EMODnet

European Marine Observation and Data Network

EMODnet Thematic Lot n° V – Biology

EASME/EMFF/2017/1.3.1.2/02/SI2.789013

Start date of the project: 19/04/2019 - (24 months)

EMODnet Phase III – Final Report

Reporting Period: 19/04/2019 – 19/04/2021

The European Marine Observation and Data Network (EMODnet) is financed by the European Union under Regulation (EU) No 508/2014 of the European Parliament and of the Council of 15 May 2014 on the European Maritime and Fisheries Fund.

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Executive summary

The renewal stage of Phase III covered the period from 2019-04-19 to 2021-04-18. The work planned in the renewal document was somewhat constrained by the COVID-19 pandemic; plans changed, delays in data submission and product publication occurred but the consortium was able to reach the end of the period with all deliverables being met by the end of this phase.

Due to the constraints caused by the pandemic, all events and meetings planned, from mid-2020 until the end of the project, took place online. The various events, more specifically, the WP2 and WP3 digitisation, data entry and QC (Quality Control) workshop, the WP4 Data product workshop and the WP5 Transatlantic data integration and product development workshop and WP5 End user showcase event had to be adapted for the online format. Likewise, both annual project meetings, held in September 2020 and May 2021 took place online due to travel restrictions imposed by the many European countries where our partners are based.

Despite the difficulties, 9 data products, one proof of concept for a future product and an EMODnet WFS (Web feature Service) R tool were made freely and openly available. All code and documentation are available via the EMODnet GitHub.

The data inventory grew from 854 to 1077 datasets with freely and openly available online data, corresponding to an increase of 3.762.756 occurrence records. The majority of the data were submitted by project partners and data grant holders, but other submissions resulted from ad-hoc data providers or datasets forwarded from EMODnet Ingestion.

At the end of phase III, EMODnet Biology has roughly 25.5 million occurrence records available, covering a period that spans from 1700s to 2020.

The WP5 events allowed the consortium to present the project and better understand the needs of our stakeholders, which will be used to guide the Phase IV work.

Other highlights include:

- Coordination and support for the OpenSeaLab II event held in September 2019 in Ghent, Belgium, where teams competed and brought their expertise to develop novel marine and maritime applications using EMODnet, ICES (international Council for the Exploration of the Sea) and Copernicus Marine Service's (CMEMS) wealth of marine data and services
- The launch of a call for data grants in late 2019, which saw 16 new data providers submitting data from 85 new datasets to the network. The data originates not only from monitoring and research programs, but also various citizen science activities;
- Redesigning of the course on "Contributing datasets to EMODnet Biology" freely available from the Ocean Teacher Global Academy (OTGA) platform, which is managed by IODE (International Oceanographic Data and Information Exchange);
- Publication, in 2020, of a peer-reviewed paper on "Supporting the essential - Recommendations for the development of accessible and interoperable marine biological data products"
- Contribution to the EMODnet-CMEMS MSFD (Marine Strategy Framework Directive) product portfolio focusing on the Baltic Sea region

1.Introduction

The renewal stage of EMODnet Biology Phase III ran from 2019-04-19 to 2021-04-18, and was a two year extension to the Service Contract EASME/EMFF/2016/1.3.1.2/Lot5/SI2.750022. The project tasks remained the same as in the performance stage, more specifically, developing and maintaining:

1) a common method of access to data held in repositories;

2) products constructed from one or more data sources that provide users with information about the distribution of parameters in time and space;

3) procedures for machine-to-machine connections to data and data products;

4) a web portal allowing users to find, visualise and download data;

5) the coherence with efforts of regional sea conventions;

6) the interoperability with data distributed by non-EU organizations;

7) a process to monitor performance and deal with user feedback;

8) a help desk offering support to users.

For the Biology thematic lot, the requirements established in the Contract were, to make data and metadata available resulting from observations of marine species in European waters excluding parameters that are collected or distributed under the MSFD for fisheries. The data shall include information about phytoplankton, zooplankton, angiosperms, macroalgae, invertebrate bottom fauna, birds (surface observation at sea and coastal nesting), mammals, reptiles, fish.

The consortium was composed by 22 organisations scattered across Europe as shown in the map below:

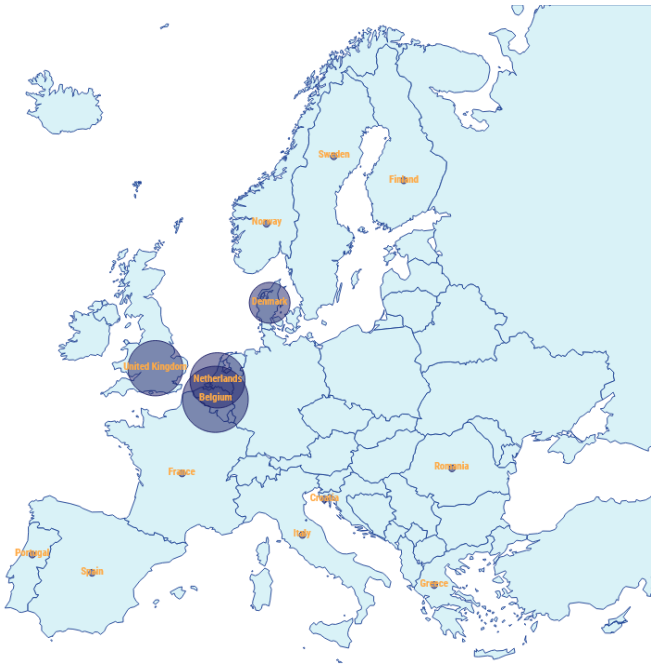

Figure 1. Map depicting the consortium countries. The bubbles represent the number of partners in each country (bigger bubbles for countries with two, three or four partners and smaller bubbles for countries with one partner)

The consortium included international organisations, National Oceanographic Data Centres (NODC) recognised by IOC-IODE (Intergovernmental Oceanographic Commission - IODE), government agencies, universities and also SMEs (Small and Medium Enterprises), in a total of 22 partners.

The consortium's geographic spread ensured that all European regional seas were represented and, due to the inclusion of three Ocean Biodiversity Information System (OBIS) nodes, and two international organisations (ICES- International Council for the Exploration of the Sea and IODE), that connections with international initiatives were also maintained.

The inclusion of 16 data grant holders, from late 2019 until the end of this phase, allowed for a wider geographic spread and collaboration with various Non-Governmental Organisations (NGO's) as well.

The thematic lots' activities were divided in 6 Work Packages, as shown in Figure 2.

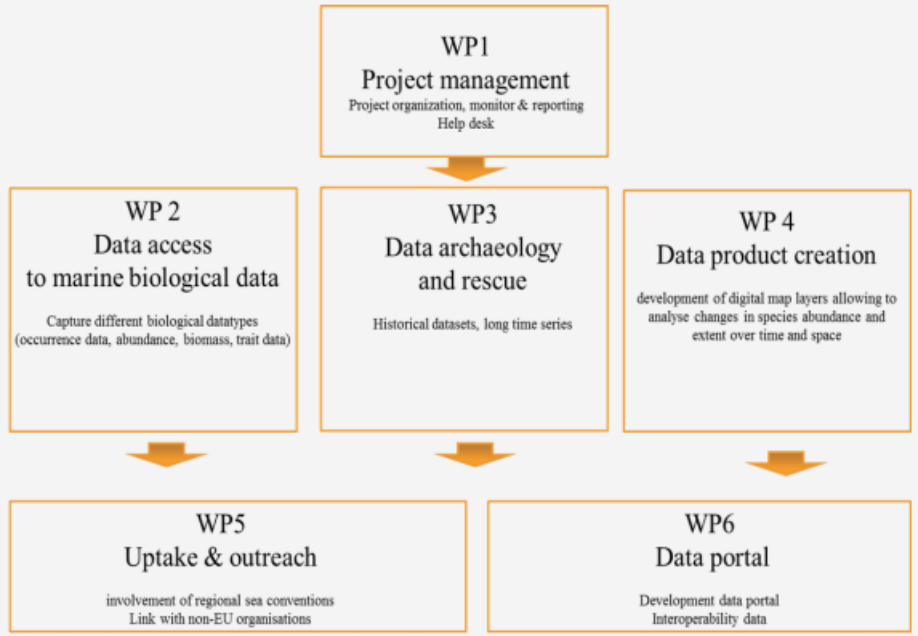

Figure 2. EMODnet Biology Phase III Work Packages

The project was characterised by a strong push for data standardisation (initiated in the performance phase) by the use of the World Register of Marine Species (WoRMS) for the taxonomic data, Marine Regions for the geographical coverage and the Natural Environment Research Council (NERC) Vocabulary Server hosted and managed by the British Oceanographic Data Centre (BODC NVS) for the additional biotic and abiotic measurements.

2.Update on the Tasks

Task1: Data access to marine biological data and Data archaeology and rescue

This task was fully covered during the renewal stage of EMODnet Biology III. Although described as a single task, it encompassed several topics, dealing with the data on different levels, from formatting, to quality control and standardisation (WP2 & WP3). Before partners' submission, each dataset was organised according to the DarwinCore Archive (DwC-A) standard, more specifically in the EventCore format. This required some adaptation from the partners, as EventCore involves three tables, instead of the two tables of the previously recommended OccurrenceCore format. Although this involves an extra level in the data structure, all partners have been able to adhere very well to this upgraded format and recognised the strengths and advantages of this. Within WP3 (Data archaeology & rescue), the process of making data available encompassed the additional step of firstly digitising the data, as this WP focused on historical data, collected at least 70 years ago (before 1950) and rescue data, data published between 1960-2000 which only existed on paper or in digital text files.

A detailed overview of the data made available during this renewal stage can be found under the Work Package updates of WP2 & WP3.

Task 2: Data product creation

The task has mainly focused on three objectives:

- creation of 'intermediate data layers', i.e. curated datasets on occurrence and abundance of the functional groups identified as Essential Ocean Variables (EOVs), and compiled from diverse sources. Examples are occurrences (presence/absence) of macrobenthos in the Greater North Sea, or phytoplankton in North Sea and Baltic Sea.
- creation of links to other EMODnet lots. An R package has been developed to access environmental information from web services provided by other EMODnet lots and external sources, and an example workflow has been worked out
- preparing EMODnet Biology datasets, in combination with chemical and physical information from other sources, as input to modelling efforts. A proof-of-principle product has been produced for this aim

Details of these products are provided in the deliverables of the project and further down in this report (WP4 section).

Task 3 & 4: Technical update EMODnet biological portal & machine to machine connections

These tasks were in the workplan assigned to WP 6. Throughout the reporting period, the EMODnet Biology Portal increased its functionality and the services provided to users.

The data portal has continuously been working on since Phase I. In Phase III there was an emphasis on improving the GIS viewer and linking it to the dataset search & download toolbox. The metadata catalogue was also one of the main areas of development, with the objective to enhance ISO19115 and INSPIRE compliance in the metadata records. Lastly, improvements to the OGC web services were also made, in order to comply with the Central Portal requirements. A more detailed overview can be found under the WP6 updates.

Task 5 & 6: Coherence with efforts of regional sea conventions and interoperability with non-EU organizations

These tasks were achieved through the engagement and outreach activities of WP5. The Regional Sea Conventions (RSC) actively participated in all stakeholder events, both in person and virtually during Phase III of the project, however, given the differences between each of the conventions and their implementation it is not possible to create products that suit all needs. Future, more targeted engagement will be pursued in Phase IV.

Additionally, non-EU (European Union) organisations have been integral in the development of the data products, and evolution of the longer-term ambitions for EMODnet Biology. Organisations including IODE, the Ocean Tracking Network (OTN), Fisheries and Oceans Canada (DFO-MPO), the Marine Biodiversity Observation Network (MBON), and NOAA (National Oceanic and Atmospheric Administration) have been engaged, and included in workshops and online events. These relationships will be developed further, including the running

of shared 'code-sprints' and actions related to the United Nations Decade of Ocean Science for Sustainable Development.

Tasks 7 & 8: Monitor performance and deal with user feedback and operate a help desk offering support to users

Tasks 7 and 8 were allocated to WP1- Project Management. The continuous monitoring was performed at various levels and using different tools, more specifically:

- Website visibility and analytics using Matomo
- Web services monitoring using GeoHealthCheck (implemented in March 2020)
- Data downloads and user information using in-house systems

Additionally, the project's visibility and outreach were also monitored using Twitter analytics. User feedback via the helpdesk service (operating during regular office hours) was collated and all questions/feedback addressed in a timely manner.

