

EMODnet Thematic Lot n° 5 BIOLOGY

EMODnet Phase 2 – Annual (interim) report 2

Reporting Period: 01/09/2014 – 01/09/2015

Simon Claus, Nicolas Bailly, Olivier Beauchard, Daphnis De Pooter, Klaas Deneudt, Peter Herman, Dan Lear, Lennert Tyberghein, Leen Vandepitte, Francisco Hernandez, Jan Mees and all EMODnet Biology project partners

Date: 23/09/2015

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List of abbreviations and acronyms

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

CORESET: Operationalization of HELCOM core indicators

DIVA: Data-Interpolating Variational Analysis, allows the spatial interpolation of data (analysis) in an optimal way, comparable to optimal interpolation

EMODnet: European Marine Observation and Data Network

ESFRI: European Strategy Forum on Research Infrastructures

EurOBIS: European Ocean Biogeographic Information System, a distributed system that allows to search multiple datasets simultaneously for biogeographic information on marine organisms in European waters

EUBON: European Biodiversity Observation Network

FAO: Food and Agriculture Organization of the United Nations

HELCOM: Baltic Marine Environment Protection Commission - Helsinki Commission

ICES: International Council for the Exploration of the Sea

ICGCOBAM: Intersessional Correspondence Group on the Coordination of Biodiversity Assessment and Monitoring, OSPAR expert group

IPT: Integrated Publishing Toolkit (IPT), a free open source software tool written in Java that is used to publish and share biodiversity datasets

IUCN: International Union for Conservation of Nature

MedOBIS: Mediterranean node of Ocean Biogeographic Information System

MSFD: Marine Strategy Framework Directive, a European instrument aiming at Good Environmental Status (GES) of the EU's marine waters by 2020

NODC: National Oceanographic Data Centre

OGC: Open Geospatial Consortium

OSPAR: Convention for the Protection of the Marine Environment of the North-East Atlantic

OOPS: Operational Oceanographic Products and Services, proposal formulated by ICES to assist in the ICES advisory process

SDN: SeaDataNet, an infrastructure linking 45 national oceanographic data centres and marine data centres

WoRMS: World Register of Marine Species, an authoritative and comprehensive list of names of marine organisms, including information on synonymy. ERMS is the European component of WoRMS

WRIMS: World Register of Introduced Marine Species,

1. Introduction

Marine biodiversity data are essential to measure and study the ecosystem health of maritime basins. These data are often collected with limited spatial and temporal scope and are scattered over different organizations in small datasets for a specific species group or habitat. Therefore there is a continuous need to assemble these individual datasets, and process them into interoperable biological data products for assessing the environmental state of overall ecosystems and complete sea basins.

In this three-year project, running from 2014 till 2016 a consortium of 21 government agencies and research institutes with national and international expertise in marine biological data monitoring and data management will build further upon the work carried out during the biological preparatory action of EMODnet and will deliver data, metadata and data products of surveys in the water column and on the sea bed from phytoplankton, zooplankton, angiosperms, macroalgae, benthos, birds, mammals, reptiles and fish occurring in European marine waters.

The EMODnet biological data portal provides access to different thematic databases and to several long-term national marine biological monitoring datasets from all European regional seas. We identify and focus on biological data types, species, species attributes, sampling methods and biological indicators to support the variety of legislations, and create biological data products, indicating the temporal and spatial trends in abundance of marine life to support environmental legislations including the Marine Strategy Framework Directive.

2. Highlights in this reporting period

- *An EU-wide assessment of those species and communities identified as indicators for descriptors 1, 2, 3, 4 and 6 of the Marine Strategy Framework Directive was performed. The indicators were resolved to target species level and it is now possible to search the EMODnet Biology Data Portal for the relevant species and observations using the “Species importance to society” selection.*
- *A review of the utility and availability of biological and ecological traits for marine species so as to prioritise the development of a world database on marine species traits has been performed and published in peer review. In addition a proposed standard trait vocabulary has been published and is currently under review by different experts.*
- *A total of 1,957,215 records from 98 datasets became available through the EMODnet biology data portal. Some of these datasets were collected within the framework of ongoing activities of the European Ocean Biogeographic Information System (EurOBIS). The EMODnet Portal reached a new milestone, now containing over 20 million records from 673 datasets including several long-term national marine biological monitoring data collections.*
- *Data archaeology identified more than 220 datasets through literature research of which 76 were suitable for digitization/rescue within the scope of EMODnet. A framework to run small grants for their digitization, standardization and quality control was launched and set up.*
- *Over 60 data products indicating the abundance of different marine species are available (5 microorganisms products, 6 phytoplankton products, 11 zooplankton products, 19 benthos products, 6 fish products, 10 bird products, 8 mammal products, 1 reptile product, 10 angiosperm products, 6 macroalgae products, see annex 1 for the species per product). They cover a wide taxonomic range, from the smallest organisms (e.g. bacteria, viruses) to the largest ones (e.g. fish, mammals), encompassing all trophic levels. Among the products, different data series provide relevant indicators evidencing the deleterious effects of human activities on the marine environment.*
- *The EMODnet zooplankton data products are since 2015 produced as Operational Oceanographic Products and Services to facilitate ICES’ Ecosystem Overviews which describe the trends in pressures and state of regional ecosystems.*

- *A new interface, including updates and new functionalities with the aim of improving the user-friendliness and intuitively of the EMODnet biology data portal have been developed. Between 01-09-2014 and 01-09-2015 1840 data downloads have been registered.*

3. Summary of the work done

The second general meeting took place on the 17th and 18th of September 2014 in Horta in the Azores. The activities of year one were presented and the 9 deliverables, planned for year two were discussed.

A total of 1,957,215 records from 98 datasets became available through the EMODnet biology data portal. In August 2015, the portal reached a new milestone, containing over 20 million records from 673 datasets including several long-term national marine biological monitoring data collections. About 27 datasets (with an estimated 2 million occurrence records) are still pending delivery, but are expected to be available through the EMODnet-biology portal before January 2016. During the second year the work package on data archaeology (WP4) finalized the description of identified historical datasets. In total, more than 220 datasets were proposed or identified through literature research and with input through social media. 4 small grants with 3 institutions were set up in order to digitize the historical datasets.

Work package 2 performed an EU-wide assessment of those species and communities identified as indicators for descriptors 1, 2, 3, 4 and 6 of the Marine Strategy Framework Directive. The indicators were resolved to target species level, after consulting the different regional sea commissions and it is now possible to search the EMODnet Biology Data Portal for the relevant species and observations using the “Species importance to society” selection. A review of the utility and availability of biological and ecological traits for marine species so as to prioritise the development of a world database on marine species traits has been performed and published in peer review. In addition a proposed standard trait vocabulary has been published and is currently under review by different experts.

The outputs of WP5 on the creation of gridded data products consist of 65 products. They cover a wide taxonomic range, from the smallest organisms (e.g. bacteria, viruses) to the largest ones (e.g. fish, mammals), encompassing all trophic levels; (5 microorganisms products, 6 phytoplankton products, 11 zooplankton products, 19 benthos products, 6 fish products, 10 bird products, 8 mammal products, 1 reptile product, 10 angiosperm products, 6 macroalgae products - Annex 1 displays all the products. Several remaining issues related to spatial and temporal data availability across Europe, presence-only data and taxonomic resolution and rarity are presented. During the second year, the data products were presented to different stakeholders in order to review their relevance for policy support within the context of integrated ecosystem assessments or for the Marine Strategy

Framework Directive. As a result the zooplankton data products are since 2015 produced as Operational Oceanographic Products and Services to facilitate ICES' Ecosystem Overviews which describe the trends in pressures and state of regional ecosystems. These advice processes will require regular inputs of monitoring information on the oceanography and hydrology of the regions. As such, the EMODnet zooplankton data products will directly contribute to this process.

We implemented several updates and new functionalities with the aim of improving the user-friendliness and intuitively of the of the EMODnet biology data portal while migrating the website to a new management system. Main new features include a redesigned home menu, which generates a list of newly added datasets – including a direct link to the metadata and data, a fully integrated portal into the EMODnet Biology website, you can select by different species list (species functional group, regional MSFD indicators, protection status, commercial importance) and you can download and add to the data attribute table abundance and biomass data that have been provided through the 'MeasurmentorFacts' extension. Between 01-09-2014 and 01-09-2015 1840 data downloads have been registered. The most common purpose (40%) was for research, training counted for 7%, testing and exploring of the system counted for 36% of the downloads, Management and planning counted for 4%, while data management and visualisation purposes was good for 12% of the downloads.

Deliverable Name	WP	Status
D1.1: bimonthly progress reports	1	√
D1.2 first interim report after phase 1	1	√
D2.2.EU-wide assessment of those species and communities identified by national MSFD leads as required for MSFD monitoring and reporting (M18)	2	√
D2.4: Publication of proposed standardized species attributes vocabulary (M24)	2	√
D3.2: Data standardization and formatting of all datasets mentioned under data coverage section of proposal for linking with EMODnet biology	3	√
D4.2: Description of identified historical datasets	4	√
D4.3: Report describing the datasets that are digitized, standardized and mobilized into system including dataset documentation and QC procedures applied	4	X
D5.2: All data products	5	√
D6.3: Maintenance of Portal	6	√

Table 1: Overview of deliverables, reports available at EMODnet website

Planning final year

Deliverable Name	WP
D1.4: Draft final report	1
D1.5 Final report	1
D2.5: Selected European marine species tagged with relevant species attributes information and available through WoRMS and on the EMODnet biological portal (M36).	2
D3.2: Data standardization and formatting of all datasets mentioned under data coverage section of proposal for linking with EMODnet biology	3
D4.2: Description of identified historical datasets	4
D4.3: Report describing the datasets that are digitized, standardized and mobilized into system including dataset documentation and QC procedures applied	4
D4.4: Workshop report including description of mechanisms and guidelines on mobilization of historical data into the systems M36	5
D6.3: Maintenance of Portal	6

8 deliverables are scheduled for the final year. WP3 still has to deliver 28 datasets. The standardization and formatting of these datasets will take most of the time of this WP. WP4 will further digitize, standardize and mobilize datasets that were as part of the data inventory. WP2 plans to further update the indicator list, based on new developments within the MSFD and will further work on the trait data, and making these available through the portal. The workpacke 5 has no more deliverables, but plans to create dataproducts around time series from fixed measuring stations and will further investigate data products including both observation and functional trait data. Also, WP5 will further collaborate with ICES to finetune the OOPS products, possibly in communication with the HAWG, the ICES Working Group on Herring Assessment, being one of the oldest and more traditional ICES expert groups. The portal developments will continue with the release of a new download tool box, beginning 2016.

Furthermore, we will continue communication with relevant actors of the MSFD and actively contact new possible data providers.

4. Challenges encountered during the reporting period

Indicator species identification:

The identification of species that will comprise indicators or components of indicators for the MSFD is a large and complex task; the Directive requires reporting across regions and sub-regions that encompass waters of different member states, with varying levels of coordination in the past to address marine environmental issues. The North East Atlantic and the Baltic Sea have long histories of cooperation through their respective regional seas commissions, whereas weaker trans-boundary governance arrangements in the Mediterranean and Black Seas, which are also surrounded by non-EU states. In addition some taxa have long histories of monitoring, for example certain species groups such birds and cetaceans, while there have been few comprehensive monitoring surveys of benthic habitats, especially at the spatio-temporal scales required for reporting. Finally, some of the indicators proposed are complex indices that are not possible (or fairly meaningless) to resolve to individual species; for example multi-metric indices are being used to assess benthic habitats or the plankton life form indicators for water column habitats that use all the species in the Continuous Plankton Recorder Database.

Data access:

There were delays in the delivery of datasets through the SeaDataNet protocol due to the development of the ODV-biology format (which was finalised and communicated to the EMODnet partners in January 2015) and the development and subsequent testing of the SeaDataNet EMODnet Biology exchange buffer. Other delays occurred due to the development of web services and data quality issues. About 27 datasets (with an estimated 2 million occurrence records) are still pending delivery, but are expected to be available through the EMODnet-biology portal before January 2016.

