherlands Institute for Sea Research	NIOZ	Netherlands
Spanish Institute of Oceanography	IEO	Spain
Suomen ympäristökeskus - Finnish Environment Institute	SYKE	Finland
Swedish Meteorological and Hydrological Institute	SMHI	Sweden
Ukrainian Scientific Center of Ecology of Sea	UkrSCES	Ukraine
Université de Liège	ULiège	Belgium

ii. Mapping the complex ecosystem of biodiversity actors across Europe

The biodiversity monitoring ecosystem in Europe is complex and continuously evolving. It is currently made up of a plethora of disconnected networks, initiatives, projects, legislative and statutory bodies that could contribute to a regional level MBON in Europe. There appears to be overlapping roles and services amongst institutions at regional and national levels. To ensure that efforts to establish an MBON in Europe are harmonised and leveraged, EMODnet Biology could help map the ecosystem of biodiversity actors across Europe. This could help identify gaps and ways to collaborate with existing key actors, and recognise how established networks such as EMODnet could contribute to and fit within an MBON Europe. For example, the following map was created to visualise the connections between EMODnet Biology and its key stakeholders and initiatives to show some of the key linkages with UN Decade Programmes, Regional Sea Conventions, ICES Working Groups, and other EMODnet thematic lots.

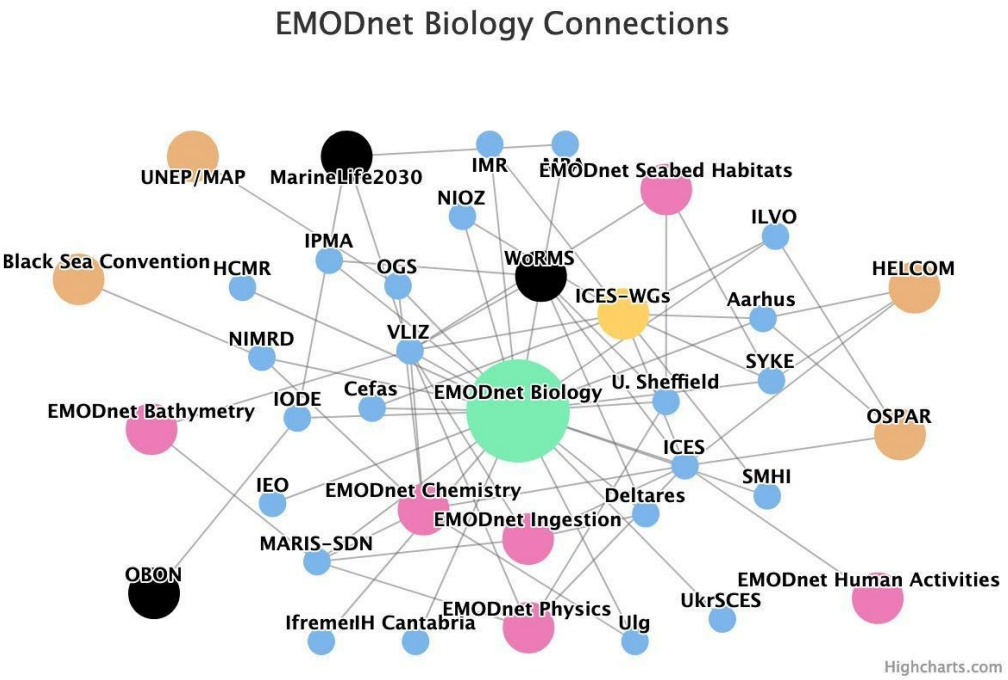

Figure 1: EMODnet Biology's key linkages with the UN Decade Programmes, Regional Sea Conventions, ICES Working Groups and the other EMODnet thematic lots.[1]

iii. Guide, support and coordinate the data workflow into EMODnet Biology

A key mission of EMODnet Biology is to ensure free and open access to biodiversity data in all European Seas and the Caribbean. This is done through the infrastructure backbone of the European node for the Ocean Biodiversity Information System (EurOBIS). The databases feeding into EMODnet Biology contain data from all regional and sub-regional seas of Europe, as specified by the Marine Strategy Framework Directive (MSFD). Data submitted to EMODnet Biology undergoes a series of quality control procedures before being made available online.