3.Work Package updates

Table 1. Phase III Milestones and Deliverables

Status of the Milestones and Deliverables listed in the workplan				
Milestone/Deliverable	WP	Date due	Status (Delivered/Delayed)	If Delayed: reason for delay and expected delivery date
Maintenance of help desk	WP1	18/04/2019 - 18/04/2021	Delivered	
Quarterly progress reports	WP1	various dates	Delivered	
Interim report	WP1	18/04/2020	Delivered	
Final report	WP1	18/04/2021	Delivered	Date due as stated in call for tenders, actual due date is two months after end of phase
Evaluation and definition of partner-specific data flows	WP2	31/10/2019	Delivered	
Technical implementation of partner-specific data flows, for those partners belonging to group 1	WP2	31/10/2019	Delivered	
Hands-on workshop on data formatting, QC and publishing	WP2	30/04/2020	Delivered	Was delayed and moved to an online event from 08/06/2020 - 19/06/2020 due to COVID
Report on data standardization of proposed new and update datasets	WP2	18/04/2021	Delivered	
Prioritization report based on data gaps analysis and WP4 feedback	WP3	30/11/2019	Delivered	
Workshop on digitization, data entry and QC	WP3	30/04/2020	Delivered	Was delayed and moved to an online event from 08/06/2020 - 19/06/2020 due to COVID
Scientific document on the design of the workflow of text mining technologies in data archaeology	WP3	31/10/2020	Delivered	Was delayed to 09/12/2020 due to COVID
General report on data entry	WP3	18/04/2021	Delivered	
Report with proposed list of data packages and underlying datasets with specific recommendations on (meta)data gaps	WP4	30/09/2019	Delivered	
Data product workshop	WP4	30/06/2020	Delivered	Held as an online event from 15/06/2020 - 19/06/2020
Update Atlas of Marine Life	WP4	18/04/2021	Delivered	
Recommendations report from stakeholder workshop May 2019	WP5	31/07/2019	Delivered	

Transatlantic data integration and product development workshop	WP5	30/06/2020	Delivered	Was delayed and moved to an online event on 09/10/2020 due to COVID
End user showcase event - Demonstration of Phase 3 achievements, and agenda setting for future development	WP5	18/04/2021	Delivered	
Portal operational	WP6	18/04/2019 - 18/04/2021	Delivered	
Maintenance of Portal	WP6	18/04/2019 - 18/04/2021	Delivered	

WP1 – Project Management

The activities assigned to this WP correspond to tasks 7 (Monitor performance and deal with user feedback) and 8 (Operate a help desk offering support to users) of the tender.

Throughout the period covered in this report, the website received a total of 17.794 visits, with an average of 34 unique visits per day, spending just under 4 minutes on average on the website. On some days the visits exceed 50 users, as can be seen in the Figure below.

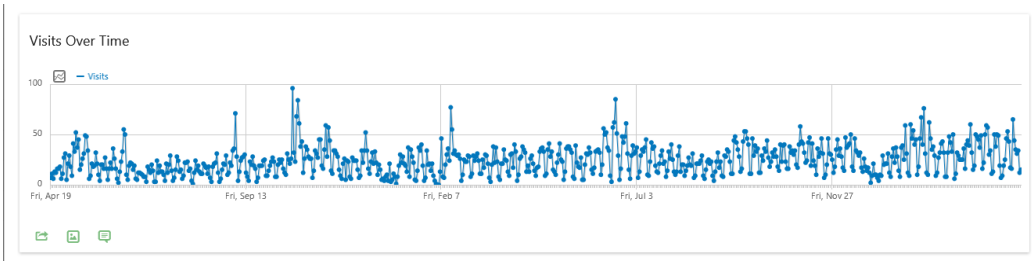

Figure 3. Visits over time (information collected from Matomo)

The geographic extent of the EMODnet Biology users is quite wide as shown in Figure 4. Just under 30% of the visits originate from the United States, followed by the United Kingdom with 11% of visits and 3% - 6.6% of visits from various European countries, more specifically Germany, Belgium, Spain, Italy and France, and 3% from Asian countries like China or India.

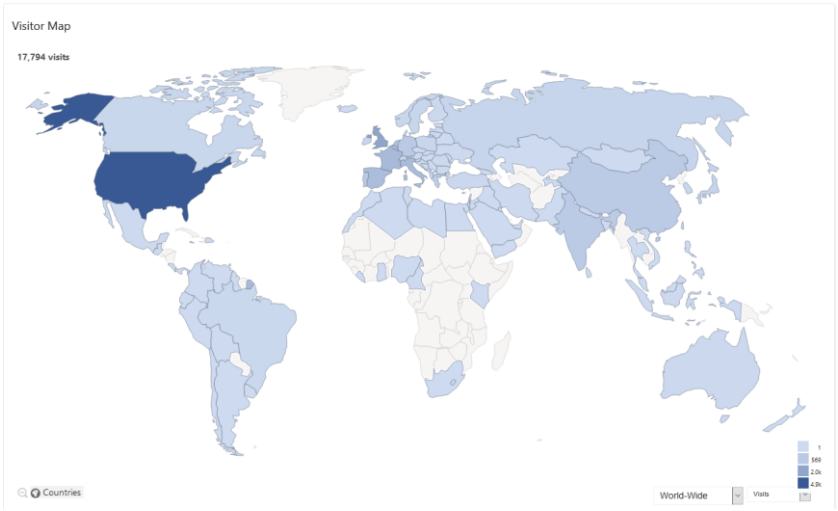

Figure 4. Visits map (information collected from Matomo)

The monitoring of OGC (Open Geospatial Consortium) services, implemented in March 2020, established that Biology's services were 100% operational and, on average, reliable by 99.6%. This exceeds the minimum requirements as included in the INSPIRE guidelines.

Feedback from 32 different users was received and 68.7% addressed within the same day. The remaining 31.3% of the instances that took longer to address were usually due to the fact that discussion within the consortium or with the user further ensued. One instance where the delay was also due to a holiday period. The first reply was always done within the one day of feedback/enquiry reception.

There was an effort to increase outreach activities, more specifically via Twitter and via the website news as well as through participation in various events. The analytics collated via Twitter seem to indicate that this approach was a good one. The @EurOBIS_VLIZ Twitter account, which is used to provide information on the various EMODnet Biology activities, has more than doubled the number of followers since 2019 (207 in 2019 to 549 followers by the end of Phase III). The more frequent publication of posts (<50 in 2019 to 241 in 2020 and 68 in the first three months of 2021) as well as the advertisement of the various activities (OpenSeaLab, workshops, data grant call, showcase event, etc) have also contributed to this increase in exposure.

Adding to the activities mentioned above, the Coordination Board was also involved in meetings with various stakeholders where the aim was always to not only introduce the thematic lot, but also capture feedback on how EMODnet Biology can better support our stakeholders, considering their requirements and the constraints in terms of data availability. Examples are the EVOLMAR2020 and Assemble 2021 conferences, as well as the Marine Data to Support Aquaculture events, hosted and organised by EaTIP (European Aquaculture Technology and Innovation Platform), CMEMS, EMODnet, DG MARE (Directorate-General for Maritime Affairs and Fisheries) and DG DEFIS (Directorate-General for Defence Industry and Space) as well as our own organised events, as mentioned throughout in the relevant WP sections.

The use of Marine Regions allowed EMODnet Biology to compile stats on data geographic coverage. For clarification, below is a summary of the regions used in the monitoring indicators section as defined for Phase III:

Table 2. Marine regions used for the EMODnet Biology reporting indicators

Region	**Polygon defined by**	**Notes**
Atlantic	https://www.marineregions.org/gazetteer.php?p=details&id=5664	North East Atlantic (general sea area) Arctic, North and Baltic Seas are excluded to avoid duplicates in the reporting numbers
Arctic	https://www.marineregions.org/gazetteer.php?p=details&id=18025	Eastern Arctic Ocean Aphia (general sea area)
Baltic Sea	https://www.marineregions.org/gazetteer.php?p=details&id=2401	Baltic Sea (IHO area)
Black Sea	https://www.marineregions.org/gazetteer.php?p=details&id=3319	Black Sea (IHO area)
Mediterranean Sea	https://www.marineregions.org/gazetteer.php?p=details&id=1905	Mediterranean Sea (IHO area)
North Sea	https://www.marineregions.org/gazetteer.php?p=details&id=2350	North Sea (IHO area)
Other Seas	All other areas, including coastal regions (polygon limits only include marine areas as given by the coastline used in Marine Regions)	

WP2 – Data access to marine biological data

The overall, general objective of WP2 remained the same from the initial stage into the renewal stage of phase III: *To develop and establish a common method of access to biological data held in repositories by the organisation collecting them and make the data interoperable such that all data of a particular type collected within a defined time and space window can be found, visualised and downloaded allowing data from different sources to be assembled without further processing.* WP2 provides access to data and metadata on observations of marine species from different groups: phytoplankton, zooplankton, macro-algae, angiosperms, benthos, birds, mammals, reptiles and fish.

As part of the work towards this general objective, the data management activities continued to focus on three main areas: (1) further automatisation of the data flow, (2) improvement of the overall quality control and fitness for use of the involved datasets and (3) consolidation of the DarwinCore Event Core format and associated standards, including controlled vocabularies of the Extended Measurement or Facts Extension (eMoF). All activities within WP2 directly relate to Task 1: Data access to marine biological data and data archaeology and rescue.

The start of this renewal phase was marked by intensive communication with each of the partners, to evaluate and further define their data flows, followed by the technical implementation of the agreed partner-specific data flows (D2.4: Evaluation and definition of partner-specific data flows and D2.4x: Technical implementation of partner-specific data flows, for those partners belonging to group 1). This has ensured a continuous and smooth data flow towards the EurOBIS (European Ocean Biodiversity Information System) database, the marine biological data infrastructure for EMODnet Biology.

Further to consolidating the existing data flows from the consortium, possibilities to widen the network were explored. In late November 2019, a data grant call was launched and over 30 applications were received. From these applications, 16 organisations and institutes within Europe were credited with a data grant, thereby contributing towards making marine biological data freely available within the framework of EMODnet Biology. Each applicant provided a list of marine datasets to be shared within the scope of the data grant and committed to attending the EMODnet Biology data workshop, scheduled to take place in the Spring of 2020. Due to the COVID-19 pandemic, the data workshop was postponed to June 2020, and was transformed from a physical one-week event to an online event spread over two weeks, with short, daily online sessions. The EurOBIS/EMODnet Biology Data Management Team made all training material available through the OTGA as a training course "Contributing datasets to EMODnet Biology", which was not just aimed at the data grant holders, but was also open for all WP2 partners, thereby allowing them to update their knowledge on the required data processing steps, and giving the opportunity to new staff within the partner consortium to understand the goals of the EMODnet Biology project, as well as developing the skills needed to correctly format biological data before submission (Deliverable 2.5: Hands-on workshop on data formatting, QC and publishing). In addition, a number of participants from outside the current consortium participated in this training and can potentially lead to a future increase in the contribution of datasets to EMODnet Biology. The data grant call approach has proven to be successful, generating 85 extra datasets for the thematic lot. The origin and scope of these datasets was quite diverse, ranging from citizen science to research, including both short-term research and long-term monitoring, covering several functional groups such as e.g. mammals, benthos or plankton, also representing a wide geographical coverage across the European marine waters.

Overall, the renewal phase of EMODnet Biology has added 223 datasets to the EurOBIS database, including 28 datasets from WP3 and updates to 63 pre-existing datasets. Of the 223 datasets, 204 are available in the preferred EventCore format. At the end of the renewal stage of Phase III, the portal provides access to 1,077 datasets, representing roughly 25.5 million occurrence records and 30 million Measurement or Facts (Table 3).

Table 3. Available data between start (April 2019) and end (April 2021) of the renewal period.

	April 2019	April 2021
Datasets	854	1,077
# occurrence records	25.6 million	25.5 million*
Quality controlled records	87%	86%
eMoF records	17.7 million	30.7 million

Species names	80,202	98,024
Accepted species names	62,220	75,658

*Note that the number of occurrence records has slightly decreased as through dataset updates, records can be dropped or merged with others, but the resulting dataset will have a higher quality than the one it replaced.

Deliverable 2.6: Data standardization of proposed new and update datasets reported in detail on the data standardisation of proposed new and updated datasets, including extensive feedback on the standards and vocabularies adopted within WP2 to improve data interoperability.

The majority of the data available through EMODnet Biology are shared with the international initiatives OBIS-82% and GBIF (Global Biodiversity information System)- 10%.

To avoid duplication within these initiatives, not all data are shared via the EMODnet Biology/EurOBIS; a number of datasets flows to OBIS and GBIF through other pathways, e.g via dedicated partner streams implemented for other OBIS nodes that are part of the consortium.

Figure 5 reflects the growth in number of occurrence records in the renewal stage, from a geographical point of view, while Figure 6 shows the overall growth of occurrence records in the EurOBIS database, both from a geographic and a functional group perspective.

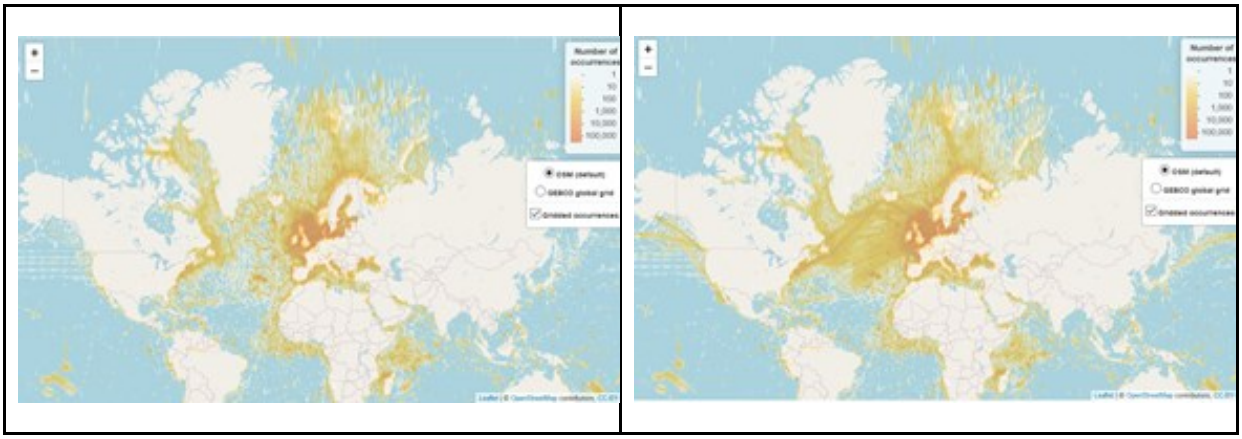

Figure 5. Comparison in available occurrence records from a geographical perspective. Situation April 2019 (left) versus situation April 2021 (right).