Data availability:

Although the data products comprise a large diversity of ecosystem components, Atlantic and north western shelves were dominantly represented. The main gaps among European basins concern the Mediterranean Sea where data were either not existing, not accessible or coverages were spatially very restricted. Besides, Black Sea data sets were extremely limited and none covers exhaustively the whole basin.

Data products:

Products resulting from temporal series were built through sliding series. However, spatial gaps in early periods prevented complete spatio-temporal coverages

Interpolation using DIVA requires the availability of zero observations: a list of stations where a species or taxonomic group could have been found, but was absent. In many datasets that we tested it was relatively easy to reconstruct the zeroes, even if only presences were recorded in the database. From the overview of sampling effort, or from the complete list of presences, it can be deduced where sampling took place. Meanwhile, a large part of available species distribution data is presence-only, with little opportunity to reconstruct the zero observations, because basic information on sampling effort is lacking. The DIVA methodology used is unable to use these data sets. Other approaches, e.g. MaxEnt modelling, can probably be used for this purpose, but the quality of the estimates is highly dependent on the availability of appropriate environmental predictors. However, for data-sparse areas such as the Mediterranean Sea it could be considered to use alternatives based on modelling presence-only data as a temporary solution. In future, better rules as to which minimum data should be made available at European level could fill the presently observed gaps in data availability.

Among the occurrences from a same data set, the taxonomic resolution was either at the species level or at higher levels. Therefore, higher taxonomic levels were preferred in some cases; for instance, organisms were considered either at the genus level when a large proportion of occurrences of this genus was not documented at the species level, or family if genus were not identified, etc. This was especially the case for mammals from the North Sea (JNCC) where seals were considered at the family level (*Phocidae*) and “whales” as the non-dolphin species within the order *Cetacea*; moreover, the scarcity of these taxa prevented a seasonal mapping.

5. Allocation of project resources

Tasks	Percent of total budget spent
Project management	3,1 %
Identification and collection of species, species attributes and species indicator information	4,9 %
Data access to marine biological data	10,4 %
Data archaeology and rescue	2 %
Creation of gridded abundance data products	11,7 %
Technical development	3 %
Organisation scientific workshops and meetings	2,7 %
Total	37,8%

Table 2: Overview of allocation of resources per activity for the second year of the project

6. Meetings held since last report

List here the meetings held since the last report, if relevant add short description

Date	Location	Topic	Short Description
1. 09 September 2014	DG MARE, Brussels	EMODNET-MSFD Meeting	A meeting was held at DG-MARE to discuss the possibilities of EMODNET for the MSFD. EMODnet Biology was invited to attend a joint OSPAR-HELCOM COBAM meeting, presenting the results to the experts.
2. 17-18 September 2014	IMAR, Horta, Azores	EMODnet Biology Second general Meeting	The second general meeting was organized by IMAR. 33 participants discussed the current status and second years' activities of the EMODnet biology project.
3. 1-2 October 2014	OSPAR-ICG-COBAM Meeting, Sweden	OSPAR ICG COBAM & CORESET, HELCOM Meeting	Attending CORESET and ICG-COBAM Meeting on MSFD biodiversity indicators, and presenting activities EMODnet biology.
4. 6-8 October 2014	CNR, Rome	Eurocean Meeting and EMODnet pre-session	Presenting EMODnet biology at EMODnet session.
5. 20-21 November 2014	EEA-Copenhagen	Options for reporting of MSFD biodiversity indicators	The aim of the workshop was to further explore and develop the collective understanding

			regarding biodiversity information flows and associated reporting requirements under the MSFD art 19.3
6. 9-10 December 2014	DGMARE-Brussels	Steering Committee Meeting	EMODnet Steering Committee meeting
7. 03-04 February 2015	PANGAEA , Bremen	Meeting dataflow PANGAEA and EMODnet biology	Current state of the dataflow between PANGAEA and EMODnet biology. Review how EMODNet displays and serves data and metadata from PANGAEA.
8. 27 February 2015	DGMARE-Brussels	EMODnet-MSFD Meeting	The objectives of the MSFD-EMODnet coordination meetings is to identify opportunities and issues of common importance between MSFD and EMODnet
9. 11-12 March 2015	Oostende, VLIZ	WP5 Workshop	WP5 Workshop on data product generation
10. 1-2 April 2015	Oostende, VLIZ	WP5 Workshop	Hands on workshop to create EMODnet biology and OOPS data products
11. 08-11 June 2015	Crete, HCMR	EMODNET WP4 Workshop: Mechanisms and guidelines to mobilize legacy biodiversity data	The presentation of tools and state-of-art approaches in mobilizing of historical data, a hands-on evaluation of these tools by a group of data managers, a

			discussion on further improvements of such tools and downstream integration into literature and data repositories – participation of WP4 partners and partners from EU-GEOBON project.
12. 09-10 June 2015	Crete, HCMR	EMODNET Biology: Marine Species Traits Workshop	This two-day workshop developed further a framework for the description, collation and dissemination of traits information relating to marine species.
13. 30 June-2 July 2015	ISPRA, JRC	EMODnet-INSPIRE workshop EMODnet Steering Committee Meeting	Workshop on information exchange between INSPIRE and EMODNet. Presentation result EMODnet Biology at Steering Committee Meeting
14. 29 July 2015	Oostende, VLIZ	WP5 Meeting	Discussion with NIOZ-VLIZ on deliverables for WP5 before next reporting.

Table 3: Overview of meetings held during the second year of the project

7. Work package updates

WP1: Project Management

Simon Claus (VLIZ) + MBA, NIOZ, HCMR

General coordination and financial management

- Contract

The contract between VLIZ and the EU was signed on August 30, 2013 and no amendments have been made.

- First interim report

The first interim report has been sent to the commission after the first phase (M1-M12) and was accepted after minor revisions. The report is available at the EMODnet biology website at:

http://www.emodnet-biology.eu/sites/emodnet-biology.eu/files/public/documents/EMODnet_Biology_II/Deliverables_EMODnet_Biology_II/D1_2_First_interim_report.pdf

- Payments

The first payment (15%) was received after acceptance of the first interim report and was transferred to the project partners and subcontractors.

- Organisation project meetings and workshops

During this reporting period 14 meetings were organised or attended by EMODnet biology (see section 6). The Second General Meeting took place 17-18 September 2014 at the Institute of Marine Research (IMAR) in the Azores. 32 partners attended this meeting, where all project activities were presented and a workplan for year two was discussed. A detailed meeting report is available at: <http://www.emodnet-biology.eu/project/documents/Meetings/EMODnet-2nd-General-meeting-%2817-18-Sep-2014%29/Meeting-report/>

During the second year of the project, three workshops (Crete, Oostende) within the framework of WP2, WP4 and WP5 were organised. These workshops were organised with project partners but also a limited number of external experts were invited (WP2; WP4). 3 hands on working meetings took place within the framework of WP3 and WP5 (Bremen, Oostende).

External communication and cooperation

EMODnet biology participated in two EMODnet steering committee meetings (Brussels, ISPRA) and in two EMODnet-MSFD meetings (Brussels). As a direct result EMODnet biology was invited and attended the OSPAR ICG COBAM & CORESET, HELCOM meeting and attended the workshop on Options for reporting of MSFD biodiversity indicators, organised by the EEA. This meetings explored possible collaboration between EMODnet biology and the MSFD process. Furthermore, the EMODnet biology project was also presented during the Eurocean pre-event.

Reporting & Deliverables

D1.1 bimonthly progress reports

During the second year of the project bi-monthly progress reports were compiled and submitted to the secretariat. All report also include a section on the new data resources that are available through the data portals. They are available at <http://www.emodnet-biology.eu/documents/EMODnet-Biology-II/Progress-reporting/>

D1.2 first interim report after phase 1

The first interim report has been sent to the commission after the first phase (M1-M12) and was accepted. The report is available at: http://www.emodnet-biology.eu/sites/emodnet-biology.eu/files/public/documents/EMODnet_Biology_II/Deliverables_EMODnet_Biology_II/D1_2_First_interim_report.pdf

WP2: Identification and collection of species, species attributes and species indicator information

Dan Lear (MBA) + University Auckland, IFREMER, ICES, SAHFOS, GBIF, MARUM, VLIZ

The focus of WP2 is to identify and collate legislative and biological traits and attributes for species, and is split into two tasks: Task 2.1 – Identification of species and species attributes information

and Task 2.2 – Collection of Species Attribute Information

During this reporting period 2 deliverables were met: D2.2, EU-wide assessment of those species and communities identified by national MSFD leads as required for MSFD monitoring and reporting (M18)¹ and D2.4: Publication of proposed standardized species attributes vocabulary (M24).

Task 2.1 – Identification of species and species attributes information

The identification of species that will comprise indicators or components of indicators for the MSFD is a large and complex task; the Directive requires reporting across regions and sub-regions that encompass waters of different member states, with varying levels of coordination in the past to address marine environmental issues. The North East Atlantic and the Baltic Sea have long histories of cooperation through their respective regional seas commissions, whereas weaker trans-boundary governance arrangements in the Mediterranean and Black Seas, which are also surrounded by non-EU states. In addition some taxa have long histories of monitoring, for example certain species groups such birds and cetaceans, while there have been few comprehensive monitoring surveys of benthic habitats, especially at the spatio-temporal scales required for reporting. Finally, some of the indicators proposed are complex indices that are not possible (or fairly meaningless) to resolve to individual species; for example multi-metric indices are being used to assess benthic habitats or the plankton life form indicators for water column habitats that use all the species in the Continuous Plankton Recorder Database. As previously stated the descriptors being addressed in this task are:

- Descriptor 1: biological diversity;
- Descriptor 2: Non –indigenous species;
- Descriptor 3: Population of commercial fish and shellfish;
- Descriptor 4: Elements of marine food webs; and
- Descriptor 6: Sea floor integrity.

With most emphasis initially on descriptors 1, 4 and 6, where information was available for descriptors 2 and 3 it was also included. Work was focussed on gathering information at a

¹ <http://www.emodnet-biology.eu/documents>

Regional Seas scale i.e. identifying species that were linked to indicators that were agreed between member states through a regional process via the regional seas commissions.