EMODnet Biology already assists national, regional, and local government agencies to seamlessly share and reuse marine open data across European borders. It is prepared to assist EuroMarine to "facilitate data mobilisation, supporting people to organise the data they collect and how to put it into open databases".

iv. Guide and coordinate on data standards and protocols etc.: identify, define, and use

To ensure interoperability, EMODnet Biology implements (and if necessary adapts) common standards and vocabularies defined and used by BODC-NVS , WoRMS (World Register of Marine Species), OBIS (Ocean Biodiversity Information System), INSPIRE, GBIF (Global Biodiversity Information Facility), TDWG (Biodiversity Information Standards), Marine Regions, OGC (Open Geospatial Consortium) and the Lifewatch infrastructure.

EMODnet Biology could provide advice and help develop guidelines on the following topics:

- ✔ What is the optimal data flow?

[1] https://emodnet.ec.europa.eu/en/biology

- ✔ What data infrastructure will be used, e.g., EMODnet Biology (using the EurOBIS data infrastructure), and who is best placed to do it?
- ✔ How will biodiversity monitoring be conducted annually and by whom?
- ✔ What protocols will be adopted to collect, analyse and compare data?
- ✔ How will observations be standardised?
- ✔ How will contributions of members be monitored and supported, and acknowledged?
- ✔ How to help members publish into OBIS, e.g., via the EurOBIS node?

v. Provide rapid access to a solid foundation of existing European marine biodiversity data

"Collect once and use many times."

EMODnet Biology provides access to data from a wide range of sources, and can help with the identification of gaps and inclusion of new and historical datasets. For example, it has demonstrated expertise and knowledge to identify and rescue old datasets that should be digitised and made publicly accessible. Although the majority species records occur from 1900 onwards, EMODnet Biology/EurOBIS offers species occurrence data that date back to 1526. The following map shows the location of the distribution records available to date through EMODnet Biology/EurOBIS: 1251 datasets, 30,124,812 occurrence records from 104,324 species names – of which 73,029 are accepted (as of 19 April 2023).

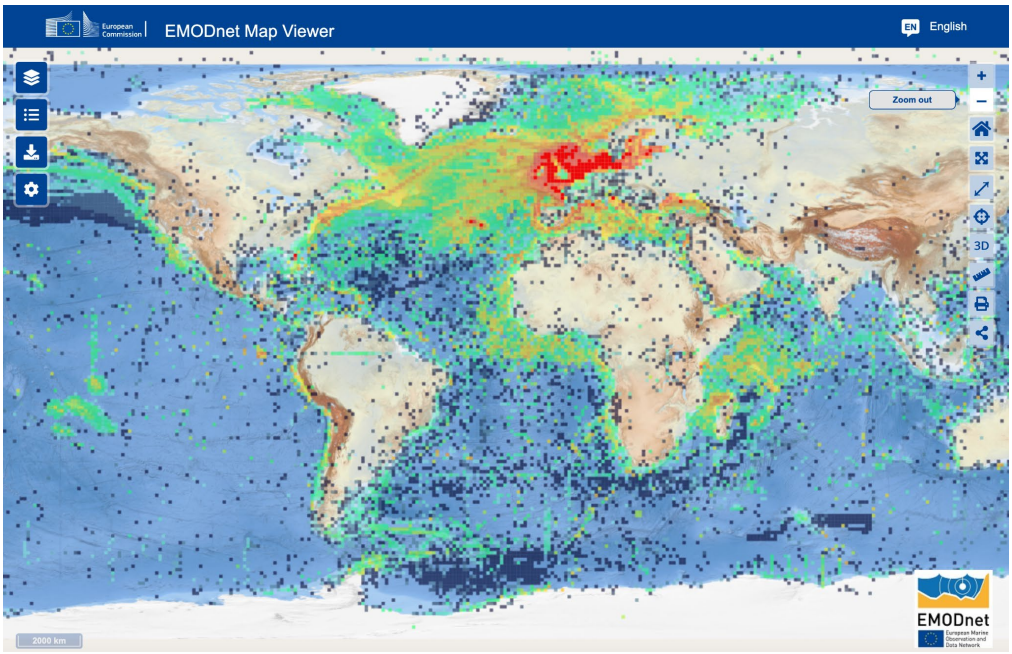

Figure 2: Map showing the location of the distribution records available in EMODnet Biology/EurOBIS to date.

vi. Offer a solid data infrastructure

The data infrastructure of EMODnet Biology can handle different data protocols and data standards for exchange of marine biodiversity data, for example:

- ✔ World Register of Marine Species (WoRMS) as taxonomic backbone.