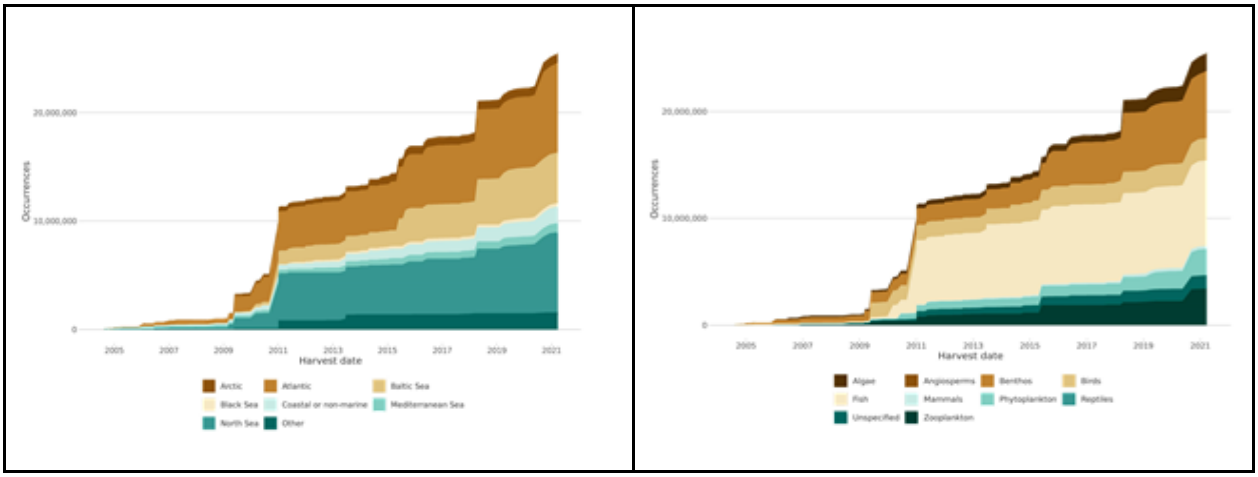

Figure 6: Overall growth in number of available occurrence records in the EurOBIS database. Left: from a geographical perspective; Right: from a functional group perspective.

WP3 – Data archaeology and rescue

The activities assigned to this WP correspond to Task 1 (Data access to marine biological data and Data archaeology and rescue) of the tender. The WP3 of EMODnet Biology has been in charge of prioritising, digitising and submitting historical and rescue biodiversity datasets mainly from the Mediterranean and Black Seas. During Phase III of EMODnet Biology four main deliverables and a series of activities were fulfilled within the WP3:

Within the scope of the attempt for filling spatial and temporal biodiversity gaps, the need of prioritising datasets among a sea of information emerged. Hence, the D3.5: Prioritisation report based on data gaps analysis and WP4 feedback provided a list of prioritised historical and rescue datasets based on various purpose-built criteria such as thematic and taxonomic coverage, temporal and geographic scope, language constraints and accessibility. In continuity, the scheduled D3.6: Workshop on digitization, data entry and quality control was eventually implemented as an online workshop due to the COVID-19 pandemic (as mentioned in the WP2 section). A special section entitled "Dealing with archaeology data" was included, providing insights on the importance and the processing of data archaeology. Subsequently, the D3.7: Scientific document on the design of the workflow of text mining technologies in data archaeology was prepared, where a significant work on assisting archaeology data curators was performed. At a later stage, this work gave birth to the bioinformatic tool DECO, a biodiversity data curation workflow that combines state of the art image processing and OCR (Optical Character Recognition) tools with text mining technologies and Web APIs (Application Programming Interface) in order to assist curators (Figure 7).

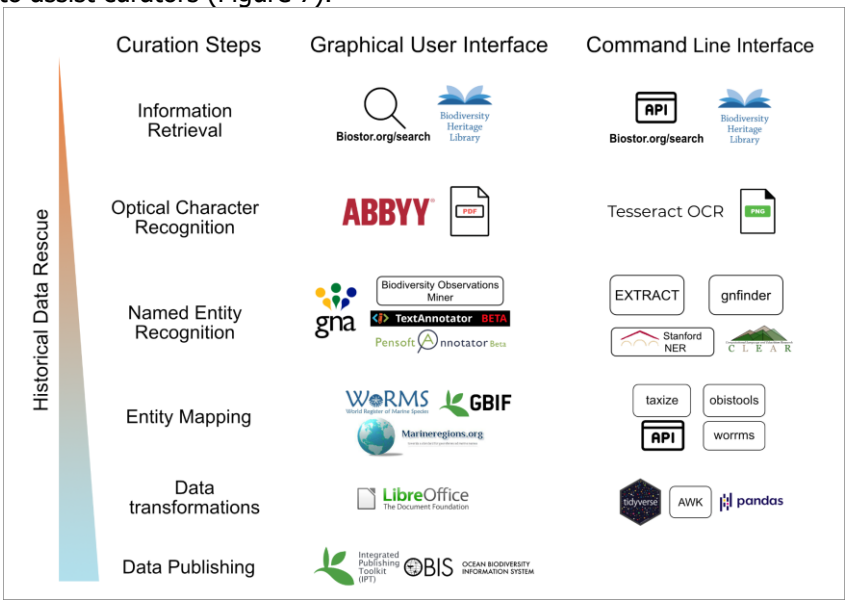

Figure 7. A step by step workflow on the curation of historical data

Last but not least, the D3.8: General report on data entry (update) was composed, compiling all the information on datasets that were processed and eventually submitted to the EMODnet Biology portal within the WP3. Overall 27 new datasets were processed and another one was updated, the metadata of which are presented in Table 4. The area studied concerned mainly the Mediterranean Sea, and part of the Black Sea, the Eastern Atlantic Ocean, and the Suez Canal, as shown via the occurrence records in Figure 8.

Table 4. General metadata of the 28 datasets published by WP3 within EMODnet Biology phase III

Occurrence records	Events	Extended Measurements or Facts (eMoF)	Species number	Taxa number	Temporal coverage (years)
46,041	5,706	47,919	1,526	1,767	1898 - 2017

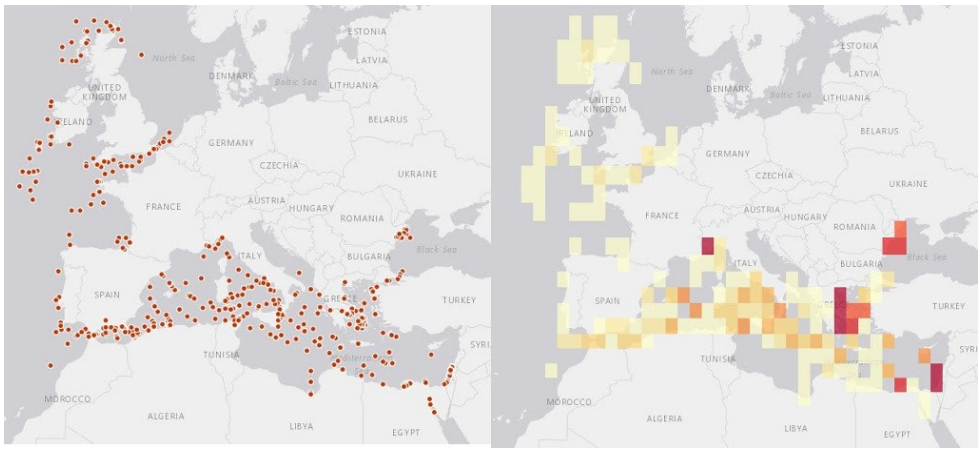

Figure 8. Distribution maps of the occurrence records for all 28 datasets: with toggle points (left) and gradient colours (red colour indicates the highest values, right)

A total of 1,526 species and 1,767 taxa were reported within WP3 activities. Regarding the taxonomy, there was a wide coverage observed, a great part of which consisted of benthic invertebrates with phytoplankton, zooplankton, fish and macroalgae being also reported. Specifically, 24 phyla were reported; namely Annelida, Arthropoda, Brachiopoda, Bryozoa, Cercozoa, Chaetognatha, Chordata, Ciliophora, Cnidaria, Ctenophora, Echinodermata, Euglenozoa, Foraminifera, Haptophyta, Hemichordata, Mollusca, Myzozoa, Nematoda, Nemertea, Ochrophyta, Porifera, Radiozoa, Rhodophyta, Sipuncula. The aforementioned groups correspond to five out of the ten EOVs followed in EMODnet, thus addressing different needs of the project (e.g. to support policy decisions and potential future development of data products). In Figure 9 the occurrence records of the reported taxa are presented per year.

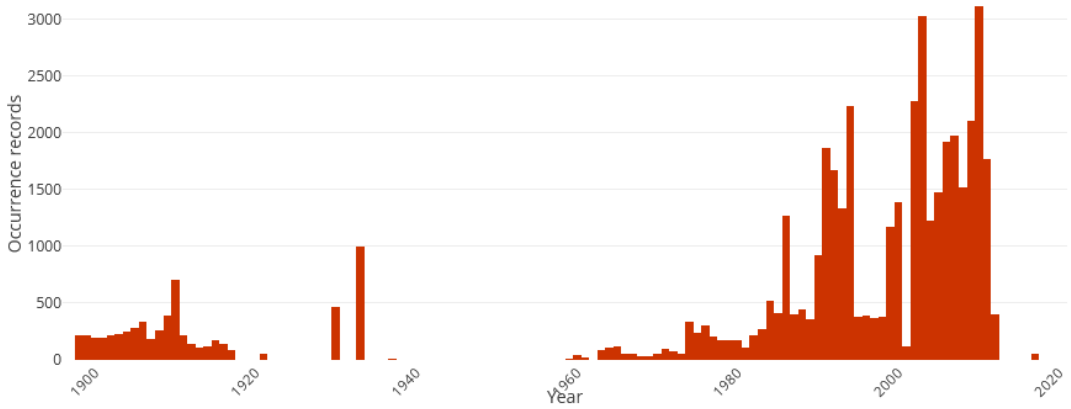

Figure 9. Bar plot depicting the occurrence records per year for all 28 digitised datasets

WP4 – Data product creation

During the third phase of EMODNET Biology, it was decided to structure the data products around the Essential Ocean Variables, advocated in the international context as a framework to obtain an overview of marine biodiversity and its temporal development (Lear et al, https://doi.org/10.1016/j.marpol.2020.103958). In order to best support that effort during Phase IV, reported upon here, much emphasis has been placed on the production of curated, composite datasets of broad functional groups (sensu EOV) that are based on multiple datasets but together can provide a consistent image of the representation of this group in space and time. As a second priority, connecting the biological information in EMODnet Biology to environmental information in the other EMODnet lots and in the external work has received emphasis.

For the first time, the results of WP4 have been entirely derived using electronic interaction between partners. A fully online workshop has been organised as a central activity of the work package (D4.6: Data Product workshop). Preceding the workshop, an intensive online cooperation had fixed a prototype workflow and made an inventory of approaches to develop integrated datasets. The finishing and publishing of the data products was also organised through online cooperation events.

Production of curated intermediate level datasets of single functional groups, and based on multiple data sources

In this priority field, EMODnet Biology has focused on the intermediate-level data layer, in between the 'raw' datasets delivered to the database and the actual applications, e.g. in indicators or other policy relevant products. The preparation of such intermediate datasets defines a number of requirements with respect to their documentation, control of consistency, and links between them, their metadata, and supporting databases such as WoRMS for taxonomy or the Marine Regions Gazetteer for spatial information.

Basic workflow

Deliverable D4.5: "Report with proposed list of data packages and underlying datasets with specific recommendations on (meta)data gaps" has investigated the different information needs involved and proposed the elements of a workflow capable of producing an intermediate level dataset of presence/absence within a functional group. This is work based on the Darwin Core data, that essentially represent species' presences in the database.

This workflow was worked out in detail for macrobenthos in the Greater North Sea in product "Summary presence/absence maps of macro-endobenthos in the greater North Sea, based on nearly 100,000 samples from 65 assembled monitoring datasets".

The approach was extended to cover also EventCore data in the product on "Data product numerical abundance of benthic macroinvertebrates in North Sea and Baltic Sea", where an estimate of species' abundance was made. The product is based on fewer datasets than the previous one, despite the larger geographical area, as not all datasets contain useful information on species abundance. Development of the workflow has provided experience with using the relatively recent EventCore, and provided feedback to data management with respect to the data format.

Validation of workflow

The workflow was validated (and in the process refined and improved) by using a very different functional group (phytoplankton) in the North Sea. This resulted in the data product "Presence/Absence maps of phytoplankton in the Greater North Sea". A second validation was performed for phytoplankton in the Baltic Sea "Presence/Absence maps of phytoplankton in the Greater Baltic Sea". Both validation exercises have further contributed to the improvement of the workflow.

Extension of workflow

The workflow was extended by the implementation of new developments in the DIVA (Data-Interpolating Variational Analysis) interpolation tool. Using neural network approaches, DIVA was extended to interpolate data of fraction presence. The interpolation incorporates knowledge of environmental layers to obtain optimal interpolation. It was applied in the products Probability maps for different benthos species in the North Sea and Probability maps for different phytoplankton species in the North Sea.