Some of the regional seas are subdivided into subregions, namely the North-East Atlantic and Mediterranean Seas, while the Baltic and Black Seas are not divided into subregions (Fig 1):

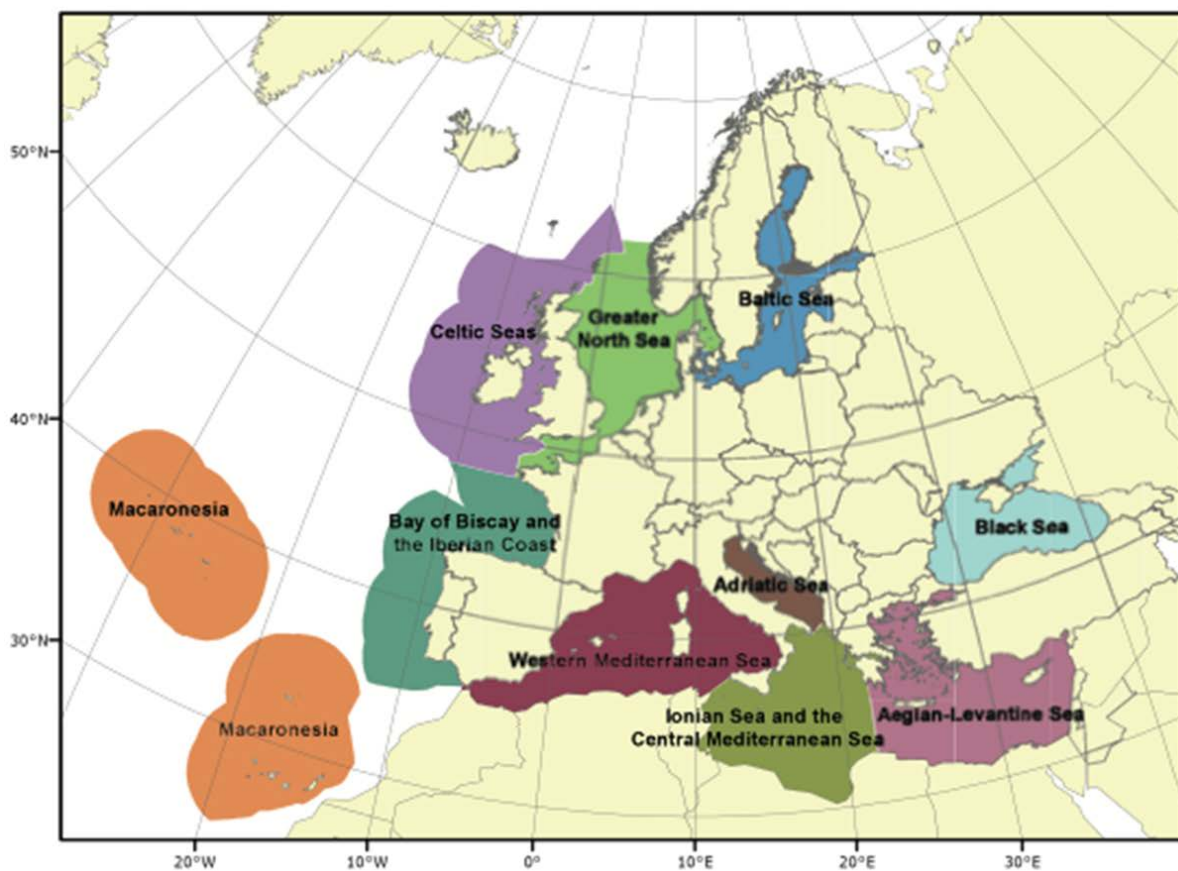


Figure 1 . Map of the regional seas and subregions defined within the MSFD.

While the most emphasis has been placed on the OSPAR and HELCOM region since this appears to be furthest forward in the process, contact has also been made with the MSFD leads in the other regional seas commissions to

- 1) identify at what stage in the process they are
- 2) ask for lists of agreed indicators.

Table below is a subset of one of the output tables showing the structure the information was collated into. The full tables are available through the EMODNet Biology Web Portal.

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Indicator name	Indicator title	Priority indicator	Common indicator (subregions)	Likely to deliver to 2017*	Possible to resolve to target species?	Target species (T) or indicative (I) obtained	Comments
D1 Mammals 1	Distribution seals	N					Not priority
D1 Mammals 2	Distribution cetaceans		II				Incorporated into M4. Removed.
D1 Mammals 3	Abundance of seals	Y	II	Y	Y	T	
D1 Mammals 4	Abundance of cetaceans	Y	II	Y	Y	I	These have to be agreed by CPs in early 2015
D1 Mammals 5	Seal pup production	Y	II	Y	Y	T	
D1 Mammals 6	Mammals bycatch	Y	II	N	Y	I	Overlap with CFP is delaying development, indicative species likely to remain unconfirmed until after 2017.
D1 Birds 1	Abundance of marine birds	Y	II & III	Y	Y	I	IA 2017 may include OSPAR regions I, IV & V which may include additional species. Currently only regions II & III have been resolved to species
D1 Birds 2	Breeding success of kittiwake	N	Possibly III	Y	Y	T	
D1 Birds 3	Breeding status of marine birds	Y	II & III	M	Y	I	IA 2017 may include OSPAR regions I, IV & V which may include additional species. Currently only regions II & III have been resolved to species

Table 4: Biodiversity indicators (Source: OSPAR Common and Candidate Indicators: updates reported to ICG MSFD April 2014) (subset)

Due to the disparity in progress between the regional seas in their implementation of MSFD indicators it was felt worthwhile to undertake an additional data collation process, to be undertaken in Months 25/26 of the project. The outcomes of this will update the online interface and be presented as an update to the original deliverable report.

The information obtained by this task is summarised in the deliverable report and it is now possible to search the EMODnet Biology Data Portal² for the relevant species using the “Species importance to society” in the drop-down menu on the left-hand side of the interface. The different categories that can be selected and for which a species list and available data can be retrieved are currently:

- MSFD indicators: Black Sea proposed indicators
- MSFD indicators; HELCOM core biodiversity indicators
- MSFD indicators: Mediterranean proposed indicators - Adriatic Sea
- MSFD indicators: Mediterranean proposed indicators - Aegean-Levantine Sea
- MSFD indicators: Mediterranean proposed indicators - Ionian Sea
- MSFD indicators: Mediterranean proposed indicators - Mediterranean Sea
- MSFD indicators: Mediterranean proposed indicators - Western Mediterranean
- MSFD indicators: OSPAR candidate indicators: Bay of Biscay and the Iberian Coast
- MSFD indicators: OSPAR candidate indicators: Celtic Seas
- MSFD indicators: OSPAR candidate indicators: Greater North Sea including outside EU
- MSFD indicators: OSPAR candidate indicators: North Sea
- MSFD indicators: OSPAR common indicators: Greater North Sea including outside EU
- CITES (Annex 1, 2, 3)
- FAO-ASFIS: Species for Fishery Statistics
- Habitat directive (Annex 2, 4)
- IUCN Red List (Endangered, Data Deficient, Endangered, Least Concern, Near Threatened, Vulnerable)
- OSPAR List of Threatened and/or Declining Species and Habitats

² <http://www.emodnet-biology.eu/portal/index.php>

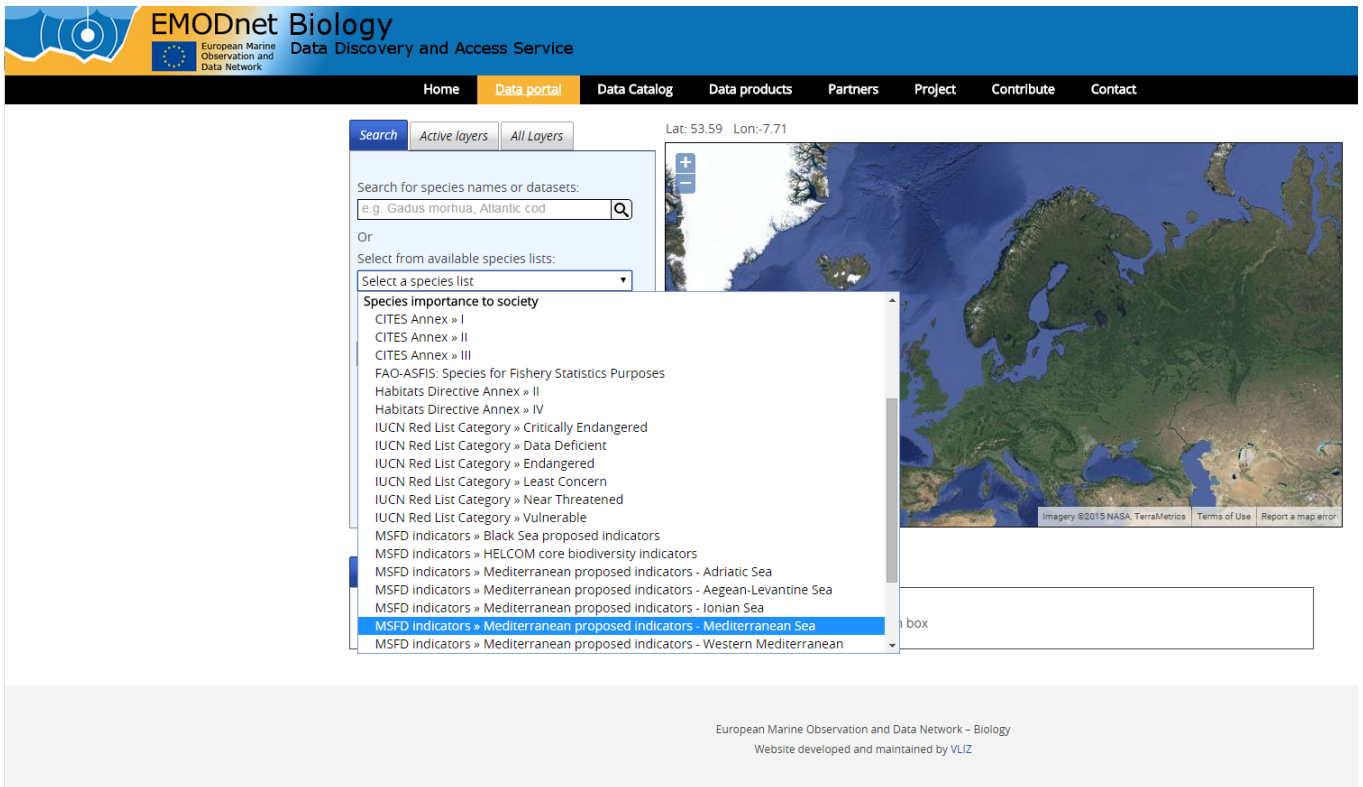


Figure 2. “Species important to society” search interface on the EMODnet Biology Portal.

Task 2.2 – Collection of Species Attribute Information

The bulk of work within Task 2.2 centred on the migration of the spreadsheet-based traits hierarchy into a semantic wiki-based solution, alongside the development and publication of a peer-reviewed paper on the rationale and utility behind the prioritisation and collation of 10 priority-traits.

The detailed workplan for year 2 was developed at the 2nd EMODnet Biology General Meeting, held in the Azores in September 2014. Here, progress from Year 1 was presented alongside discussions on the next steps for ensuring the traits hierarchy develops into a system that is as relevant and useful as possible to the widest user group. Consequently, during year 2 of the EMODnet Biology project the WP2 team ensured the promotion of the work relating to the biological and ecological traits of marine species through the publication of a peer-reviewed paper on the rationale and approaches utilised.

The paper (Costello, et al, 2015³) available at <https://peerj.com/articles/1201/> was published in the open access journal PeerJ and outlines how traits information for marine species has developed, the rationale behind the work carried out through EMODnet Biology and the prioritisation of 10 core traits and the work to extract existing information and develop a database of marine species traits values,

³ <https://peerj.com/articles/1201/>

linked to the taxonomic backbone provided by the World Register of Marine Species (WoRMS⁴). The paper received in excess of 1000 views in the first month of publication.

The publication of the vocabulary is accessible through a Semantic Media Wiki installation. A semantic Wiki is well suited for capturing hierarchical knowledge organisation systems such as thesauri or other taxonomies. The trait terms and definitions and relationships between each term were migrated into the Wiki. Whilst entering the terms, the opportunity was also taken to improve existing trait definitions, linking them to citeable material, in addition to ensuring the hierarchy was logical. The use of the semantic wiki and the expertise of the VLIZ technical team ensured that tools were available to easily review the terms and their inter-relationships, reducing the time taken to undertake this task. Within the wiki, an additional namespace, 'traits' was created. So every trait name, value, concept and collection falls under the namespace 'traits' within the Coastal and Marine Wiki, and is available under the same base URL as the World Register of Marine Species at <http://www.marinespecies.org/traits/wiki>. This will make it possible to integrate the trait vocabulary into the EMODnet biology portal search interface, allowing users to search for taxonomic and observational data of a specific 'trait', similarly as the EMODnet portal users now have the possibility to search for observational data of a specific 'taxon or species'.

To increase the awareness of the traits hierarchy work and to engage with individuals and groups undertaking related activities a workshop was organised at the Hellenic Centre for Marine Research, Crete in June 2015. Participants included representatives from the WoRMS Steering Committee, Encyclopaedia of Life, Lifewatch, FishBase, EUBON and EMODnet Biology WP4 (Data Archeology) to ensure the activities of WP2 were communicated and relevant to a wider user-group. The workshop report is published on the EMODnet Biology website and outlines the presentations, recommendations from focussed breakout sessions and the agreed next steps for Year 3 activities within WP2.