- ✔ Darwin Core standard used by the Global Biodiversity Information Facility (GBIF) and the Ocean Biodiversity Information System (OBIS).
- ✔ Specific data format enabling National Oceanographic Data Centers (NODC's) to make biological data accessible using the SeaDataNet infrastructure.
- ✔ Several OGC Web services making accessible geospatial data.

vii. Access to a wide range of Data Products

EMODnet Biology assembles individual datasets and processes them into the following interoperable data products for assessing the environmental state of ecosystems and sea basins[2]:

- ✔ Gridded abundance maps of various species/groups
- ✔ Presence absence maps of various species/groups
- ✔ Modelled species/groups distributions
- ✔ Host for diverse external products

viii. Create online maps via the EMODnet mapping portal

EMODnet's Map viewer is a central point of access for all EMODnet thematic outputs and offers functionalities for seamless access to search, discovery, visualisation, and download of multidisciplinary marine environmental and human activities data. It can be used to create online maps on what biodiversity is being monitored (habitats, taxa, methods) where and when in European seas. This could allow for compilation and mapping of the past and present marine biodiversity monitoring in Europe.

ix. Provide a platform to share data and data products in support of Europe's maritime economy

EMODnet's Data Ingestion Portal reaches out to data holders, explaining the benefits of submitting their data to EMODnet and offering a support service to assist them in doing so.

x. Offer capacity building, training and data tools

EMODnet Biology could provide the MBON Europe community training on:

- ✔ Publishing data into EMODnet Biology/EurOBIS. For example, an open access course in Ocean Teacher Global Academy (OTGA) has been developed which teaches students how to format, standardise and quality control biological data for submission to EurOBIS/EMODnet Biology.
- ✔ Applying relevant, open community standards for biodiversity data, including Darwin Core.
- ✔ Communities involved in separate EOVs and different observing methods (omics, acoustic, imaging, etc.), and encourage data flow/data mobilisation in a standardised manner.

EMODnet Biology has also developed or uses several open access tools to aid with data preparation and integration:

Integrated Publishing Toolkit (IPT) developed and maintained by GBIF: The Integrated Publishing Toolkit (IPT), a freely available open-source web application using the Darwin Core standard, makes it easy to share biodiversity-related data and information with the EMODnet portal.

[2] https://www.sciencedirect.com/science/article/pii/S0308597X19301915

Quality Check Tool (QC Tool): The Quality Check tool, developed in collaboration with LifeWatch, is based on OBIS QC tools, and supports data providers in assessing the quality of their datasets prior to submission. It can be used either through an Rshiny application or as an R package.

MBON aims to organise at least one Data Mobilisation Workshop per year, in collaboration with OBIS/GBIF and IOOS in the US. EMODnet and a European level MBON could consider co-organising these for Europe.

xi. **Contribute to the development of scientific papers, e.g., synthesising the current status of biodiversity monitoring in Europe, identifying opportunities and gaps**

xii. **Contribute to the development of Essential Biodiversity Variables (EBVs) and Essential Ocean Variables (EOVs)**

xiii. **Community building, communication and outreach**

MBON is organising a series of monthly webinars: the "Marine Biodiversity Networking Fridays" to increase engagement around marine biodiversity monitoring and the role MBON can play as a knowledge provider. EMODnet and MBON Europe could identify speakers and organise several webinars per year.

Annexes

Memorandum of Agreement from EuroMarine for organisations agreeing to become MBON Europe members

Memorandum of Agreement

regarding

monitoring marine biodiversity

Preamble

We, the [organisation name], based at [town, country], [and a member of EuroMarine], recognise the importance of the availability of marine biodiversity data for research and to inform government policy on trends in the distribution and abundance of species of ecological, economic and social importance, and changes in ecosystem processes and services.

Such data underpin commitments to UN SDG 14 and the Convention on Biological Diversity goals and targets, as well as regional and national needs to understand what is happening to the natural world. This knowledge informs society on how to adapt to improve environmental sustainability.

Thus, we wish to contribute towards the vision of the Marine Biodiversity Observation Network, part of the Group on Earth Observation Biodiversity Observation Network to improve the availability of ecologically representative marine biodiversity data in geographic space and over time.

We agree to the following:

1. Our organisation will collect data on marine biodiversity on at least an annual basis;

2. Our sampling or observation methods will be standardised to aid comparability of data over the years, and may be adjusted to aid comparability with datasets internationally;

3. Our data will be published into the Ocean Biodiversity Information System (OBIS) as one or more datasets each year.

Signed on behalf of the organisation	Signed on behalf of EuroMarine
Name	Name
Position	President