Linking information from EMODnet Biology with maps from other EMODnet lots

A second focus of WP4 was the link between different EMODnet lots, the aims of which were twofold. On the one hand, it can improve the data products of EMODnet Biology, as shown earlier with the enhanced DIVA interpolation using environmental layers. On the other hand, biological information on presence or abundance of particular species can be used as a check on the accuracy of environmental layers. If a particular species, known to occur only in coarse sand because it lives in the interstitial space between sand grains, is found in an area reported to consist of muddy sediment, then one of the two observations cannot be true. Such observations can help to quality control both the biological datasets and the environmental layers. If the latter have been obtained by spatial interpolation, the biological information could, in principle, be incorporated to improve the interpolation results. Such interaction has not yet been reached at present, but is expected in Phase IV.

A major step forward for the workflows envisaging combining information from different EMODnet lots, was the production of an R package "EMODnetWFS: Access EMODnet Web Feature Service data through R" that can easily access Web Feature Services (WFS) of EMODnet and other resources.

An example workflow making use of this facility linked the abundance and presence/absence of macrobenthos to information on habitat classification and on sediment grain size composition "Benthic occurrences, habitat maps, and species traits".

Further development of this approach is aimed for in Phase IV, by connecting the EMODnet Biology information to modelling efforts. A proof-of-principle product "Physico-chemical and commercial shellfish species data to illustrate potential vulnerability to ocean acidification Directory structure" links changes in pH as observed in the field, to occurrence of benthic mollusc species and to models of ocean acidification.

Open workflows

During this phase, WP4 has devoted much attention to completely open and reproducible workflows. All workflows have been documented on Github (https://github.com/EMODnet). The data products, consisting of thousands of maps for the different species, can be downloaded through the EMODnet portal, but can also be reproduced and/or modified using this open source workflow.

WP5 – Uptake and outreach

Activities within Phase III for Work Package 5 continued with the model of continual stakeholder engagement, Taking the recommendations and feedback from previous events and interactions to drive processes with WP2 and WP4. However work was also undertaken with an eye to the future, including emerging requirements for supporting EOVs and Essential Biodiversity Variables (EBVs).

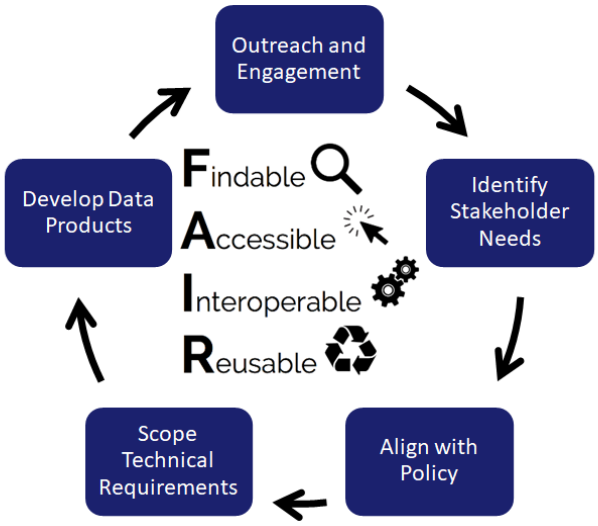

Figure 10. The EMODnet Biology Cycle of Continual Engagement for Product Development

The first deliverable (D5.4: Recommendations report from stakeholder workshop May 2019) within this phase focused on capturing the outcomes and discussions from the stakeholder engagement event that was held in Lisbon in May 2019 as a side event of European Maritime Day.

The event was structured with EMODnet Biology partners presenting the range of FAIR (Findable, Accessible, Interoperable and Reusable) data products developed to data, alongside a relevant policy, industry or academic stakeholder, highlighting the 'real-world' applications of the solutions developed by the EMODnet Biology partnership. All presentations were given in the framework of the relevant EOVs, and included keynote presentations highlighting how this vital framework has been developed.

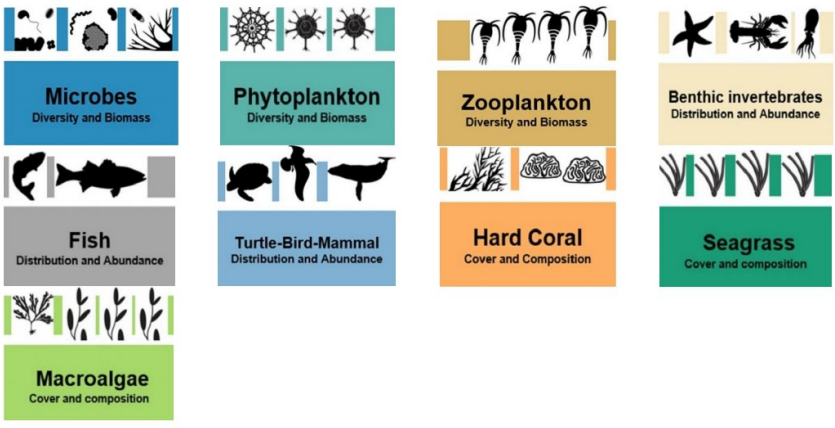

Figure 11. EOV Categories relevant to EMODnet Biology.

EMODnet Biology's approach received general endorsement from all the participants, with the recognition that it is unfeasible to develop a comprehensive range of fully operational data products to meet the requirements of all stakeholders. As such subsequent focus would be on a set of curated, standardised intermediate products that can serve as an intermediate step between raw data and finalised, use-specific products. In this way EMODnet provides a significant value-added service, lowers technical barriers, and removes laborious data formatting tasks, facilitating rapid reuse of these vital biodiversity data.

Following the event in Lisbon, and in support of the aims of the Galway and Belém statements on Transatlantic cooperation the next activity planned within WP5 was a hands-on workshop, working with colleagues from the US and Canada. The initial aim was to test the open and FAIR nature of the EMODnet Biology data products with alternative source datasets, primarily focusing on inshore coasts and bays around North, South and Central America. In this way the open methodologies developed with WP4 could be seen as transferable and facilitate great interoperability and the development of comparable outputs.

Due to the COVID19 global pandemic, it was not possible to run the event in the original planned format and was moved to an online workshop format.

With participation from 17 European, US and Canadian organisation the event served to demonstrate the process of data product development and sought to initiate closer partnerships and develop dialogues to inform the work of EMODnet Biology in the next phase, including closer links and integration with the global MBON. Key opportunities to progress these relationships included shared code-sprints and knowledge transfer activities. The full workshop report is available on the EMODnet Biology website.

To close the activities of Work Package 5 within Phase III we took the opportunity to celebrate the achievements of all aspects of the partnership (D5.6: End user showcase event - Demonstration of Phase 3 achievements, and agenda setting for future development). Again, the ongoing global pandemic necessitated a move to online delivery, however in this case there was a clear benefit to using videoconferencing tools. The increased reach meant that much broader participation was possible and also enabled the EMODnet Biology team to deliver the same content to participants in different time zones.

The event attracted over 80 colleagues from across Europe and North America. Pre-recorded presentations were used to minimise technical difficulties, and were followed by an open session to allow participants to question the EMODnet Biology team on all aspects of the project and its deliverables to date.

WP6 – Technical update EMODnet biological portal & link with other portals

One of the main improvements at the start of this reporting period was the GeoServer space restructure for the EMODnet Biology data products. The data products were previously accessible through two different name spaces, resulting in two separate web service URLs (Uniform Resource Locator). These have been unified and harmonized into one single service. The metadata content has also been improved (i.e. data download URLs were added) to enhance the INSPIRE compliance of the GetCapabilities request.

The webservices documentation was updated to reflect the new changes and to be more comprehensive and the URL that was kept is: http://geo.vliz.be/geoserver/Emodnetbio/wms?service=WMS&version=1.1.0.

New developments were implemented in the download tracking system and, from 2019-07-01 onwards, it became possible to report on the number of records, record type and downloads.

An additional step was added to the harvesting procedures to generate a view of the available data in order to feed the R Shiny based data availability or reporting tool.

Work was also undertaken in the Darwin Core harvester (the tool used by the data management team to index datasets from different IPT instances into the EurOBIS database) to make the error messages' more verbose, allowing for a quicker identification of possible problems.

Work was initiated, and will continue through Phase IV, to allow for an easy removal of datasets from the harvester. Once implemented, this will avoid dataset duplication, i.e where the dataset exists in multiple IPT (Integrating Publishing Toolkit) instances.

Changes required to comply with data privacy regulation, including the setup of the https protocol for the portal, were implemented. A Brexit disclaimer was added in 2020-02-01 and later removed following DG MARE's request.

The download form was updated to include several mandatory fields that allow for user details collection, assisting in the thematic lot with its metrics' reporting.

In MetaGIS, the tool that manages the metadata and links the geospatial layers to the map viewers, a number of bug fixes were performed and existing code was restructured. For map viewers containing a substantial number of layers, pagination was implemented, which allows these layers to be displayed in multiple pages, and facilitates their management. Changes to the FreeMarker template (.ftl file) allow for the possibility to overwrite from Geoserver in MetaGIS. This ftl file affects the appearance of the WMS GetFeature info and WFS GetFeature calls (e.g. which attributes are shown, what attribute name should be shown, in what layout should the attribute info be shown, etc).

Several enhancements of the EMODnet Biology reporting tool, internal standardisation and documentation (on how the stats that appear on the website are calculated) were also performed.

An internal tool that automates the reporting on the number of downloads per quarter was developed. An email is automatically sent to the Biology team on the 1st day of new quarter, with a delimited file attached that lists the downloads details, which are used for the indicator's reporting.

A technical knowledge transfer was held due to the replacement of an IT staff member. Due to the complexity of the EurOBIS system and related tools (data portal, GeoViewer, indexing process, QC, etc) this was essential for the continuous maintenance and operationality of the EMODnet Biology portal.

The development of a Python client for harvesting the biological data within the SeaDataNet portal (filtered for Biological records) was initiated but as SeaDataNet/MARIS informed the Biology team that a new API was being developed, the Python client development was stopped and is currently waiting for the API to be finalise before this work can be proceed.

The development of a Python tool was initiated with the aim to fully implement and automate the fitness for use label on the datasets and data records. After every data harvest cycle the script will calculate the QC value for every data record which will be translated into a category that users will be able to use for data filtering. From the 20 checks defined, 18 were technically feasible to implement i.e. they could be automated. More info

on the checks can be found in Vandepitte, L. et al. (https://doi.org/10.1093/database/bau125). The code is open source and can be found in the LifeWatch GitHub. The tool was originally developed by OBIS and used as a basis, by EurOBIS, to include further checks. Full implementation is expected in the first few months of Phase IV.

Following the publication of new data products, a tidying up of the GeoServer was done, in order to standardise the layers' names, by adding the acronym "EMODnet" to the beginning, which is hoped, will strengthen the EMODnet brand.

4.Identified issues: status and actions taken

A. Priority issue(s) identified and communicated by CINEA/ DG MARE/ SECRETARIAT				
Priority issue	Status (Pending/ Resolved)	Action(s) taken / remaining actions planned	Date due	Date resolved
All EMODnet data products should start with the acronym "EMODnet"	Resolved	Updates to all (41) biology layers visible in the main EMODnet portal (EMODnet Biology layers)	QR10	QR10
Including in metadata records online resources	Pending	More information is needed on what the expected end result should be	-	
Giving access to all OBIS data through EMODnet	Resolved	Initial discussion was held at the Steering Committee meeting and main obstacles to pursue this are: Request permission from OBIS (not an obstacle *per se* but something that needs to be done before proceeding) Possible data quality issues (OBIS and EMODnet Biology have different levels of quality control, so this shouldn't be a "simple" important of all OBIS data, as it would have to be quality controlled following the established procedures for EMODnet Biology project) Checks on controlled vocabularies needs to be done to make sure the OBIS datasets conform with what has been implemented for EMODnet Biology. Priority datasets will be identified and added to the workplan		
Implementing https on all EMODnet portals	Resolved		31/12/2019	31/12/2019
Implementing Marine-ID	Pending	Review of potential alternatives (QR10 report feedback)		
Updates to Data Protection compliance	Resolved	Data Privacy notice published	11/12/2019	11/12/2019
CINEA request for Brexit disclaimer on all EMODnet portals	Resolved	Following CINEA's confirmation, the disclaimer went live on February 1st 2020	01/02/2020	
Including data and metadata URL in web services of data products	Ongoing	Completed for all layers considered relevant. Secretariat performed an analysis and requested clarification items specific items where this implementation was not optimal		
Portal content post-Brexit	Resolved	UK map representation in EMODnet Biology is not affected by guidelines received. EMODnet Biology focus mainly but not only on European territory (e.g.	31/03/2020	

		we have received data collected in Australia by a European scientist). Statistical data provided by EMODnet Biology (e.g. number of datasets, number of occurrences) includes data collected/made available by all partners/organisations as included in the contract. EMODnet Biology is not affected by UK Eurostat information.		
Banner not displaying correctly	Resolved	EMODnet banner wasn't displaying properly	QR12	
Include data download size (MB) in the quarterly report indicators file	Resolved	Minor changes to download information storing procedures	QR13	
GDPR requirement from SC&DGIT	Resolved	Confirmed no changes were required concerning third party services used on the EMODnet Biology portal	25-08-2020	25-08-2020
Create Terms of use page	Resolved	Page created and text adapted to EMODnet Biology's requirements (https://www.emodnet-biology.eu/terms-use)	QR14	QR15
Assessment of performance				
Portal specifies the schedule for publication of the products	Pending	Provisional dates were agreed and setup with partners however it was not possible to keep them and no product was published in QR15 as initially envisaged. Most delays were due to COVID19 related consequences, with some partners falling ill or having added caring responsibilities that were not envisaged when the workshop took place and the initial deadlines were set	QR15	QR16
Task 5: The EMODnet Secretariat recommends that the Thematic Coordinator is asked on whether the task can be fully achieved (i.e. contact with al RSCs)	Resolved	No delays are envisaged for any Phase III task or deliverables.	QR15	QR15
Portal provides a status update of Deliverable	Resolved	D5.5- Transatlantic workshop was held on October 9th as communicated on QR14 report. Workshop report is available via the website (link included in the narrative for Tasks 5 & 6)	QR15	QR15
It is recommended that the new delivery dates for the 'delayed datasets' would be listed in the Biology Final Report, so that these can be known as they are part of Phase III (and the Biology lot	Ongoing	All Phase III data will referred to as such in future reports	QR16	