Currently the vocabulary is under final review by the project team, the terms will then be available to the user community to review and refine definitions through the Semantic Media Wiki interface, allowing the disparate user-group and mechanism to comment, and suggest alterations which can be implemented by the editorial team based at VLIZ, University of Aukland and the MBA.

The Trait vocabulary is available at:

http://www.marinespecies.org/traits/wiki/Traits:Marine_species_traits

⁴ <http://www.marinespecies.org/>



Figure 3. 'Wordle' of terms from the Priority Traits paper.

Reporting & Deliverables

D2.2, EU-wide assessment of those species and communities identified by national MSFD leads as required for MSFD monitoring and reporting (M18)

Deliverable is available at:

http://www.emodnet-biology.eu/sites/emodnet-biology.eu/files/public/documents/EMODnet_Biology_II/Deliverables_EMODnet_Biology_II/D2_2_EU-wide_assessment_of_those_species_and_communities_identified_by_national_MSFD.docx

D2.4: Publication of proposed standardized species attributes vocabulary (M24)

Vocabulary: http://www.marinespecies.org/traits/wiki/Traits:Marine_species_traits

Rationale: **Costello, M.J.; Claus, S.; Dekeyzer, S.; Vandepitte, L.; Ó Tuama, É.; Lear, D.; Tyler-Walters, H.** (2015). Biological and ecological traits of marine species. *PeerJ* 3(e1201): 29 pp. [hdl.handle.net/10.7717/peerj.1201 - https://peerj.com/articles/1201/](https://peerj.com/articles/1201/)

WP3: Data access to marine biological data

Leen Vandepitte (VLIZ)+ SAHFOS, ICES, SMHI, MBA, IEO, Aarhus Univ, OGS, IMR, IFREMER, ILVO, Deltares, IMARES, IMAR, IMGW

The general objective for WP3 is to provide data and metadata on surveys in the water column and on the seabed from the different groups of marine species (phytoplankton, zooplankton, macro-algae, benthos, angiosperms, birds, reptiles, fish and mammals).

In the second year of the project focus was on harvesting the in WP3.1 identified datasets by the European Ocean Biodiversity Information System (EurOBIS) and EMODnet Biology. During the period 01/09/2014 – 01/09/2015, 65 new datasets of EMODnet partners have been made available through the EMODnet Biology portal (see Annex 2).

The majority of the partners use the IPT (Integrated Publishing Toolkit), to publish their biological data. Two partners have set up their own IPT and three have made use of an IPT hosted by VLIZ:

Partner	Data transfer protocol	# datasets
AU	SeaDataNet	1
Deltares	OGS (WFS)	1
IEO	IPT	11
ILVO	IPT	4
IMAR	IPT	16
IMGW	SeaDataNet	1
IMR	IPT	10
OGS	IPT	17
SMHI	Webservices	4

Table 5: Number of datasets per partner, including data transfer protocol delivered in year 2 (A dataset is a collection of data that has been collected within the same framework, often by the same organization, for similar purpose, using the same methodology. This can for example be long time series of a governmental agency for monitoring purposes or a short term field campaign within the framework of scientific study.)

Together these datasets account for more than 1.8 million occurrence records belonging to the following functional groups. field campaign within the framework of scientific study:

Functional group	# records
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Benthos	945,952
Phytoplankton	256,101
Pisces	210,096
Zooplankton	176,459
Not specified	155,866
Aves	72,910
Mamalia	25,756
Plankton	16,678
Nekton	5,598
Reptilia	3,501

Table 6: Number of data records per functional group. A record is an observation of a specific species at a certain time, at a certain depth is a certain location. A record can also contain information on the abundance or biomass of that species or species group.

Of the 65 datasets which were harvested, 35 contain abundance records, 17 biomass information and 11 datasets also contain other information (mainly size classes and length measurements, but also abundance classes and abiotic information) kept in EurOBIS as a Measurement or Fact (MoF).

Data types	# Datasets	# Records
Abundance	35	1,552,582
Biomass	17	793,181
Other MoF measurements	11	293,845
Occurrence data only	21	289,907

Table 7: Number of data records per different datatype (MoF=Measurements or Facts, including a range of different parameters). Abundance is the total number of individuals of a species or type present in a given area. Biomass, is the mass of living biological organisms in a given area or ecosystem at a given time. Biomass can refer here to species biomass, which is the mass of one or more species.

While a lot of work has been done in the second period, the data delivery is not yet complete. Many of the datasets provided by the partners result from ongoing research and data are continuously being added. Therefore EurOBIS will continue to update these datasets.

There were delays in the delivery of datasets through the SeaDataNet protocol due to the development of the ODV-biology format (which was finalised and communicated to the EMODnet partners in January 2015) and the development and subsequent testing of the SeaDataNet EMODnet Biology exchange buffer. Problems were solved and in August 2015 EMODnet harvested the first dataset through SeaDataNet. Currently the data provided by EMODnet biology partners through the Seadatanet infrastructure is made available through an EMODnet biology data exchange data-buffer within the SDN infrastructure. This data is harvested and made available through the EMODnet biology data portal. The data harvest is semi-manual at this stage but an API is being developed to automatically crawl and harvest the EMODnet data buffer. Other delays occurred due to the development of web services and data quality issues. About 27 datasets (with an estimated 2 million occurrence records) are still pending delivery, but are expected to be available through the EMODnet-biology portal before January 2016.

Partner	Protocol	# datasets
AU	SeaDataNet	3
Deltares	SeaDataNet and OGS	2
ICES	Own Webservices	10
IEO	IPT	1
IFREMER	SeaDataNet	3
IMGW	SeaDataNet	3
MBA	IPT	4
OGS	IPT	2

Table 8: Number of datasets per partner still to be delivered

As the EMODnet portal is closely intertwined with EurOBIS, it also benefits from efforts made by EurOBIS outside the EMODnet framework. During the period 01/09/2014 – 01/09/2015, EurOBIS identified 33 new datasets accounting for almost 68,000 records. This data is also available through the EMODnet portal:

Functional group	# records
Benthos	30,261

Pisces	21,942
Not specified	13,266
Reptilia	805
Nekton	767
Zooplankton	628
Mamalia	104
Aves	7
Angiospermae	2

Table 9: Number of records per species group delivered to EurOBIS, not in the framework of EMODnet

Reporting & Deliverables

D3.2: Data standardization and formatting of all datasets mentioned under data coverage section of proposal for linking with EMODnet biology (M12-M36). This activity is ongoing and progresses as planned.

WP4: Data archaeology and rescue

Nicolas Bailly (HCMR) + GBIF, VLIZ, ICES

The overall objective of the work package is to fill the spatial and temporal gaps in EMODnet data availability by implementing data archaeology and rescue activities. This is a two-part process of first identifying and locating data, and then performing the steps required to merge them into a digital database, which will be further distributed through EurOBIS, and the EMODnet data portal. The work focused on the Black Sea and Eastern Mediterranean Seas, but is not be limited to this region. There were three main tasks identified in the WP:

- To identify historical data that are at risk of being lost and mobilize the human resources for their archaeology and rescue. D4.1. delivered year 1 and D4.2 delivered on M18 (see report year 1 for delay explanations).
- To run a framework of small grants for their digitization, standardization and quality control. Main activity during the year 2. D4.3 postponed from M24 to M30.
- To propose a mechanism for the networking of the supporting community to ensure continuous inflow of datasets in the future. D4.4: The workshop activities were conducted in June 2015 together and/or back to back with WP2 workshop, and with a EU-BON meeting, M21.

During the second year, after completing the report deliverable 4.2, this WP started to run 4 small grants with 3 institutions aiming at digitizing 4 legacy datasets, and to organize a workshop on historical data mobilization. The digitization work is done by the colleagues in these institutions who were provided with templates, both for metadata and data entry. The work of standardization and quality control is done in HCMR, in close communication with the data providers through email exchanges, and skype remote discussions when necessary. In addition, some direct contact/discussion were done during the EMODnet WP4 Workshop organized in HCMR, Crete in June 2015. The objectives and the associated ongoing activities included:

- Finalizing the deliverable 4.2: The report was delivered on M18.
- Finalizing the 4 small grant contracts: Prepare the description of the expected work/deliverables for the contracts established by VLIZ. See list below.
- Preparing the data entry work: Introduce the work through the explanation of the templates for data and metadata entry.
- Helping to the data encoders at the beginning when field definitions were not clear or ambiguous, or to be adapted.
- Collecting and standardizing the datasets: Even with a template, each domain or team adopts a number of idiosyncrasies that have to be disambiguated in order to fit in the standard structure. Our recommendation for this type of work is that data providers should be asked to send the first 100 records as soon as possible for an early check (even if some detail verifications remain to be performed over all the dataset in the

end). It allows to fine-tune the understanding of the semantic of the fields by the encoders that after all is not a trivial matter, and avoids a lot of work afterwards.

- Performing Quality control: After the standardization phase during which a number of corrections is made already, a control of the consistency of each column is performed: outlier detection, and detection of typos in multi-choice fields. The most important point is the control of the WoRMS AphiaID given for each taxon. The difficult point for providers is when a general name, often scientific but sometimes vernacular, that is used in the original published dataset may designate several taxa.
- Publishing the datasets on OBIS nodes (MedOBIS, EurOBIS): This is an ongoing work.
- Organizing a workshop on mobilization of historical data: Held on 8-9 June 2015 in HCMR, Crete, Greece, in collaboration and back to back with EU BON workshops: 13 participants (from PLAZI, GBIF, HCMR, EMODnet small grants, LifeWatchGreece data managers, ...) attended the workshop where both formal presentations and hand-on work on real datasets were performed with the PLAZI software GOLDENGate.

So far 3 over the 4 datasets, for which a grant was allocated were delivered:

- Temporal evolution of zooplankton from 1898-1917 and 1966 onwards in the north-western Mediterranean Sea
Delivered 1st: 24 June 2015, a sample for first checking. Delivered full: 10 August 2015, metadata 02 September 2015. Status: Quality control done. Metadata on MedOBIS IPT to be checked by the provider (<http://lifewww-00.her.hcmr.gr:8080/medobis/resource.do?r=zooplanktonnwmediterranean>) Data being integrated in MedOBIS node.
- Romanian Black Sea Phytoplankton data from 1956 to 1960
Delivered 1st: 27 July 2015 (the delivery was overlooked by us during vacation time). Status: Quality control starting. Data to be integrated to MedOBIS node.
- Historical data on benthic macrofauna, demersal fish, and fish stomach content from the North Sea and the Baltic Sea
Delivered 1st: 04 September 2015. Status: Quality control to start week 21 September. Data to be integrated to EurOBIS node.
- Quantitative data on benthos and zooplankton from the NW Black Sea, sampled from 1954 to 1968 and macrobenthos sampled from 1997 to 2014
Delivered 1st: Not given. Data to be integrated to MedOBIS node.

In addition, a number of datasets for the Mediterranean listed in the deliverable 4.2 are being digitized under the LifeWatchGreece programme. These datasets will be made available through the MedOBIS IPT, and further to OBIS. They will be detailed in the report D4.3.

Reporting & Deliverables

D4.2: Description of identified historical datasets M12

Due to the unplanned regional situation and changes of WP leading partner, this deliverable has been shifted to M18. In total, more than 220 datasets were proposed or identified through literature research of which 76 were suitable for digitization/rescue for digitization falling within the scope of EMODnet (relevant and quality information, biogeographical data and from European waters) or because the information contained is not sufficient for the creation of a high-quality dataset. See the report deliverable at:

http://www.emodnet-biology.eu/sites/emodnet-biology.eu/files/public/documents/EMODnet_Biology_II/Deliverables_EMODnet_Biology_II/D4.2-Description%20of%20identified%20historical%20datasets.docx

D4.3: Report describing the datasets that are digitized, standardized and mobilized into system including dataset documentation and QC procedures applied M24

For the same reasons as above that delayed the start of the activities, this deliverable has been shifted to M30.

D4.4: Workshop report including description of mechanisms and guidelines on mobilization of historical data into the systems M36

The workshop report is being finalized but the first notes and comments are available at: https://docs.google.com/document/d/1BL0AgWtRH77Ptb90mTuJ02qqO_HHz-1Jk32nqDo-rYc/edit?pli=1

WP5: Creation of gridded abundance data products

Peter Herman & Olivier Beauchard (NIOZ)+ ULg, VLIZ, SAHFOS, ICES, MBA, MARUM

Implementation and progresses of the work

The work for WP 5 was initiated by a workshop on 23rd-24th January 2014 in Yerseke (NIOZ). The discussions concerned first data availability in the different European seas and the selection of well-known and published cases as key ecosystem components from diverse data sources; second, technical aspects of the DIVA software (Data-Interpolating Variational Analysis; Beckers *et al.*, 2014) were detailed and use was exemplified through several study cases (benthic invertebrates and fish) with both density and presence/absence data. The workshop was concluded with the elaboration of a planning of tasks attributed to the different partners of the WP.

A meeting on 11th June 2014 was held in NIOZ Yerseke to discuss progresses regarding WP5 (gridded abundance products) and specific issues of product elaboration. Some technical constraints induced by data gaps were highlighted. Data selection was then chosen based on both time and space so that products, although spatially restricted, be more reliable. Product elaboration was more intensive and results were presented and discussed at the EMODnet Biology second general meeting in Horta (Azores) on 17th-18th September 2014.

Operational oceanographic products and services (OOPS), responding to a call for expressions of interest launched in 2014 by ICES, were studied for proposal and implementation. The variables included in the services provided by EMODnet biology are the abundance of the top 6 Copepod species by number and the ratio of large to small Copepod species. The services will include gridded map layers showing the abundance for copepod species most frequently recorded from the North Atlantic CPR dataset. These map layers will be calculated for different time windows (monthly, seasonal, annual or multi-annual). We will also provide zooplankton indicator based on the ratio of large to small copepods for each sample from the North Atlantic CPR dataset. A specific workshop was held in Oostende (VLIZ) on 11th-12th March 2015 for discussing additional products mainly related to zooplankton and the status of the current data products and products to deliver before year II.

Data products

The outputs of the WP consist of 66 products. They cover a wide taxonomic range, from the smallest organisms (e.g. bacteria, viruses) to the largest ones (e.g. fish, mammals), encompassing all trophic levels; Annex 1 displays all the products. Among the products, different data series provide relevant indicators evidencing the deleterious effects of human activities on the marine environment; for instance, the case of Cod (*Gadus morhua*) illustrates fishing pressure and stock depletion (Greenstreet *et al.*, 2012) (Fig. 4).

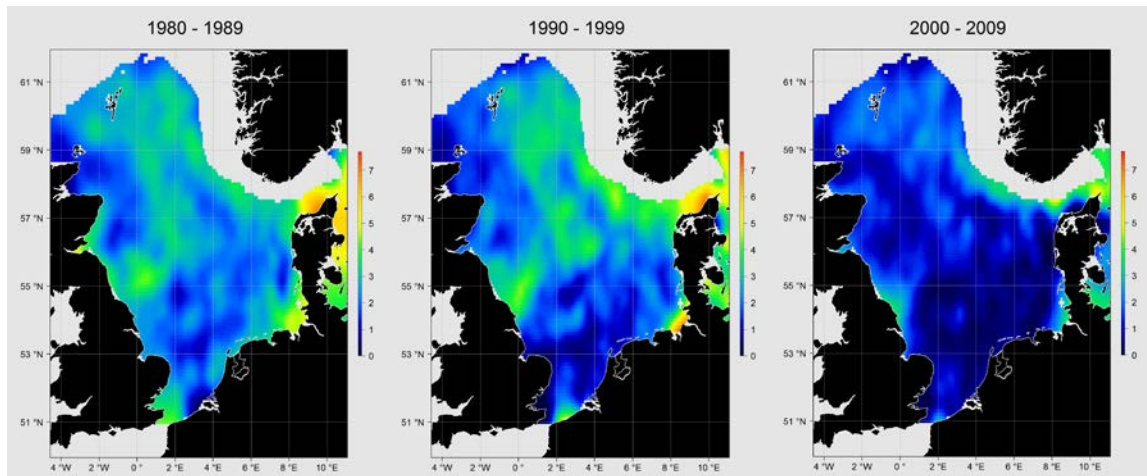


Figure 4. Three distant slices of the spatio-temporal distribution of Cod (*Gadus morhua*) in the North Sea showing stock depletion. Scale: *log*-transformed CPUE.

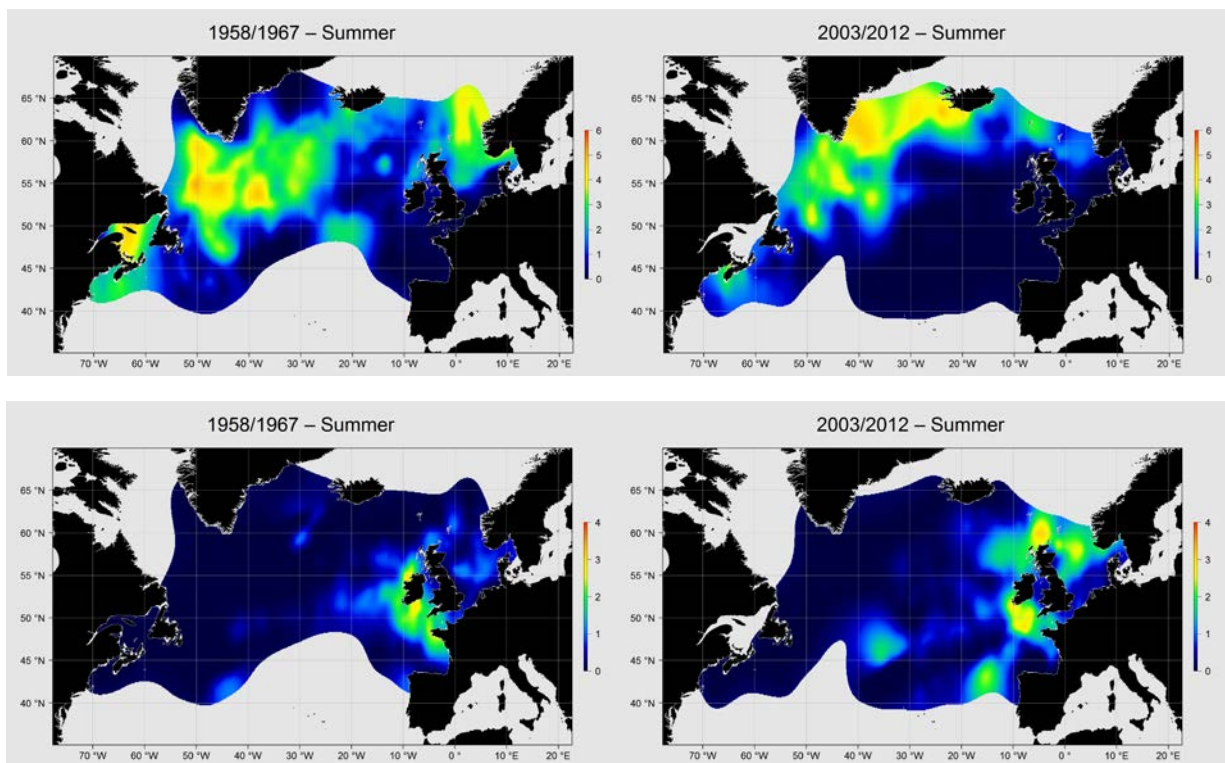


Figure 5. Distributions of *Calanus finmarchicus* (above) and *Calanus helgolandicus* (below). These distributions illustrate the evolution of sea surface temperatures over the last fifty years whereby the first species requires lower temperatures than the second one. Scale: *log*-transformed concentrations (nb. Ind./L).

The distributions of the copepods *Calanus* spp. (Beaugrand *et al.*, 2002) reflect the evolution of sea surface temperatures over the last fifty years and potential modifications of local food web structures (Fig. 5).

Other products provide species distributions and taxon richness, and additional products were built to represent more specifically some ecological processes such as toxic algal blooms along the French coasts (Fig. 6).

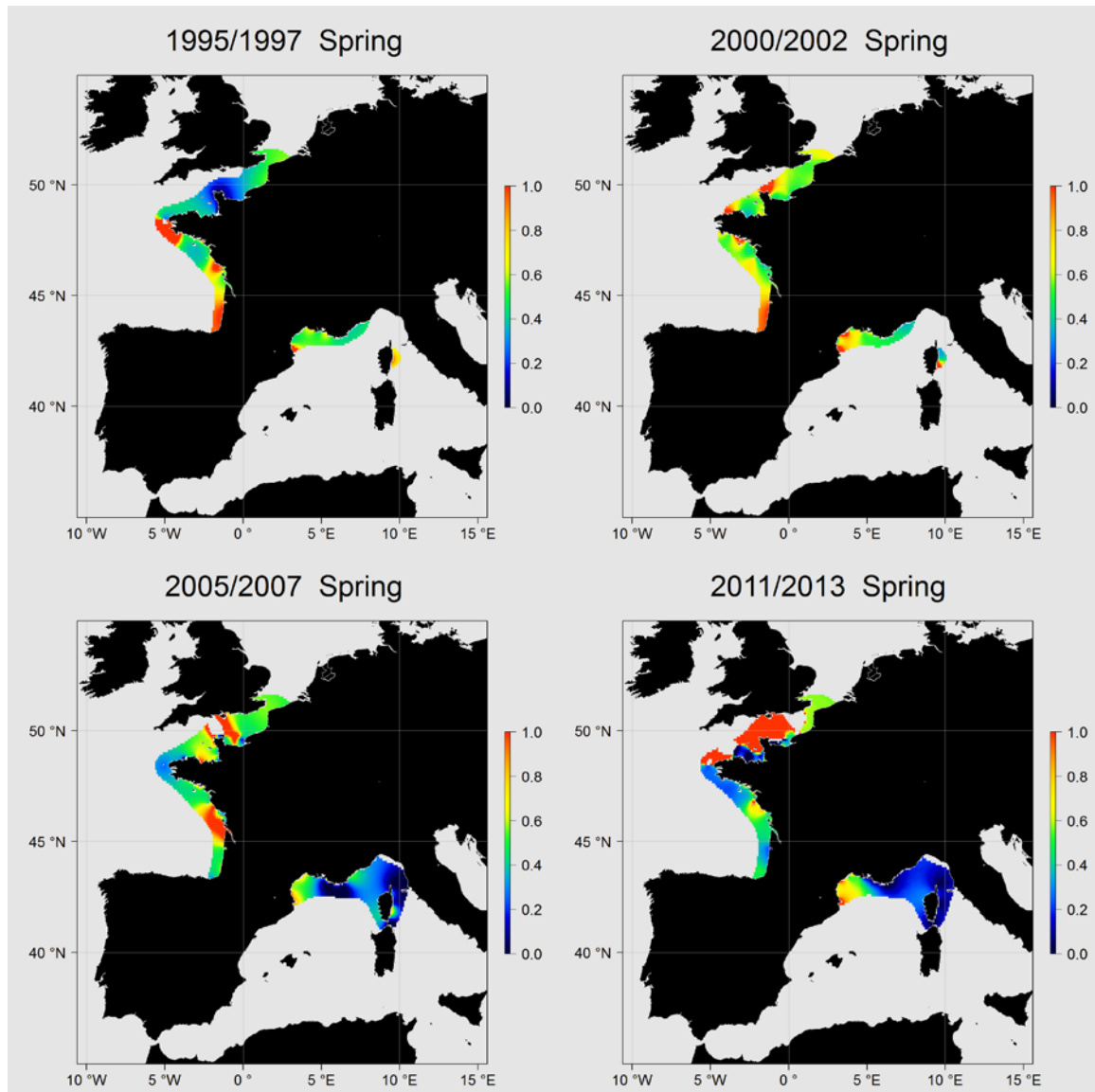


Figure 6. Algal toxicity along the French coasts. Taxa were documented for their potential toxicity and a ratio was built by dividing the concentration of harmful planktonic cells by the sum Harmful + Harmless.