is now in Phase IV), so as to ensure delivery in the near future				
It would have been useful to have already included some reflections/highlights/key messages on Deliverable 5.6[1] in the EMODnet Biology Q1 2021 progress report, i.e., indicate which types of feedback were provided in light of the next phase and how EMODnet Biology would take this forward in phase IV. This is especially necessary as the Coordinator states the feedback will be used to 'inform development in the next phase'.	Resolved	The information was not shared in a quarterly report as the meeting report was due to be published and was in the final stages of writing, which happened on 19/04/2021. It can now be found via the link https://www.emodnet-biology.eu/sites/emodnet-biology.eu/files/public/documents/Workshops/Data_Solutions_Changing_Ocean/D5.6.pdf?_t=1618838249	QR16	QR16
There was not update provided on this task in the report. As indicated in the previous assessment report, Secretariat recommends to have a discussion between CINEA/DG MARE and all thematic coordinators at the next Steering Committee meeting in September 2021 to formulate guidance and to understand the objectives of the collaboration (per RSC if possible and per thematic node), and so gain a priority perspective and targeted way forward.	Pending	Updates will be provided in future reports	QR16	
Observations in view of Section 1.7 of the Tender Specifications on Performance and Quality Requirements				
Indicator 1	Resolved	- The decrease in records due to the update of the CPR dataset is accounted for in the narrative. The map figures show only the data harvested during the reported period - Total volume in GB is not available as data are held in a database and files are compiled on the fly as data are requested and downloaded. - The difference in the number of downloads is due to the fact that they refer to different items. The value 70 refers to the number of downloads from the various pages of the Biology portal as reported by Matomo. The value 225 refers to the number of data (unique) downloads as reported by the monitoring systems linked to the download toolbox.	QR15	QR15

		- Webservices trends are not reported as there is no system in place to obtain this information		
Indicator 2	Resolved	- Considering the changes that will occur in phase IV, it is considered that performing such changes are not a good use of the time/resource as it would involved a number of technical developments on the download toolbox which, after 6 months will be deprecated	QR15	QR15
Indicator 5 & 6	Pending	- Sum of European countries added for QR15 indicators. It was not included in QR14 due to an omission - The statistics collected on the number of use cases viewed each quarter show that they do spark a big interest with our users (be it through the Biology or the Central portals). The project's coordination board will discuss whether the time/resource required to produce such use cases will result in an increase of their uptake	QR15	QR16
Indicator 5	Resolved	The Secretariat noted some data entry errors in the excel table, i.e., 206 users giving information, vs. 23 total users for quarterly period. It was therefore not possible to interpret the results and perhaps clarify this in the final report which is still due. - It is indeed a typo and 23 should be replaced by 206 (all users provided information)	QR16	
Indicator 8	Resolved	Due to an omission the statists for acquisitions were not included in the QR14 report.	QR15	QR16
Indicators 9, 10 & 11	Resolved	As referred by the Secretariat, a bug in the figures for QR14. The figures for QR15 (which also include the previous quarter) indicate that decrease was not as accentuated as it appeared. Also note that the QR14 reporting period covered the summer months in a year where research (field work) was severely limited due to COVID	QR15	QR15
Summary of the data and data products available should be included in the portal	Pending	Updates to the portal will be required due to phase IV funding and this summary can be included in this work	QR15	QR17
Other technical recommendations/advice				
Organisation of the web-services	Pending	Further clarification is requested as this feedback is not clear. The page https://www.emodnet-biology.eu/emodnet-biology-api was	QR15	QR16

		updated in early June, ahead of the WP4 workshop. Even though the Secretariat reported timeouts, the tools monitoring the webservices operationality and reliability indicate that the portal is consistently above 99.5% reliability, so the instances found could have been due to glitches and not reflective of the portal's performance.		
Report compliance, completeness and quality				
Final report due on 18/04/2021	Resolved	The date is included as stated on the call for tenders, however the actual submission date is two months after the end of each phase, so in this case 18/06/2021	QR17	QR17
Progress solving identified issues				
The portal has made progress on this issue but while their report indicates this issue as resolved, outstanding tasks remain	Ongoing	The portal requests that better communication and timely checks (e.g. every month) are done on the metadata URL so there is enough time to resolve them ahead of QR submission		

B. Issues / challenges identified by the thematic assembly group itself				
Priority issue / challenge	Status (Pending/Resolved)	Action(s) taken / remaining actions planned	Date due	Date resolved
Change of staff (project leader)	Resolved	Ensure overlap between former and current project coordinator, document work and procedures, maintain solid communication channels with work package leaders, organize coordination board meeting.	QR8	QR8
Change of staff (data manager)	Resolved	An additional data manager was hired ensuring an overlap to transfer knowledge. All the procedures had already been documented in our internal system (Confluence). The core activities (communication with providers, data standardization, harvesting and publication) are being	QR9	QR9

		kept. Additional features will experience some delays (e.g. data availability tool).		
Three marine regions missing from the dataset used in the reporting tool	Resolved	Datasets included in the reporting spreadsheet are up to date Investigation by IT colleagues to determine which part of the procedures allowed for this error to happen Procedures will be set in place to prevent these issues from arising in future reports	QR11	QR11
New staff	Resolved	With a senior staff member leaving, a new team member was recruited to handle the harvest tasks. This had as a consequence a slight increase in the ingestion time due to knowledge acquisition	QR10	QR10
Data download toolbox free text search not working properly	Resolved	Bug fixing	QR12	
Data download form to include standardised organisation type, country and purpose	Resolved	Implemented on development server, waiting to be made live	QR13	2020-06-03
Data download toolbox does not retrieve all parameters when they are not linked to occurrences	Pending	Feature request		
Data product gallery not easy to find **(https://www.emodnet-biology.eu/data-products)**	Pending	Solution proposed is to merge this page with https://www.emodnet-biology.eu/toolbox/en/gallery/		
Changes in download form to more consistently capture user information	Pending	Include dropdown list of standardised Organisation type, country and purpose. These three fields will be mandatory	QR13	2020-06-03
Standardisation of how statistics in https://www.emodnet-biology.eu/statistics are calculated	Resolved	Implemented internal consistency in reporting and documented how the numbers are calculated	QR14	QR14

Accepting OBIS files instead of DwC-A files?	Resolved	No action. Our procedures are designed for DwC-A files, no other (DwC) formats are accepted	QR14	QR14
Improvements to EMODnet Biology Biocheck tool	Pending	Feature requests to make the tool more user friendly		
Issues with MACROBEL, POHJE and NSBS datasets	Ongoing	Data management team will analyse each dataset and assess the work required	QR15	QR16
Removing data from a DOI-ed dataset	Resolved	Clarified with partner what procedures could be done, when they could be done and when they would be in place. Also clarified the rules for a dataset DOI	QR15	QR15
Partner request for team to disclose dates when data are harvested so they can adjust their work patterns	Resolved	Data management team will assess all pros and cons with the release of exact dates. At present, an email is sent to all partners one month ahead of the data harvest process so they can submit any datasets they have been working on	QR15	QR16
Setup of a Python client for SeaDataNet API	Ongoing	Initial development started in QR15 and testing will commence in QR16	QR16	
QC flag implementation	Ongoing	QC steps to be implemented in the database which will allow users to select the data based on the fitness for purpose. These checks are consistent with the ones implemented in OBIS. Initial development started in QR15	QR16	
COVID impact: the pandemic has affected several partners and data grant holders. The consequences were a delay in completion of tasks (e.g. data submission by data grant holders) and a decrease in the activity and response by some	Ongoing	The WP leaders where the consequences of the delays were more visible have been made aware and new plans forged as deemed appropriate, in order to ensure that the		

partners. Communication was established with all partners and data grant holders to ensure that no technical issues were impacting their work		project is finalised with all deliverables complete.		

5.Allocation of project resources

Allocations are based on the EMODnet Biology budget, as approved on the proposal submitted, and on a rough assessment on the required resources, as some categories fall under various Work Packages.

Information on the allocation of project resources	
Categories	Resource usage (%)
Making data and metadata interoperable and available	52%
Preparing data products	15%
Preparing web-pages, viewing or search facilities	3%
Managing user feedback	3%
Project management	10%
Outreach and communication activities	17%
Others	-

In 'Outreach and Communication' activities included are not only the publication of news and tweets but also events attended and/or organised, as well as the peer reviewed paper published in 2020.

The category "Preparing web-pages, viewing or search facilities" includes non-IT technical work, and therefore the resource spent is low as no structural changes were implemented in the portal over the past two years. Changes implemented were all related to content.

6. User feedback (Contact us form, online chat & other communication means)

Overview of user feedback and/or requests received in this quarter							
Date	Organisation	Type of user feedback (e.g. technical, case study, etc.) and short description of the feedback received	Means of contact	Response time	Status of user query: resolved/pending	Measures taken to resolve the query	Status: if not (yet) resolved/pending, explain reason why and expected timeline
03/05/2019	Individual	Staff member from Oceana Europe asking for clarifications on additional data available from MediSEH and how to access it.	Email	4 days	Resolved		
04/06/2019	Individual (PhD)	Marine biologist from NUI Galway interested in sharing part of the data from their projects.	Email	3 days	Resolved		
09/08/2019	Marine Geospatial Ecology Lab Nicholas School of the Environment (Duke University)	Downloading gridded abundance maps on EMODnet?	Email	Within 1 day	Resolved		
02/09/2019	ILVO	EMODNET Benthic dataset for ICES WGFBIT purpose	Email	< 1 day	Resolved		

27/09/2019	EMODnet Seabed Habitats	Request for environmental temperature and salinity data.	Email	< 1 day	Resolved		
16/10/2019	VLIZ	LifeWatch EMODnet Biology QC tool technical issues	Email	1 day	Resolved	File used for QC had issues. No action required from	
22/01/2020	VLIZ	Technical (Map search in the download toolbox is not working)	Email	1 day	Resolved	Bug fixed	
04/03/2020	Algarve University (CCMAR)	EMODet Data product download advice	Email	3 weeks-initial reply sent on 05/03/2020	Resolved	Directed user to links from where the data products could be downloaded	
19/03/2020	EMODnet Secretariat	Help to search/download Bowhead Whale data	Email	1 day	Resolved	Showed how the download toolbox works and how to search for the data in the catalogue	
2020-06-16	Marine Institute, Ireland	Difficulty downloading OOPS data product	Email	1 day	Resolved	File sent manually. Technical issue subsequently fixed	
2020-06-18	Private	Information about EMODnet Biology Workshop/Ocean Teacher course	Email	1 day	Resolved	Workshop was almost over, suggested that user enrols in course once it is made public in July	
14/07/2020	NIB	Request to access http://www.eurobis.org/imis?module=dataset&dasid=744 to assess new	email	< 1 day	Resolved	Clarified contents of dataset and how user could submit new data for an update. Sent links to OBIS-ENV	

		additions and how to cite the dataset				format, and download toolbox	
10/07/2020	CSIRO	Information for a global map of marine biological observing networks	Email forwarded by EMODnet Secretariat	4 days	Resolved	Clarified data flow in Europe, how to access biological monitoring data through EMODNet Biology catalogue and directed user to EMODnet Biology partners and EurOBIS providers	
10/08/2020	NIOZ	Requested .XML file to examine zooplankton data	Email forwarded by EMODnet Secretariat	1 day	Resolved	Question was not clear as EMODnet Biology does not provide information in .XML. Directed user to API, download toolbox and IPT, all accessible from the portal.	
20/08/2020	EuroGOOS	Map EMODnet Biology infrastructure	Email forwarded by EMODnet Physics	2 weeks (first email replied on the same day)	Resolved	After clarifying what information, the user was asking for, an export of specific catalogue fields was provided	
07/09/2020	Blackpool & Fylde College	Extracting data from EMODnet Biology	Email forwarded by EMODnet Secretariat	1 week (delay due to holidays)	Resolved	Clarified, for the specific dataset how data could be accessed and what the different file formats were and how they could be visually checked	