Furthermore different data products on historical and current data of seagrass beds, coralligenous and mäerl beds in the Mediterranean Sea, developed within the Mediseh project became available through the data portal.

During the project, the data products were presented to different stakeholders in order to review their relevance for policy support within the context of integrated ecosystem assessments and for the Marine Strategy Framework Directive.

As a result the zooplankton data products are since 2015 produced as Operational Oceanographic Products and Services to facilitate ICES' Ecosystem Overviews which describe the trends in pressures and state of regional ecosystems. These advice processes require regular inputs of monitoring information on the oceanography and hydrology of the regions. As such, the EMODnet zooplankton data products will contribute directly to this process.

The data products were also presented to OSPAR ICG-COBAM group to discuss how these products could be used within the framework of the MSFD. The experts expressed there is potential that appropriate products could be developed, but this would require dialogue with the expert groups in the design and planning of any future products to ensure that they meet the specific requirements of the indicators in question.

DIVA processing

1. Representation of time dynamics

Depending on data availability, we have used different methods to represent temporal change in the gridded variables. For some applications, e.g. the cod example shown in Fig. 4 that constitutes a very long series with considerable year-to-year variation, the data were grouped in decades to represent the major long-term changes. In other applications with shorter time series or less year-to-year variation, we have used sliding time windows. With a three-year sliding window, subsequent maps represent the combined data of years 1-3, 2-4, 3-5 etc. This 'running average' approach avoids strong jumps between maps, while retaining high temporal resolution. The problem of seasonality further complicates the picture. In many data sets containing several surveys per year, strong seasonal effects were noted. In these cases seasons were delineated in line with the biology of the species, and it was avoided to mix data from different seasons, even in the mapping of the long-term development.

2. Comparison with standard geostatistical models

DIVA output was compared with a standard geostatistical method, isotropic kriging based on a standard (spherical) variogram. The output of the two methods is compared in Fig. 7. In general, the outputs are very well comparable. The correlation length used in DIVA seems to be a bit smaller than that chosen in the kriging algorithm. As a consequence, the DIVA interpolation follows the data somewhat more closely. Both methods also differ slightly in their extrapolation outside the domain of sampling. In general, however, the similarity between both dominates the picture. This results is expected based on theoretical considerations, because both methods share the same basic approach to spatial interpolation. The difference is in the solution algorithm, where DIVA adopts a non-linear

grid-based approach. This results in considerably longer calculations times. However, the advantage of this approach in DIVA is its capacity to take natural disconnections, barriers, islands, etc. into account, because the finite-element grid only covers the real domain of interest (Troupin *et al.*, 2010).

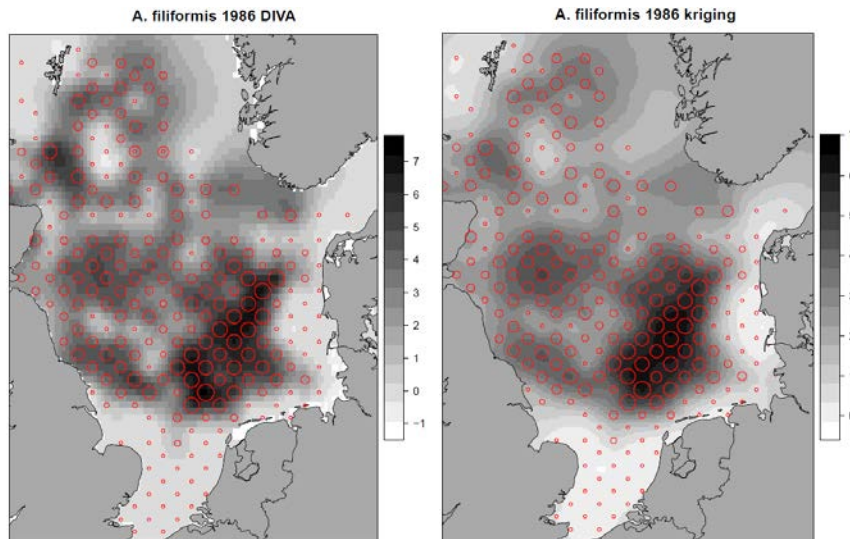


Figure 7. Distribution of *Amphiura filiformis* in the 1986 North Sea Benthos Survey (NSBS). Red circle are proportional to observed density. Shades of gray produced by DIVA interpolation (left) and ordinary kriging (right). Scale: \log -transformed density (nb. ind./m²).

3. Uncertainty analysis of the interpolation results

An important feature of the DIVA interpolations is the formal derivation of uncertainty measures of the interpolated values (Beckers *et al.* 2014). These results are standard included in the (netcdf) output file of the analysis. These estimates of uncertainty have been used in the data products, as masks for the output shown in the maps: areas with too high uncertainty have been excluded from the representation. It is possible to produce separate maps of the uncertainty, but this has not been done as a standard procedure. In case the statistical reliability of results for specific areas would be needed, the feature could be added to products on request.

4. Presence-absence data

DIVA was originally devised for gridding based on quantitative data, such as concentrations or abundance density. However, many biological data are only available as presence/absence data. The DIVA methodology has been extended to produce maps of probability of occurrence using p/a data. The method has been applied to different data sets, including comparisons with full numeric data that had been reduced to presence/absence. It has been shown to work well in all test cases.

5. Incorporation of environmental variables into DIVA interpolation maps

DIVA is essentially an interpolation software that cannot be used for species distribution modelling outside the range and scope of available data. Thus, a DIVA map cannot incorporate regression-type models for extrapolation. However, DIVA is able to restrict interpolation to areas of expected spatial

covariance. Wherever barriers in the environment occur, e.g. sudden change of depth or substrate, or strong currents that limit exchange across streamlines, DIVA can be programmed so as not to interpolate across these gradients. This is achieved by spatially specifying the correlation length. Essentially, the correlation length expresses the spatial scale over which a significant spatial correlation can be expected, and thus information flows exist in the interpolation. It is estimated based on the spatial autocorrelation in the available data, but can be amended based on external information. This feature may help to improve interpolations with knowledge of environmental variables. During the project, we applied this method on the example case of *Amphiura filiformis* in the North-Atlantic. Based on a strong relation between occurrence of the species and water depth (the species being restricted to intermediate depth), we have limited the correlation length along strong depth gradients. This avoids spurious interpolations that would otherwise predict (limited) presence in the deep troughs of the North Sea, clearly an undesirable feature of the maps. The modulation of the interpolation procedure using environmental variables requires the (external) evaluation of basic species distribution models using available environmental data, and is difficult to automate for multiple species and cases. We have not included this feature in most products, as it would require extensive documentation for each case and would make the products highly dependent on the accuracy of the models. Specific studies of certain groups (e.g. macrobenthos in the North Sea) could however make use of the feature to improve the correctness of the interpolation, provided common factors (barriers for correlation length) across species can be discovered.

6. Automation of workflow using R scripts

The workflow of DIVA contains a large number of steps, including the preparation of a topography, preparation of data files, preparation of a parameter file that is consistent with the topography and data files, running the analysis and post-processing the output. While the versatility of DIVA almost excludes the complete automation of all possible workflows, in specific applications it is possible to script out the treatment. The biggest advantage of this procedure is that the workflow is fully documented and any errors can easily be corrected. Moreover, it offers the possibility to easily extend the script to new applications. As an example, the R script used to analyse the *Marenzelleria* data is included as an example (Appendix 3). All scripts are applied under Linux. Basically, the scripts prepare system commands that are sent to the operating systems. Output of the DIVA analyses are stored as files, usually with fixed names, that are subsequently used in other analyses. The scripts regulate the directory structure of input and output files. The main script *doMARdiva_direct.R* (Listing 1) first defines the directory structure, sets default parameters and defines a number of constants used in the processing. It calls required R packages, cleans up the DIVA working directory (with backup) and then calls the script *prepgebco.R* (Listing 2), which is used to prepare the topography based on gebco output. The script *prepinput.R* (Listing 3) reads in the basic data file, and prepares the sliding time windows of observations, to be written in a series of DIVA input files that will be processed one by one. Subsequently, the DIVA analysis is called for each data input file. A function is defined for this purpose, and called in a loop over the input files. The script *plotrstanddat.R* (Listing 4) defines a number of plotting parameters, and a function that is used to plot observed point data on the background of the interpolated grid. This function is subsequently called for all DIVA results, to produce both a pdf and an animated gif output.

Remaining issues

1. Spatial data availability across Europe

Although the products comprise a large diversity of ecosystem components, Atlantic and north western shelves were dominantly represented. The main gaps among European basins concern the Mediterranean Sea where data were either not existing, not accessible or coverages were spatially very restricted (Renzi *et al.*, 2015). Besides, Black Sea data sets were extremely limited and none covers exhaustively the whole basin. The invasive ctenophore *Mnemiopsis* spp. was initially on the list of products, but it was discarded as strange order-of-magnitude differences between the different data sets were found, even in the same region and period. A number of subsets of the data has been corrected, but contacting the data originators has not been successful for all data sets.

2. Temporal data availability

Products resulting from temporal series were built through sliding series. However, spatial gaps in early periods prevented complete spatio-temporal coverages (Fig. 8).

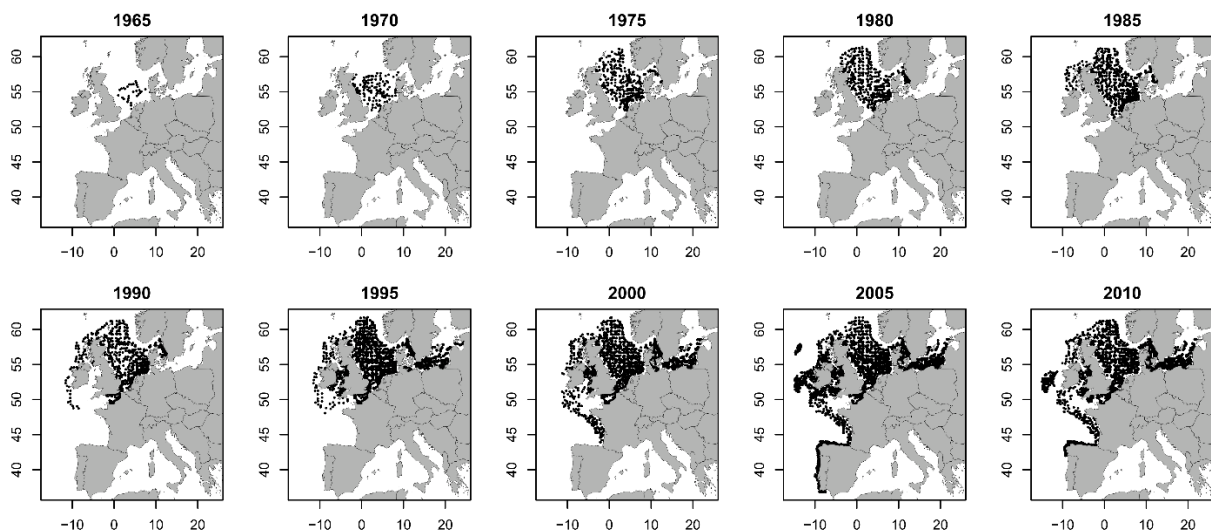


Figure 8. ICES fish International Bottom Trawl Survey extent exemplifying the spatio-temporal heterogeneity of data.

3. Presence-only data

Interpolation using DIVA requires the availability of zero observations: a list of stations where a species or taxonomic group could have been found, but was absent. In many datasets that we tested it was relatively easy to reconstruct the zeroes, even if only presences were recorded in the database. From the overview of sampling effort, or from the complete list of presences, it can be deduced where sampling took place. In future, and with storage capacity becoming less limiting, it should be considered whether storage of zero observations can be part of the design of databases.

Meanwhile, a large part of available species distribution data is presence-only, with little opportunity to reconstruct the zero observations, because basic information on sampling effort is

lacking. The DIVA methodology used is unable to use these data sets. Other approaches, e.g. MaxEnt modelling, can probably be used for this purpose, but the quality of the estimates is highly dependent on the availability of appropriate environmental predictors.

For many European marine biological datasets that we tested, the quality of the (meta)data suffices to use model-independent interpolation using DIVA. This is by far the preferred method of data presentation, since it contains minimal assumptions and reconstructions. However, for data-sparse areas such as the Mediterranean Sea it could be considered to use alternatives based on modelling presence-only data as a temporary solution. In future, better rules as to which minimum data should be made available at European level could fill the presently observed gaps in data availability.

4. Taxonomic resolution and rarity

Among the occurrences from a same data set, the taxonomic resolution was either at the species level or at higher levels. Therefore, higher taxonomic levels were preferred in some cases; for instance, organisms were considered either at the genus level when a large proportion of occurrences of this genus was not documented at the species level, or family if genus were not identified, etc. This was especially the case for mammals from the North Sea (JNCC) where seals were considered at the family level (*Phocidae*) and “whales” as the non-dolphin species within the order *Cetacea*; moreover, the scarcity of these taxa prevented a seasonal mapping.

Reporting & Deliverables

D5.2: All data products

The calculated dataproducts are listed as part of Annex 1 of this report and can be visualized and downloaded at <http://www.emodnet-biology.eu/data-products>

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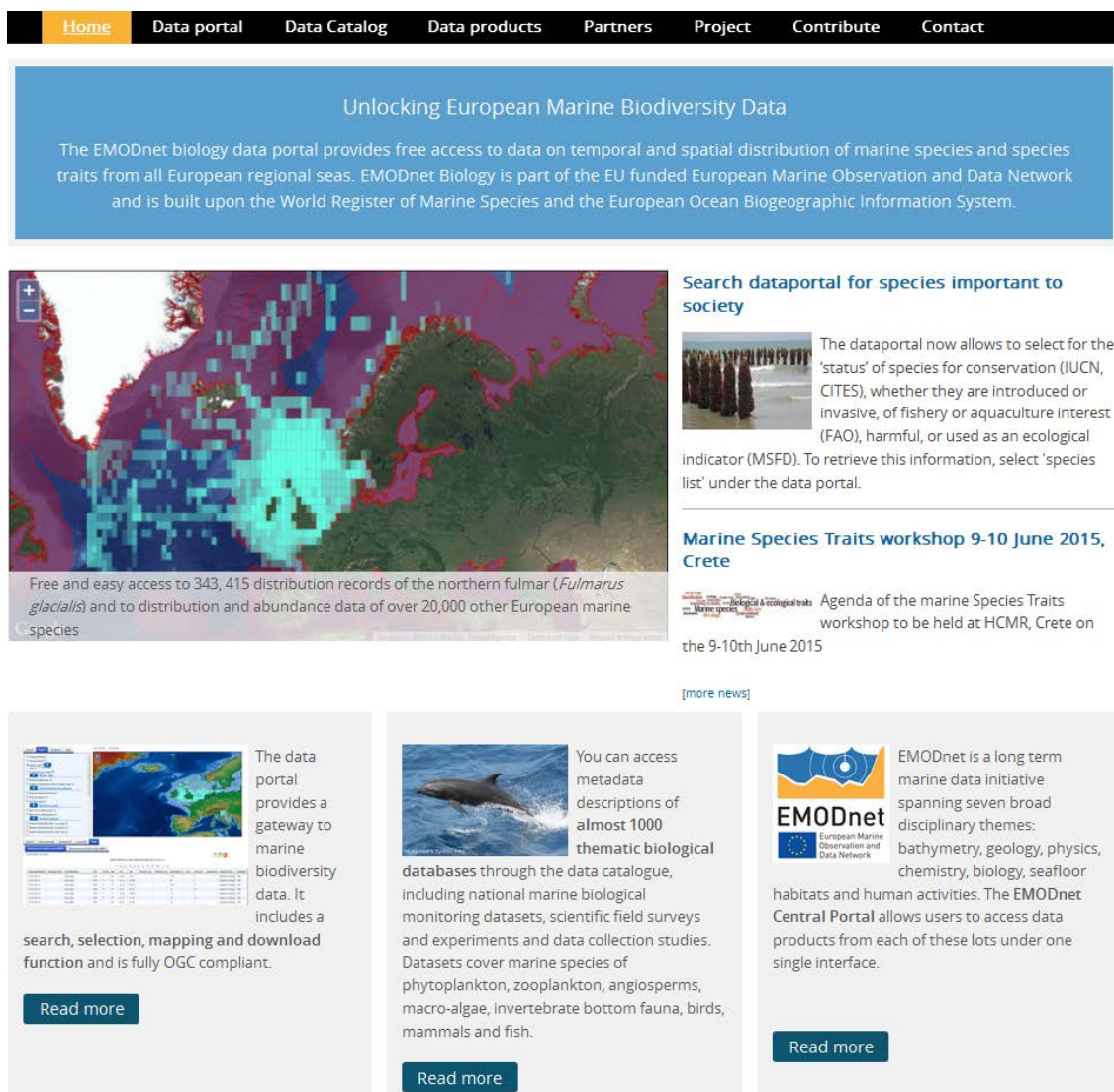
WP6: Technical update EMODnet Biology portal & link to other portals

Klaas Deneudt (VLIZ)+ MARIS, ULg

The objectives of WP6 is to develop and maintain the EMODnet biological portal and portal services and to make the data, metadata and data products that are created and mobilized during the project available.

Improved functionality of the EMODnet Biology Portal

First, we implemented several updates and new functionalities with the aim of improving the user-friendliness and intuitively of the of the EMODnet biology data portal while migrating the website to a new management system.



The screenshot shows the EMODnet Biology portal website. At the top is a navigation bar with links: Home, Data portal, Data Catalog, Data products, Partners, Project, Contribute, and Contact. Below the navigation bar is a blue banner with the text: "Unlocking European Marine Biodiversity Data. The EMODnet biology data portal provides free access to data on temporal and spatial distribution of marine species and species traits from all European regional seas. EMODnet Biology is part of the EU funded European Marine Observation and Data Network and is built upon the World Register of Marine Species and the European Ocean Biogeographic Information System."

The main content area features several news items:

- Search dataportal for species important to society:** A map of Europe showing distribution records of the northern fulmar (*Fulmarus glacialis*). Text: "The dataportal now allows to select for the 'status' of species for conservation (IUCN, CITES), whether they are introduced or invasive, of fishery or aquaculture interest (FAO), harmful, or used as an ecological indicator (MSFD). To retrieve this information, select 'species list' under the data portal."
- Marine Species Traits workshop 9-10 June 2015, Crete:** Text: "Agenda of the marine Species Traits workshop to be held at HCMR, Crete on the 9-10th June 2015"
- The data portal provides a gateway to marine biodiversity data:** Text: "The data portal provides a gateway to marine biodiversity data. It includes a search, selection, mapping and download function and is fully OGC compliant."
- You can access metadata descriptions of almost 1000 thematic biological databases:** Text: "You can access metadata descriptions of almost 1000 thematic biological databases through the data catalogue, including national marine biological monitoring datasets, scientific field surveys and experiments and data collection studies. Datasets cover marine species of phytoplankton, zooplankton, angiosperms, macro-algae, invertebrate bottom fauna, birds, mammals and fish."
- EMODnet is a long term marine data initiative:** Text: "EMODnet is a long term marine data initiative spanning seven broad disciplinary themes: bathymetry, geology, physics, chemistry, biology, seafloor habitats and human activities. The EMODnet Central Portal allows users to access data products from each of these lots under one single interface."

Each news item includes a "Read more" button.

Figure 9. New EMODnet biology website, launched 05 May 2015: www.emodnet-biology.eu

Main new features include:

- The home menu is redesigned, to draw the attention to specific new products and news items and to allow the user to enter the data system in one click and to allow the user to enter the data system in one click
- The home page generates a list of newly added datasets – including a direct link to the metadata and data
- The data portal is now fully integrated into EMODnet Biology website.
- There are direct links to animated temporal data products.
- The data portal menu is divided into ‘Active layers’ and ‘All layers’, which allows you to add and navigate more easily between the data layers
- You can select by different species list (species functional group, regional MSFD indicators, protection status, commercial importance).
- You can now download and add to the data attribute table (Hide/show columns) abundance and biomass data that have been provided through the ‘MeasurmentorFacts’ extension.
- The EMODnet biology website has been made responsive. Responsive design means that the layout will adapt according to the device (smartphone, tablet...) that is used to visit the site.

In parallel, new functionalities for improved downloading, exploration and visualization of the data are under development.

In the first year a detailed user analysis and functional analysis of the current EMODnet dataportal has been performed. Based on these analysis, a new concept that differentiates more between data – unprocessed raw observations or measurements- and data products derived from the data has been formulated. The data component should focus on its easy and intuitive downloading, while the focus of the data products component focuses on a good visualization, a better overview of existing data and a quick understanding of the data.

We are now developing new components of the download toolbox of the dataportal. This download toolbox will guide the user through a step-wise workflow where one can select datasets, perform predefined geographic and temporal selection, can add specific taxonomic or functional filters, and select for data with a certain quality and precision. At any time the user will have a clear overview of the specific performed filters and queries through a selection overview. We plan to launch the download toolbox beginning 2016.

Home / Occurrence Data / Explore

Select Datasources
(optional)

Free text:

Datasource:

Data origin:

Dataset Name	+
BfG - Estuary Monitoring Programme Macrozoobenthos	+
Cetacean sightings in the north western mediterranean Sea by écoOcéan Institut and partners 1994-2011	+
Checklist of benthic marine algae and cyanobacteria of northern Portugal	+
Danish benthic marine monitoring data from ODAM	+
Epibenthos and demersal fish monitoring at long-term monitoring stations	+
Epibenthos and demersal fish monitoring data in function of wind energy development	+
European Seabirds at Sea - data collected by the Research Institute for Nature and Forest (INBO), Belgium	+
IMR Capelin larvae monitoring	+
IMR Herring larvae monitoring	+
IMR Juvenile fish monitoring	+

Select the geographical area
(optional)

Select the time period
(optional)

Selection overview

- 1 Datasources
- Danish benthic marine monitorin...
- ∞ Spatial
- ∞ Temporal

Records: 20250139

Figure 10. Download toolbox under development

Reporting & Deliverables

D6.3: Maintenance of Portal (M12-M36).

The Portal has been maintained and was available 24-7 throughout this reporting period.