28/09/2020	OBIS	Clarification on restricted datasets	email	< 1 day	Resolved	Majority of datasets are from HCMR, OBIS harvests them from MedOBIS and not EurOBIS. Contacted HCMR for them to update their records. Remaining datasets will be checked by data management team	
01/10/2020	Academic/Research	Request for clarification on species information	email	1 day	Resolved	Provided an explanation on how to query the data in the download toolbox and briefly explained how species are added to the various taxonomic catalogues	
18/10/2020	Commercial	Information for Poseidon Pipelines	Contact form	1 day	Resolved	Directed to Human Activities as this was most likely within their remit	
04/11/2020	Private	Delete Profile Picture from the OpenSeaLab 2019	email	1 day	Resolved	GDPR guidance followed, action completed	
01/12/2020	Private	EMODnet Biology workshop on data formatting QC & publishing	email	1 day	Resolved	Directed user to online training course available through the Ocean Teacher platform	
03/12/2020	Academia/Education	Arctic Shipping Datasets	Contact form	1 day	Resolved	Directed user to various possible sources of information	

						including the Vessel density layer in the Central Portal	
11/12/2020	Academia/Education	SOCIB Sharing data request	email	Ongoing	Pending	Directed user to information on the portal and more questions were asked about the data file submission during the Christmas break, these were replied in January	Pending more questions from user before setting this query to resolved
05/01/2021	EOSC WP4 partner	Requested examples of the categorisation of sensitive data and resources	Email	1 day	Resolved	provided information on best practises used within the Biological community, included examples of datasets where data are considered sensitive and clarified how the matter was approached	
25/01/2021	Commercial	Request to fill in a survey to assist with options to replace JNCCC's Marine recorder	Email	1 week	Resolved	Survey filled in	
26/01/2021	Commercial	Requested information on associated parameters for a dataset accessible via OBIS	Email	1 day	Resolved	Clarified how additional information could be retrieved if available	
10/02/2021	International organisation	Requested information on news, courses, workshops and other activities	Email	1 day	Resolved	Clarified that such information is available via the website, Twitter and	

						also the EMODnet news digest	
01/03/2021	International organisation	Feedback related to the "Data solutions for a changing Ocean" event	Email	1 day	Resolved	User participated in the event, which took place on March 24th and questions were answered. A future follow up on this feedback is planned	
01/03/2021	Government agency	Forwarded by OBIS secretariat. requested information on data submitted to GBIF would flow to OBIS	Email	1 day	Resolved	Clarified how the OBIS network works and how data can flow from GBIF to the OBIS nodes and then OBIS	

7.Meetings/events held/attended & planned

A. Meetings/events organised and attended					
Date	Location	Type event (internal or external meeting, training/workshop)	Indicate if a ppt was given (yes/no + short description)	Meeting attended (A) / organised (O)	Short description and main results (# participants, agreements made, etc.)
07/05/2019	Liverpool	External: SeaDataCloud Steering Group meeting	No	A	Presented progress in transformation tool ODV to DwC and discussed content for the SDC training workshop in June.
15/05/2019	Lisbon	Internal: EMODnet Biology stakeholder event	Yes	O	Showcase the Atlas of Marine life and get feedback and engage in discussion for future work with a range of end users.
16-17/05/2019	Lisbon	Internal: EMODnet Biology general meeting	Yes	O	Discuss progress and upcoming priorities for the EMODnet Biology consortium.
24/05/2019	Brussels	External: OSL II Kick-off meeting	No	A	Event to officially open registration for the second edition of the EMODnet OSL hackathon. All the EMODnet thematic lots were presented.
27/05/2019	Oostende	External: Meeting with OBIS	No	O	To discuss with OBIS on the new VLIZ structure and future collaborations in relation to new data types.
28/05/2019	Remote	Internal: Meeting with Aarhus University	No	O	WP2 breakout session via skype (Aarhus U. could not attend the EMODnet meeting).
13-14/06/2019	Oostende	External: FAIR data workshop (Assemble +)	Yes Presented interoperability using EMODnet Biology as an example.	A (as trainer)	Course focussed on the specific Data FAIRness phase in the Environmental and Earth sciences URL: https://www.lifewatch.eu/web/guest/iss-data-fairness

19 & 24/06/2019	Oostende	External: SDC Training session	Yes Presented automated QC procedures for biological data.	A (as trainer)	Presented results on integration of biological data generated by the project URL: http://www.jerico-ri.eu/events/jerico-next-final-general-assembly/
28/06/2019	Brussels	External: E-BIND focus group meeting		Attended	20 participants Progress since last SC meeting Discussions on data accessibility to support the implementation of the Birds and Habitats Directive.
04/09/2019	Ghent, Belgium	Internal: EMODnet Technical Working Group	Yes	A	Ongoing technical bottle necks were discussed and suggestions to move forward
04/09/2019 to 06/09/2019	Ghent, Belgium	External: EMODnet Open Sea Lab II	Yes	A/O	70 participants Hackathon in Ghent, coaching to teams and data and services used were from EMODnet Biology
18/09/2019	Oostende, Belgium	Internal: Meeting with partner (ILVO)	No	A/O	Three main items were discussed, two of them of a technical nature (IPT and DwC related) and one related with datasets for next harvest. 7 dataset updates and one new dataset will be included in the next harvest.
16/09/2019 to 20/09/2019	Honolulu, Hawai'I, USA	External: OceanOBS19	No	A	1368 participants Participation in breakout sessions and networking activities, contribution to EMODnet white paper URL: http://www.oceanobs19.net/
24/09/2019	Online call	Internal: WP4 meeting with WoRMS, WP2, WP6	No	O	Discussion on (meta)data recommendations from WP5, WoRMS traits work and EMODnet database work (WP2, WP6).

02/10/2019 to 04/10/2019	Pisa, Italy	External: EOSC Blue-Cloud Kick-off meeting	Yes	A	Presentation on the current state of EMODnet Biology and EurOBIS infrastructures.
22/10/2019 to 25/10/2019	Leiden, Netherlands	External: BioDiversity Next Conference	No	A	Main objective this year was networking More than 700 attendees from 76 countries
05/11/2019 to 08/11/2019	Santa Marta, Colombia	External: SG-OBIS-Eighth session of the IODE Steering Group for OBIS	No	A	WP2, WP3 and WP5 leaders attended this meeting. Report not published at the time of report drafting
02/12/2019 and 06/12/2019	Online	Internal: Data grant evaluation (WP1, WP2, WP3, WP4 and WP5 leaders)	No	O	Analysis of submitted proposals Evaluation of said proposals following criteria established in the call
16/12/2019	Online	Internal: WP3 archaeology datasets meeting	No	O	From an initial inventory of >230 datasets a discussion was held on which ones to prioritise and how to proceed with the available information
20/12/2019	Lisbon, Portugal	External: Meeting with EMSA	Yes	A	Overview of EMODnet Biology Discussion of opportunities for the use of EMODnet Biology data Highlighted Annual conference in 2020
22/01/2020	Online	Internal meeting with partner (ICES)	No	O	Clarification on ICES dataset status
03/03/2020 and 13/02/2020	Online	Internal meeting with partner (ICES)	No	O	Provide support in data reformatting to new ICES data manager
13/02/2020	Online	Internal meeting with partner (IFREMER)	No	O	Clarify IFREMER's status in the project and reassign tasks within WP2 and WP4
28/02/2020	Oostende, Belgium	External: Advancing Data Stewardship Workshop	No	A/O	http://lifewatch.be/en/advancing-data-stewardship

06/03/2020	Hasselt, Belgium	External: Open Belgium	No	A	https://2020.openbelgium.be/session/breaking-out-research-data-cycle-20-years-marine-data-management
2020-04-20	Online	External: CMEMS-EMODnet Coordination meeting	No	A	Bring together EMODnet, CMEMS, inter-DG representation and the EEA to discuss marine data and data products and information on Coastal behaviour. Objectives include assessing existing capabilities and emerging areas for collaboration across EMODnet themes and between EMODnet and CMEMS, in particular with a regional focus
2020-04-21/22	Online	Internal: EMODnet Steering Committee	Yes	A/O	DG MARE Vision Objectives & Priorities for next phase of EMODnet, General feedback and discussion on EMODnet central Portal Gateway framework, Interactions with other initiatives, framework for new developments, prioritisation of ongoing developments
2020-04-23/24	Online	Internal: EMODnet Technical Working Group	Yes	A/O	DG MARE Vision Objectives & Priorities for next phase of EMODnet and implications, Updates and progress since last meeting, technical development framework in view of new developments
2020-06-8/19	Online	Internal: WP2/WP3 Workshop on Data formatting, Quality control and Publishing	Yes	O	Provide training to current and future data providers on how to format and submit their data to EMODnet Biology. An average of 34 participants participated in 11 online sessions over the course of two weeks.
2020-06-15/21	Online	Internal: WP4 Data Product Workshop	Yes	A	Production of consistent data products resulting from the integration of several underlying datasets. 15 participants from the various partner organisations were involved in the workshop

2020-06-16	Online	External: EMODnet-CMEMS Thematic Workshop on Coastal Issues	No	A	Bring together EMODnet, CMEMS, inter-DG representation and the EEA to discuss marine data and data products and information on Coastal behaviour. Objectives include assessing existing capabilities and emerging areas for collaboration across EMODnet themes and between EMODnet and CMEMS, in particular with a regional focus
15/07/2020	Online	External: Exotic Invasive Aquatic Species Webinar	No	A	> 100 participants Not much outcome as when attending I realised the focus was on freshwater and not marine species
22 September 2020	Online	External: 10 years of EMODnet Webinar	Yes (EMODnet Biology overview and highlights to be included in the 10 years-10 minutes presentation)	A	> 250 participants
22 and 24 September 2020	Online	Internal: EMODnet Biology annual meeting	Yes Each WP gave a status updated for the first year and presented the collated feedback	A/O	>50 participants All partners and several Associated Data Partners attended Meeting summary will be published in the form of a report
2020-09-30 and 2020-10-01	Online	Meeting (internal)	Yes: presentation on work done over previous year, information merged with other Belgium partners	A	- EMODnet Ingestion meeting
2020-10-09	Online	Workshop (internal)	Yes: presentation on EMODnet Biology and	A/O	- WP5 Transatlantic Data Product workshop - 24 participants from various international organisations

			on EMODnet Biology data products		- Details can be found in workshop report via this link
2020-10-12	Online	Workshop (external)	Yes: EMODnet Biology scope, standardisation procedures, available resources collated by the EMODnet secretariat with information from other lots	A	- International data sharing workshop for non-UN IGOs, Global and Regional organisations and projects, NGOs and private sector
2020-10-20/21	Online	Meeting (external)	No	A	- Marine Data in Support Aquaculture in the North Atlantic
2020-11-9/10	Online	Meeting (internal)	Yes:	A	- 13th EMODnet Steering Committee meeting
2020-11-12/13	Online	Meeting (internal)	Yes	A/O	- 8th EMODnet Technical Working Group meetings
2020-11-19	Online	Seminar (external)	No	A	- EMB Science Webinar - Marine Citizen Science
2020-11-23/24/25	Online	Conference (external)	Yes	A	- EVOLMAR: 1st Italian conference on Marine Evolution - Oral session where a presentation on "How can EMODnet Biology be used for marine biodiversity studies?" was given - Book of abstracts can be accessed via the link - Social media presence in both Twitter and Facebook - 200+ participants
2020-11-24	Online	Meeting (internal)	No	A	- Discussed how we are going to address Genomics data - Included not only VLIZ but also OBIS colleagues (10 participants)

					- Coordinated approach within VLIZ so we align with the work OBIS is also doing in this area
18-29/01/2021	Online	External (conference)	No	A	ASSEMBLE Plus 2021: Marine biological research at the frontier Pursuit of collaborations for marine biological data sharing Presentation of Interuniversity Institute for Marine Sciences (EMBRC Israel): 58 participants Presentation of National Institute for Biology (Slovenia): 28 participants Presentation of IOPAS (Poland): 25 participants Technology demonstrations Presentation of the Alfred-Wegener-Institut für Polar-und Meeresforschung - Biologische Anstalt Helgoland Helgoland, Germany: 37
27/01/2021	Online	External (workshop)	No	A	Workshop on integrating an ecosystem-based approach into maritime spatial planning
26-27/01/2021	Online	External (conference)	No	A	Copernicus Assembly
09/02/2021	Online	External (meeting)	No	A	5th EMODnet-CMEMS coordination meeting
10/02/2021	Online	External (Seminar)	No	A	MASTS Seminar: Subsea power cable electromagnetic fields and effects on marine species
19/02/2021	Online	External (meeting)	Yes	A	EMODnet and Nature Presentation on EMODnet Biology and Seabed Habitats lots. Discussion on how data relevant for Nature Directives can be integrated in the EMODnet system

23/02/2021	Online	External (webinar)	No	A	SEArica: Sharing responsibility- a coherent approach to European ocean observation 100 + participants
03/03/2021	Online	External	No	A	VLIZ Marine Science Day
24/03/2021	Online	External (workshop)	Yes	O	Data Solutions for a Changing Ocean The event had 65 participants split in two sessions (morning and afternoon). Brief presentations of EMODnet Biology, data management and flow and data products were done followed by a discussion with the participants on how we can best support their activities in terms of developing new products and/or services
24-25/03/2021	Online	External (Workshop)		A	Marine Data for Aquaculture, Mediterranean and Black Sea

B. Meetings/events planned in the future				
Date	Location	Type event (meeting, training (workshop), etc.)	Meeting to be attended (A) / organised (O)	Short description and main expected outcomes
12-14/04/2021	Online	Conference	A	IMDIS 2021- International Conference on Marine Data and Information Systems
19/04/2021	Online	Meeting	O	EMODnet Steering committee
20-21/04/2021	Online	Meeting	A/O	EMODnet Technical Working Group
17/05/2021	Online	Meeting	O	EMODnet Biology end of Phase III meeting
18 and 21/05/2021	Online	Meeting	O	EMODnet Biology Phase IV kick off

8.Communication assets

A. Communication assets				
Date	Communication material	Short description (of the material, title, …) and/or link to the asset	Main results	Name of event at which material was disseminated (if applicable)
QR9	Tweets	Various tweets	11	
QR9 12/04/2019 10/05/2019	News	 Save the date: 15/05/2019. A Showcase for the European Atlas of Marine Life EMODnet Biology General meeting	1	
QR9 13-14/06/2019 19 & 24/06/2019	Various	Presentations: During a FAIR Data workshop organized by Assemble+, EMODnet Biology was used as an example on how different standards enable interoperability Presentation on EMODnet Biology and automatic QC procedures on two sessions of the SDC training workshops	2	
QR10	Tweets	Various tweets	15	
QR10 25/09/2019	News	 2nd Open Sea Lab Hackathon: https://www.eu-atlas.org/news/project-news/131-2nd-open-sea-lab-hackathon Having Fun With Marine Data – OpenSeaLab 2: https://www.eu-atlas.org/news/project-news/131-2nd-open-sea-lab-hackathon Open Sea Lab II boosting new data product ideas: http://www.vliz.be/en/news?p=show&id=8004	3	
QR10 26/08/2019 to 30/08/2019	Various	Poster: Where did all the cod go? (URL: https://2019.foss4g.org/)	1	
QR11	Tweets	Various tweets	17	
QR11 23/10/2019 04/11/2019 05/11/2019 06/11/2019 07/11/2019 28/11/2019 17/12/2019	News	Grant call: http://www.emodnet.eu/emodnet-biology-call-data-grant http://www.emodnet-biology.eu/news?p=show&id=8074 http://www.emodnet-biology.eu/news?p=show&id=8076 Open SeaLab: http://www.emodnet.eu/open-sea-lab-ii-film-report-and-future Grant call: https://www.euromarinenetwork.eu/calls/emodnet-biology-call-data-grants http://www.emodnet-biology.eu/news?p=show&id=8115 https://www.emodnet-biology.eu/news-0?p=show&id=8144	7	
QR11	Other	Videos (https://youtu.be/ixG2HtppGn4, https://youtu.be/9sJBqQzPmXk and https://youtu.be/PBiPa6X-KiM) email (Data grant call distributed to several networks) Website announcements	2	
QR12	Tweets	Various tweets	50	NA

QR12 2020-02-25	News	EMODnet Biology workshop on data formatting QC & publishing: https://www.emodnet-biology.eu/news?p=show&id=8260	1	NA
QR13	Tweets	Various tweets	35	NA
QR13 2020-06-03 2020-06-15 2020-06-22	News	https://www.emodnet-biology.eu/news?p=show&id=8389 https://www.emodnet-biology.eu/news?p=show&id=8406 https://www.emodnet-biology.eu/news?p=show&id=8425	3	NA
QR14	Tweets		47	NA
QR14 20/07/2020 10/08/2020 15/09/2020 15/09/2020	News	The EMODnet Biology workshop on data formatting, QC and publishing course is now easily accessible through OceanTeacher!: https://www.emodnet-biology.eu/news?p=show&id=8457 EMODnet Biology Interim report now available online https://www.emodnet-biology.eu/news?p=show&id=8474 EMODnet Biology Annual meeting: https://www.emodnet-biology.eu/news?p=show&id=8495 More than 1000 datasets now available for download!: https://www.emodnet-biology.eu/news?p=show&id=8496	5	NA
QR15	Tweets		83	NA
QR15 02/10/2020 13/10/2020 03/11/2020 18/11/2020 24/11/2020 09/12/2020 11/12/2020 11/12/2020	News	EMODnet Biology WP5 transatlantic data products Workshop (https://www.emodnet-biology.eu/news?p=show&id=8516) Last harvest/ingestion cycle of 2020 (https://www.emodnet-biology.eu/news?p=show&id=8556) Last data ingestion procedure of the year has started (https://www.emodnet-biology.eu/news?p=show&id=8580) Quarterly Report (01/07/2020 –30/09/2020) published (https://www.emodnet-biology.eu/news?p=show&id=8583) WP3 Deliverable on text mining is now published (https://www.emodnet-biology.eu/news?p=show&id=8615) EMODnet Biology annual meeting report is published (https://www.emodnet-biology.eu/news?p=show&id=8621) Last data harvest of the year complete! (https://www.emodnet-biology.eu/news?p=show&id=8623) WP5 Transatlantic Data Product Workshop (https://www.emodnet-biology.eu/news?p=show&id=8624)	8	
QR16	Tweets		68	NA
QR16 01/02/2021 05/02/2021 08/02/2021	News	EMODnet WFS R Package (https://www.emodnet-biology.eu/news?p=show&id=8662) Last harvest/ingestion cycle of EMODnet Biology Phase III (https://www.emodnet-biology.eu/news?p=show&id=8666) Data Solutions for a Changing Ocean online event (https://www.emodnet-biology.eu/news?p=show&id=8670)	8	

09/02/2021 08/03/2021 08/03/2021 19/03/2021 26/03/2021		Data product: Numerical abundance of benthic macroinvertebrates in North Sea and Baltic Sea (https://www.emodnet-biology.eu/news?p=show&id=8671) Quarterly Report (01/10/2020 –31/12/2020) published (https://www.emodnet-biology.eu/news?p=show&id=8673) Data product: Presence/Absence maps of phytoplankton in the Greater Baltic Sea (https://www.emodnet-biology.eu/news?p=show&id=8701) Last data harvest for EMODnet Biology Phase III (https://www.emodnet-biology.eu/news?p=show&id=8713) EMODnet Biology Stakeholder Event- Data Solutions for a Changing Ocean (https://www.emodnet-biology.eu/news?p=show&id=8715)		

B. Planned communication assets			
Date	Communication material	Short description (of the material, title, …) and/or link to the asset	Main results expected
	Tweets	Datasets made available during last Phase III harvest, news about Phase IV, events where we will attend and/or organise, information on Phase III	Increase visibility and # followers, engagements and users of our data
	News items	Last harvest of Phase III results, data products publication, project information	Increase visibility, disseminate project's activities
	Use cases	Targeting various stakeholders	

List of known publications using EMODnet data or data products				
Date	Type and name of journal, conference, …	Publication title	Author(s)	Organisation(s)
2019	EEA Technical Report	Biodiversity in Europe's seas. ETC/ICM Technical Report 3/2019: European Topic Centre on Inland and Marine Waters ISBN 978---3---944280---64---6	Vaughan D., Korpinen S., Nygård H., Andersen J.H., Murray C, Kallenbach E., Jensen N.J., Tunesi L., Mo G., Agnesi S., Klančnik K., Herbon C., Singleton G., Pagou K., Borja Á., Reker J	European Environment Agency, European Topic Centre European Topic Centre on Inland, Coastal and Marine waters (ETC/ICM)
17/07/2019	Frontiers in marine Science (https://doi.org/10.3389/fmars.2019.00395)	A Response to Scientific and Societal Needs for Marine Biological Observations	Nicholas J. Bax1,2*, Patricia Miloslavich2,3*, Frank Edgar Muller-Karger4, Valerie Allain5, Ward Appeltans6, Sonia Dawn Batten7, Lisandro Benedetti-Cecchi8, Pier Luigi Buttigieg9, Sanae Chiba10,11, Daniel Paul Costa12, J. Emmett Duffy13, Daniel C. Dunn14, Craig Richard Johnson2, Raphael M. Kudela15, David Obura16,17, Lisa-Maria Rebelo18, Yunne-Jai Shin19,20, Samantha Elisabeth Simmons21 and Peter Lloyd Tyack22	1 Oceans and Atmosphere, CSIRO, Hobart, TAS, Australia 2 Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, TAS, Australia 3 Departamento de Estudios Ambientales, Universidad Simón Bolívar, Caracas, Venezuela 4 Institute for Marine Remote Sensing, College of Marine Science, University of South Florida, St. Petersburg, St. Petersburg, FL, United States 5 Secretariat of the Pacific Community, Noumea, France 6 Intergovernmental Oceanographic Commission of UNESCO, IOC Project Office for IODE, Ostend, Belgium 7 The CPR Survey-MBA, Nanaimo, BC, Canada 8 Department of Biology, University of Pisa, CoNISMa, Pisa, Italy 9 Helmholtz Zentrum für Polar- und Meeresforschung, Alfred Wegener Institut, Bremerhaven, Germany 10 JAMSTEC, Yokohama, Japan

				11 UNEP-WCMC, Cambridge, United Kingdom 12 Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, Santa Cruz, CA, United States 13 Smithsonian, Washington, DC, United States 14 Nicholas School of the Environment, Duke University, Durham, NC, United States 15 Ocean Sciences Department, University of California, Santa Cruz, Santa Cruz, CA, United States 16 Coastal Oceans Research and Development in the Indian Ocean (CORDIO East Africa), Mombasa, Kenya 17 Global Change Institute, The University of Queensland, Brisbane, QLD, Australia 18 International Water Management Institute, Regional Office for SE Asia and The Mekong, Vientiane, Laos 19 MARBEC (IRD, Univ. Montpellier, IFREMER, CNRS), Montpellier, France 20 Department of Biological Sciences, Ma-Re Institute, University of Cape Town, Cape Town, South Africa 21 Marine Mammal Commission, Bethesda, MD, United States 22 Marine Biological Association, Nanaimo, BC, Canada
07/08/2019	Frontiers in Marine Science (https://doi.org/10.3389/fmars.2019.00440)	Ocean FAIR Data Services	Toste Tanhua1*, Sylvie Pouliquen2, Jessica Hausman3, Kevin O'Brien4, Pip Bricher5, Taco de Bruin6, Justin J. H.	1 GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany 2 IFREMER, Plouzané, France

			Buck7, Eugene F. Burger8, Thierry Carval2, Kenneth S. Casey9, Steve Diggs10, Alessandra Giorgetti11, Helen Glaves12, Valerie Harscoat2, Danie Kinkade13, Jose H. Muelbert14, Antonio Novellino15, Benjamin Pfeil16, Peter L. Pulsifer17, Anton Van de Putte18, Erin Robinson19, Dick Schaap20, Alexander Smirnov21, Neville Smith22, Derrick Snowden23, Tobias Spears24, Shelley Stall25, Marten Tacoma6, Peter Thijsse20, Stein Tronstad26, Thomas Vandenberghe18, Micah Wengren23, Lesley Wyborn27 and Zhiming Zhao28	3 Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, United States 4 Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA, United States 5 Southern Ocean Observing System, University of Tasmania, Hobart, TAS, Australia 6 NIOZ Royal Netherlands Institute for Sea Research, and Utrecht University, Texel, Netherlands 7 National Oceanography Centre–British Oceanographic Data Centre, Liverpool, United Kingdom 8 NOAA Pacific Marine Environmental Laboratory, Seattle, WA, United States 9 NOAA National Centers for Environmental Information, Silver Spring, MD, United States 10 Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, United States 11 Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Sgonico, Italy 12 British Geological Survey, Nottingham, United Kingdom 13 Woods Hole Oceanographic Institution, Woods Hole, MA, United States 14 Instituto de Oceanografia, Universidade Federal do Rio Grande, Rio Grande, Brazil 15 ETT, Genova, Italy

				16 Bjerknes Centre for Climate Research, University of Bergen, Bergen, Norway 17 National Snow and Ice Data Center, University of Colorado Boulder, Boulder, CO, United States 18 Royal Belgian Institute for Natural Sciences, Brussels, Belgium 19 Earth Science Information Partners, Boulder, CO, United States 20 MARIS Mariene Informatie Service, Voorburg, Netherlands 21 Arctic Portal, Akureyri, Iceland 22 GODAE Ocean Services, Melbourne, VIC, Australia 23 U.S. Integrated Ocean Observing System, Silver Spring, MD, United States 24 Fisheries and Oceans, Science Branch, Maritimes Region Ocean Data and Information Section, Dartmouth, NS, Canada 25 American Geophysical Union, Washington, DC, United States 26 Norwegian Polar Institute, Tromsø, Norway 27 National Computational Infrastructure, Australian National University, Canberra, ACT, Australia 28 Informatics Institute, University of Amsterdam, Amsterdam, Netherlands
2020	MCCIP Science Review (https://hdl.handle.net/10.14465/2020.arc14.dsh)	Impacts of climate change on deep-sea habitats, relevant to the coastal and marine environment around the UK	Jeffreys, R.M.; Robson, L.M.; Narayanaswamy, B.E.	University of Liverpool Scottish Association for Marine Science

20/03/2020	Science of The Total Environment (https://hdl.handle.net/10.1016/j.scitotenv.2019.136144)	Cleaning up seas using blue growth initiatives: Mussel farming for eutrophication control in the Baltic Sea	Kotta, Jonne; Futter, Martyn; Kaasik, Ants; Liversage, Kiran; Rätsep, Merli; Barboza, Francisco R.; Bergström, Lena; Bergström, Per; Bobsien, Ivo; Díaz, Eliecer; Herkül, Kristjan; Jonsson, Per R.; Korpinen, Samuli; Kraufvelin, Patrik; Krost, Peter; Lindahl, Odd; Lindegarth, Mats; Lyngsgaard, Maren Moltke; Mühl, Martina; Sandman, Antonia Nyström; Orav-Kotta, Helen; Orlova, Marina; Skov, Henrik; Rissanen, Jouko; Šiaulys, Andrius; Vidakovic, Aleksandar; Virtanen, Elina	Estonian Marine Institute Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences GEOMAR Helmholtz Centre for Ocean Research Kiel Department of Aquatic Resources, Swedish University of Agricultural Sciences Department of Marine Sciences – Tjärnö Marine Laboratory, University of Gothenburg Novia University of Applied Sciences Marine Research Centre, Finnish Environment Institute Coastal Research and Management Musselfeed AB Orbicon, Department for Nature and Environment AquaBiota Water Research Sankt-Petersburg Research Centre of Russian Academy of Science DHI Marine Research Institute, Klaipeda University Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences Environmental and Marine Biology, Åbo Akademi University
15/06/2020	Journal	Occupancy-derived thermal affinities reflect known physiological thermal limits of marine species https://doi.org/10.1002/ece3.6407	Thomas J. Webb 1 Aaron Lines 1 Leigh M. Howarth 1,2	1 Department of Animal and Plant Sciences, University of Sheffield, Sheffield, UK 2 Life Sciences Centre, Dalhousie University, Halifax, NS, Canada

29/06/2020	Journal	The BenBioDen database, a global database for meio-, macro- and megabenthic biomass and densities https://doi.org/10.1038/s41597-020-0551-2	Tanja Stratmann 1,2,3 Dick van Oevelen 1 Pedro Martínez Arbizu 4 Chih-Lin Wei 5 Jian-Xiang Liao 5 Mathieu Cusson 6 Ricardo A. Scrosati 7 Philippe Archambault 8 Paul V. R. Snelgrove 9 Patricia A. Ramey-Balci 10 Brenda J. Burd 11 Ellen Kenchington 12 Kent Gilkinson 13 Rénald Belley 14 Karline Soetaert 1	1 NiOZ Royal Netherlands Institute for Sea Research, Department of estuarine and Delta Systems, and Utrecht University 2Utrecht University, Department of Earth Sciences 3 HGf MPG Joint Research Group for Deep-Sea Ecology and Technology, Max Planck Institute for Marine Microbiology 4 German Centre for Marine Biodiversity, Senckenberg am Meer 5 Institute of Oceanography, National Taiwan University 6 Département des sciences fondamentales et Québec-Océan, Université du Québec à Chicoutimi 7 Department of Biology, St. Francis Xavier University 8 ArcticNet & Québec-Océan/Takuvik, Université Laval. 9 Department of Ocean Sciences and Biology, Memorial University of Newfoundland 10 College of Sciences, Koç University 11 Institute of Ocean Sciences, Fisheries and Ocean Canada 12 Bedford Institute of Oceanography, Fisheries and Ocean Canada 13 Northwest Atlantic Fisheries Centre, Fisheries and Ocean Canada 14 Maurice Lamontagne Institute, Fisheries and Oceans Canada
07/2020	Marine Policy	Supporting the essential - Recommendations for the	D.Lear[a] P.Herman[b]	a Marine Biological Association, Citadel Hill, Plymouth, UK

		development of accessible and interoperable marine biological data products	G.Van Hoey[c] L.Schepers[d] N.Tonné[e] M.Lipizer[f] F.E.Muller-Karger[g] W.Appeltans[h] W.D.Kissling[i] N.Holdsworth[j] M.Edwards[a] E.Pecceu[c] H.Nygård[k] G.Canonico[l] S.Birchenough[m] G.Graham[a] K.Deneudt[d] S.Claus[d] P.Oset[d]	b Deltares, Boussinesqweg 1, 2629 HV Delft, the Netherlands c Research Institute for Agriculture, Fisheries and Food, Ankerstraat 1, 8400, Oostende, Belgium d Flanders Marine Institute, Wandelaarkaai 7, 8400 Oostende, Belgium e EMODnet Secretariat, InnovOcean Site, Wandelaarkaai 7, 8400 Oostende, Belgium f Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Borgo Grotta Gigante 42/C, 34010, Sgonico TS, Italy g University of South Florida, 4202 E Fowler Ave, Tampa, FL 33620, USA h Intergovernmental Oceanographic Commission of UNESCO, Wandelaarkaai 7, 8400 Oostende, Belgium i Institute for Biodiversity and Ecosystem Dynamics (IBED), University of Amsterdam, P.O. Box 94240, 1090 GE, Amsterdam, The Netherlands j International Council for the Exploration of the Seas, H. C. Andersens Blvd. 46, 1553 København, Denmark

				k Finnish Environment Institute, Latokartanonkaari 11, 00790 Helsinki, Finland l National Oceanic and Atmospheric Administration, 1315 East-West Highway 2nd Floor, Silver Spring, MD 20910, USA m Cefas, Pakefield Rd, Lowestoft, UK
09/09/2020	Quarterly Journal of Engineering Geology and Hydrogeology	INFOMAR data in the EMODnet Geology data portal supports marine spatial planning and offshore energy development in the Irish offshore http://dx.doi.org/10.1144/qjegh2020-033	J. Guinan, C. McKeon, E. O'Keeffe, X. Monteys, F. Sacchetti, M. Coughlan and C. Nic Aonghusa	Geological Survey Ireland, Marine Institute, Irish Centre for Research in Applied Geosciences and Gavin and Doherty Geosolutions
29/09/2020	Biodiversity Information Science and Standards 4: e58932	Coordinating Efforts to Define Marine Plankton Imagery Data and Metadata Best Practices and Standards https://doi.org/10.3897/biss.4.58932	Patricia Martin-Cabrera, Fabien Lombard, Jean-Olivier Irisson, Lars Stemmann, Klas O. Möller, Markus Lindh, Veronique Creach, Lennert Schepers	Flanders Marine Institute, Institute de la Mer de Villefranche, Institute of Coastal Research, Swedish Meteorological and Hydrological Institute, Centre for Environment, Fisheries and Aquaculture
02/03/2021	EuroSea Deliverable, D1.2	Map of BioEco Observing networks/capability http://dx.doi.org/10.3289/eurosea_d1.2	Lavenia Ratnarajah	EuroSea
March 2021	Beche-de-mer information bulletin	Norwegian red sea cucumber (Parastichopus tremulus) fishery and aquaculture north of 60°N latitude: Feasible or fictional? ISSN 1025-4943	Gyda Christophersen[1], Snorre Bakke[2] and Jan Sunde[1]	1- Møreforsking AS, PO Box 5075, N-6021 Ålesund, Norway. 2- Department of Biological Sciences, Norwegian University of Science and Technolog y, Larsgårdsvegen 2, N-6009 Ålesund, Norway

9. Monitoring indicators

Matomo statistics for EMODnet Biology used in this document can be accessed via

https://grafana-emodnet.trust-itservices.dev/d/koz4-8rZz/emodnet-biology?orgId=1&from=1555624800000&to=1618783199000

	Comments on the progress indicators in the excel template	
Progress indicator	Means of collecting figures	Comment
1. Current status and coverage of total available thematic data A) Volume and coverage of available data	Statistics collated using internal systems	Overall there was an increase in the number of available data for all functional groups during the period covered in this report. The second table provides more detailed information, allowing for a better analysis. As expected for this thematic lot, not all seas had an increase in the total area covered since the last report, as this is related with the data made available to the partners and that can be shared via the thematic lot. A good example is the North Sea, which for benthos and phytoplankton has a big increase in data added unlike the Black Sea in which the increase of data is not as significant. These statistics are collated via internal systems. The marine regions used for the reporting indicators are briefly described under the WP1 section
B) Usage of data since the start of the project phase		We cannot provide the number of manual downloads on the last final report as this information only became standardised from March 2019 (end of the performance phase). At the end of Phase III there were almost 25.5 million records available for download. In total, 38.8GB of data were downloaded via manual means through the download toolbox. Webservices trends monitoring was not available during phase III, no stats could be collected. The numbers included in this table were collected via internal monitoring systems
2. Current status and coverage of total number of data products A) Volume and coverage of available data products		Note that not all products listed in table 2A fit the traditional product description, e.g. EMODnet WFS R package was developed by WP4 partners during the workshop, but is a tool, not a product per se. Also note that the coverage table does not include all the products as listed in the table above, as not all products fit under the themes given or are not products as explained before. Also note that the coverage is approximate. Over the reporting period, products developed mainly covered the phytoplankton and benthos themes. The marine regions used for the reporting indicators are briefly described under the WP1 section

B) Usage of data products since the start of the project phase		There was an increase in the downloads of products available via the portal. This could be due in part to the increasing number of products, but also users becoming increasingly more aware that such products exist and the results, as well as code and analysis summary are also freely available
3. Organisations supplying/ approached to supply data and data products since the start of the project phase		Various organisations have provided data during the period covered in the report. The majority of these organisations are project partners, but also data grant holders and some are external data providers that volunteered the data. All information was collated from the quarterly reports, and the relevant QR is added to add further clarification. Data that are made available through the portal are not restricted.
4. Online 'Web' interfaces to access or view data		No change was observed since the start of phase III. All data and products are freely and openly available for download through the portal. WCS services will be implemented in Phase IV to allow for better data product uptake.
6. Statistics on information volunteered through download forms		The information was collated from all quarterly reports published during the period covered by this report. Information was not available for the first three reports, so the numbers will be slightly higher than presented. The majority of users request the data for research purposes, followed by consultancy and education/workshop purposes. The big majority of our users are from European countries, UK, Belgium, Netherlands, France. Outside of Europe, users visit the portal primarily from Asia and North America.
7. Published use cases	Statistics collated using Matomo	The Biology thematic lot has four published use cases. User uptake of said cases is low and one aim is for the thematic lot to produce new and more targeted use cases in order to highlight how we can best support our various stakeholders and meet their needs and/or requirements
9.1. Technical monitoring		The portal presents an uptime of 100% throughout the period covered in this report, with an average response time of 709 ms.
9.2. Visual Harmonisation score		The portal concluded Phase III with 100% compliance to the harmonisation guidelines
10. Visibility & analytics for web pages		No big changes in either visibility or analytics throughout the reporting period. Most visited pages are the Home Page followed by the Data Portal (Map Viewer) and the Atlas Product stories and markdown.
11. Visibility & analytics for web sections		There was a decrease on visibility and analytics for web sections from last quarter of 2020. This could be due to COVID pandemic impacts on our users workload

12. Average visit duration for web pages		No big changes apparent throughout the reporting period. Daily visit duration is between 1 and 2 minutes for all pages monitored.

The monitoring numbers reported as part of the progress monitoring of EMODnet performance are collected through Matomo. In some cases, numbers from other monitoring systems may also be reported (e.g. Awstats, Google Analytics). Each system uses different technical approaches and therefore has its strengths and shortcomings. Therefore, results are indicative and care should be taken with interpreting absolute numbers or comparing results from different tools. It is often more sensible to consider trends over time collected by the same monitoring tool.

10. Recommendations for follow-up actions by the EU

[Give a list of recommendations and suggestions for the EU to consider and take action. Max 1 page.]

Support in addressing data gaps

As can be inferred from the information collated in this document, especially the indicators, it is fairly easy to identify where EMODnet Biology lacks data, be it at functional or geographic level. The lack of data on its own is a problem as it hinders the understanding of the environment and therefore its correct assessment and analysis of the impacts that human pressures can have. On the other hand, it also does not allow for reliable services and/or tools and products to be made available.

The main causes are usually known and include, among others:

- High level decision to not share datasets, e.g. the IOF (Institute of Oceanography and Fisheries) proposed "Demersal species from the MEDITS (Mediterranean International Trawl Survey) project on the eastern part of the Adriatic Sea" dataset for which our partner later found that permission to share the data was not possible or the Fisheries data collected under the EAF (Ecosystem Approach to Fisheries) Nansen project which, because it is was mostly collected within EEZs (Economic Exclusive Zones) are not owned by FAO Food and Agriculture Organization) but the countries that commissioned the vessel(s) where such surveys took place;
- Cultural, sectoral and/or institutional reluctance to share data;
- Data available only in analogue format which makes their sharing harder;
- Existence of sensitive or commercial data that, although of extremely important value, are kept with the originators or organisations that manage them but not made easily available to the wider users;

11. Annex: Other documentation attached

- Indicators monitoring: 20210418_EMODnetBiology_Final_2021.xlsx
- Handover document: EMODnetBiology_SI2.789013_HandoverDocument_PhaseIII_renewal.docx
- Pre-existing rights document: EMODnetBiology_SI2.789013_Pre_existing_rights_PhaseIII_renewal.docx

12. List of abbreviations and acronyms

API: Application Programming Interface

BODC-NVS: British Oceanographic Data Centre- Natural Environment and Research Council Vocabulary Server

CMEMS: Copernicus Marine Service's

DFO-MPO: Fisheries and Oceans Canada

DG-MARE: Directorate-General for Maritime Affairs and Fisheries

DG-DEFIS: Directorate-General for Defence Industry and Space

DIVA: Data-Interpolating Variational Analysis

DwC-A: DarwinCore Archive

EAF Nansen: Ecosystem Approach to Fisheries

EaTIP: European Aquaculture Technology and Innovation Platform

EBVs: Essential Biodiversity Variables

EEZ: Economic Exclusive Zone

eMoF: Extended Measurement or Facts Extension

EOVs: Essential Ocean Variables

EU: European Union

EurOBIS: European Ocean Biodiversity Information System

FAIR: **F**indable, **A**ccessible, **I**nteroperable and **R**eusable

FAO: Food and Agriculture Organization

GBIF: Global Biodiversity information System

ICES: International Council for the Exploration of the Sea

IOC: Intergovernmental Oceanographic Commission

IODE: International Oceanographic Data and Information Exchange

IOF: Institute of Oceanography and Fisheries

IPT: Integrating Publishing Toolkit

MEDITS: Mediterranean International Trawl Survey

MBON: Marine Biodiversity Observation Network

MSFD: Marine Strategy Framework Directive

NGOs: Non- Governmental Organisations

NOAA: National Oceanic and Atmospheric Administration

NODC: National Oceanographic Data Centres

OBIS: Ocean Biodiversity Information System

OCR: Optical Character Recognition

OTGA: Ocean Teacher Global Academy

OTN: Ocean Tracking Network

QC: Quality Control

RSC: Regional Sea Conventions

SMEs: Small and Medium Enterprises

URL: Uniform Resource Locator

WFS: Web feature Service

WoRMS: World Register of Marine Species