8. User Feedback

Date	Name	Organization	Type of user feedback (e.g. technical, case study etc)	Response time to address user request
12/12/2014	Mark Dickey-Collas	ICES	<p>We received feedback from ICES that the OOPS proposal on biological data products was officially accepted:</p> <p>“Thank you for making a submission to the ICES call for operational oceanographic products and services (OOPS). We were greatly impressed by the quality and quantity of the proposals. The evaluation process will be documented and presented to the ICES Science Committee (SCICOM) in spring 2015. Following the evaluation, ICES has decided to follow through the development of OOPS with the top three proposals. We are pleased to inform you that your proposal was in the top three and we now wish to further explore the creation of tangible products.”</p>	<p>We replied to ICES and discussed how to further explore the delivery mechanisms and timings of updates</p>

30/06/2015	Emily Cocoran	OSPAR Secretariat	<p>A document (ICG-COBAM (1) 15/3/2) was submitted to ICG-COBAM to indicate the products that EMODnet biology is currently developing that were considered to be of potential interest to ICG-COBAM. Following discussions, ICG-COBAM experts concluded that:</p> <ul style="list-style-type: none"> a. for the most part the proposed products were not of direct use to the implementation and delivery of biodiversity indicators in the current assessment cycle; b. in some cases there are mechanisms in place for the interpretation and analysis of data (e.g. for marine mammals) and so there would need to be further discussion as to how EMODnet could provide added value; c. the marine mammal group indicated that the absence of effort data in the development of the products affected their usefulness; d. it was expressed there is potential that appropriate products could be developed, but this would require dialogue with the expert groups in the design and planning of any future products to ensure that they meet the specific requirements of the indicators in question. One example could be discussion to see how future products could be of relevance to indicator BH1.
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19/11/2014	Francis O'Beirn	Marine Institute	<p>"In relation to the distribution of <i>Crassostrea gigas</i> in Ireland the locations indicated are all licenced aquaculture sites and do not represent all areas where <i>gigas</i> is cultured and certainly not where <i>C. gigas</i> has been observed in the 'wild'. I would advise that some indication of context should be provided for the points."</p>	<p><i>We replied same day: We are aware that the database is not complete and is not representative for all marine species (yet...). We therefore continuously encourage users to cooperate and share observation data with the system.</i></p> <p><i>For all observation points, there is contextual information available, through a link with a metadata description. You can access these links when downloading the data, or when you zoom to an individual observation with the online GIS viewer, and you click on the point to retrieve the attributes of the observation. You will then see a link in the last column 'metadata', where you will find more information on how the data was collected.</i></p>
10/06/2015	Giorgio Mancinelli	University Salento	<p><i>We were contacted to be stakeholder/enduser in European project proposal on blue crab <i>Callinectes sapidus</i> in South European waters, and aims at giving a multi-scale resolution of the blue crab fishery potential in this area, where is considered an invasive species, from fishing to processing and marketing as a shellfish product.</i></p>	<p><i>We agreed</i></p>
07/09/2015	Maria Teresa Spedicato	COISPA TECNOLOGIA & RICERCA	<p>In contact with the project partners of the Mediseh project, to make their data available through EMODnet</p>	<p>We received the requested data after one month</p>
04/09/2015	Christoph er K. Pham	IMAR - Centro da Universidade dos Açores	<p>In the context of the preparation of an international workshop entitled "Towards a an Environmental Management Plan</p>	<p>We provided the requested information</p>

			for mineral mining along the Mid-Atlantic Ridge (EMP-MAR)", we are preparing an in-depth review of available base line information of the marine environment in the Atlantic, in particular the location of sensitive deep-sea habitats, and identify major data gaps. For reaching this objective we would like to kindly ask you to send us a list of all the dataset that are in EMODNET	
16/02/2015	Antonio Sánchez	ETC-UMA	I have problems to extract data on the observations of species in a table. When I visualize data from observations in the portal I only see an empty table that appears with the message "No data found" (see the screenshot attached), despite that there are observations (the number is specified and there are several pages). When I press the button to export data and fill the form, all I see is a white screen but no file is exported.	The issue was fixed the same day

Table 10: User feedback received during the second year

9. Outreach and communication activities

Date	Media	Title	Short description and/or link to the activity
09/09/2014	Presentation	EMODnet biology	Meeting with regional sea commissions, EEA and ICES on cooperation within framework of MSFD
02/10/2014	Presentation	EMODnet Biology	Presentation of EMODnet biology, and the data products currently developed to ICG-COBAM expert group of OSPAR
06/10/2014	Presentation	EMODnet biology	Speed pitching presentation of EMODnet biology at EMODnet pre-event at Eurocean meeting
20-21/11/2014	Presentation	Data exchange mechanisms developed under EMODnet biology	Presentation at EEA workshop: Options for reporting of MSFD biodiversity indicator.
20/02/2015	Presentation	EMODnet regional gridded abundance products: a tool to facilitate ecosystem assessments	Presentation on EMODnet biology data products during the VLIZ Young Marine Scientists' day (> 300 participants)
20/02/2015	Demonstration	EMODnet biology	Demonstration of the EMODnet biology dataportal during the VLIZ Young Marine Scientists' day (> 300 participants)
02/07/2015	Presentation	EMODnet	Presentation EMODnet at the European Parliament Intergroup – Seas, Rivers, Islands and Coastal Areas “Marine Data: What role for Europe?” – with focus on MSFD related data
02/07/2015	Presentation	EMODnet biology	EMODnet-JRC seminar
29/05/2015	Digital news item	Renewed emodnet-biology.eu for an even better unlocking of European marine biodiversity data	News item on VLIZ website and in VLIZ digital newsletter http://vliz.be/en/news?p=show&id=4174 http://www.vliz.be/docs/vlazine/vl_16_5.htm#2.2
28/08/2015	Tweet	Milestone-EurOBIS now has more than 20.000.000 distribution records http://www.eurobis.org/ Also	9 Retweets-2 favourites

		available at http://www.emodnet-biology.eu/ @EMODnet	
11/06/2015	Tweet	A productive enjoyable joint meeting between @EUBON1 and @EMODnet on how to model and formalize traits at HCMR	4 Retweets
01/06/2015	Tweet	#marinespecies @EMODnet Biology Traits workshop 9-10 June 2015, Crete http://www.emodnet-biology.eu/news?p=show&id=4180 ...	3 Retweets
05/06/2015	Tweet	EMODnet Biology revamps website & data portal - http://www.emodnet-biology.eu/ - let us know what you think! #marinespecies #eurobis	2 Retweets – 2 favourites
10/04/2015	Tweet	#EurOBIS data in @EMODnet Biology portal now lists #biomass and #abundance http://www.emodnet-biology.eu/portal (hide/show columns on the download tab)	1 Retweet
18/03/2015	Tweet	World Register of Marine Introduced Species WRIMS officially launched & contributing to EMODnet Biology & LifeWatch: http://bit.ly/1904vmq	4 Retweets – 1 favourite
30/09/2015	Tweet	Do you have historic marine biology datasets from Europe in need of digitizing? EMODnet #Biology is looking for them! http://bit.ly/1CCLjFy	6 Retweets – 1 Favourite

Table 11: Outreach and communication activities during second year of the project

10. Updates on Progress Indicators

Using the indicator as a header list the metrics collated and the time interval. If there was no activity to report leave the section under the indicator header blank.

Indicator 1 - Volume of data made available through the portal

In total 1,957,215 records from 98 datasets became available through the EMODnet biology data portal during this reporting period. This is about the same number of datasets compared with the previous year but three times as much distribution records. Out of these 98 datasets 65 were provided by WP3 data providers, 33 were added by external data providers within the framework of ongoing EurOBIS activities. The complete list is attached as Annex 2

Indicator 2 - - Organisations supplying each type of data based on (formal) sharing agreements and broken down into country and organisation type (e.g. government, industry, science).

Data provider institute	Country
University of Aarhus; Department of Bioscience (BIOS)	Denmark
Instituut voor Landbouw- en Visserijonderzoek (ILVO)	Belgium
Vlaams Instituut voor de Zee (VLIZ)	Belgium
Observatoire Océanologique de Banyuls-Sur-Mer	France
Senckenberg Nature Research Society	Germany
Aristotle University of Thessaloniki	Greece
Hellenic Centre for Marine Research (HCMR)	Greece
Preveza Fisheries Department	Greece
Arta fisheries department	Greece
Diveboard	Int

National Institute of Oceanography and Experimental Geophysics (OGS)	Italy
University of Montenegro; Institute of Marine Biology	Montenegro
Deltares	Netherlands
Norwegian Institute for Nature Research	Norway
Institute of Meteorology and Water Management; Maritime Branch (IMWM MB)	Poland
University of the Azores; Department of Oceanography and Fisheries (DOP)	Portugal
Russian Academy of Sciences; P. P. Shirshov Institute of Oceanology (SIO RAS)	Russia
Moscow State University;	Russia
Spanish Ministry of Economy and Competiveness; Instituto Español de Oceanografía (IEO)	Spain
Associació Cetàcea	Spain
University of Málaga	Spain
Swedish Meteorological and Hydrological Institute (SMHI)	Sweden
University of Gothenburg	Sweden
National Biodiversity Network Trust (NBN)	UK
National Academy of Sciences of Ukraine; Institute of Biology of the Southern Seas	Ukraine

Table 12: Data supplying organisations

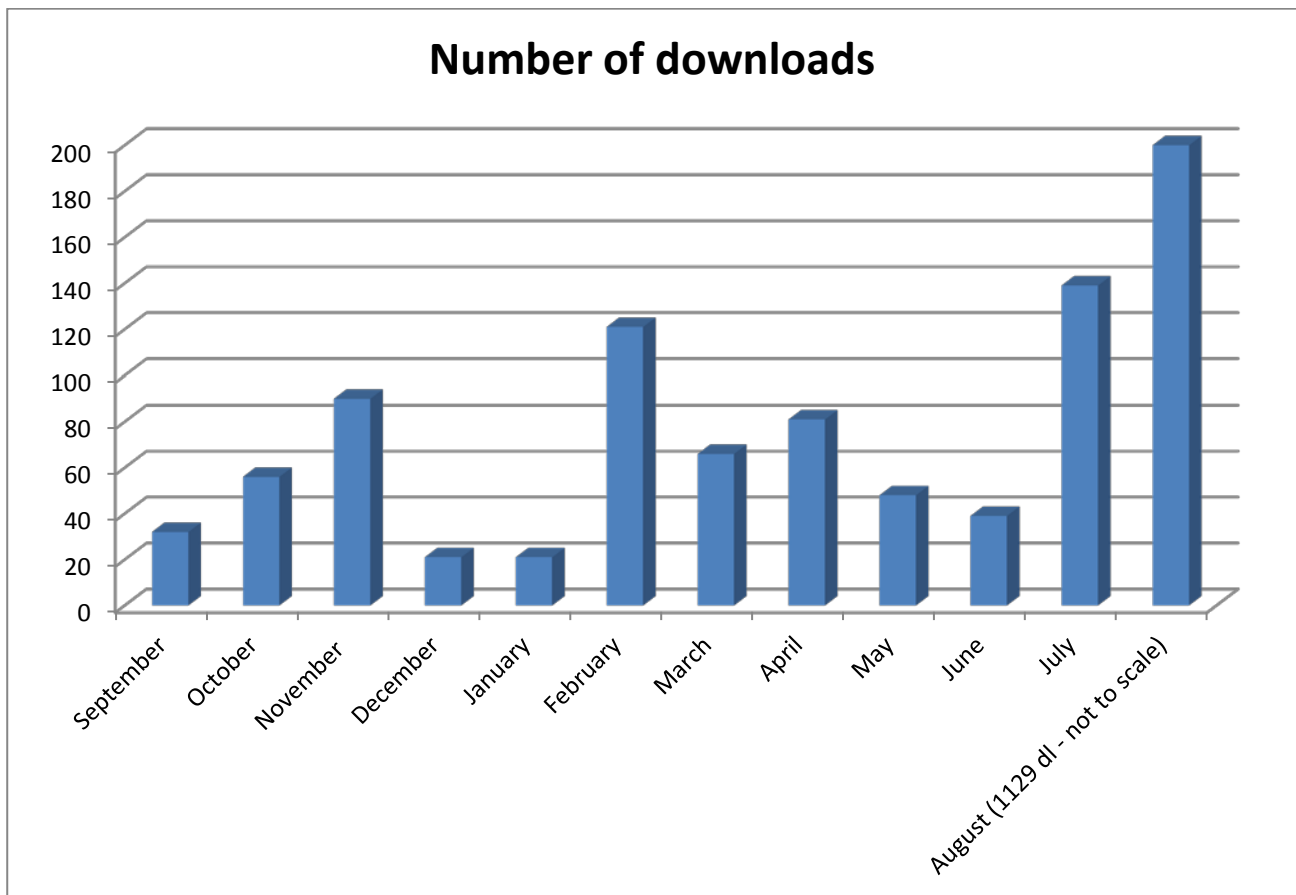
Indicator 3 - Organisations that have been approached to supply data with no result, including type of data sought and reason why it has not been supplied.

- We approached the Italian Governemental agency to provide MSFD related data and are waiting feedback for this request. After initial agreement, the data submission seems pending.
- We approached ASCOBAMS for Mediterranean data on mammals but no feedback after initial agreement to cooperate.
- We are approached MEDITS to have access on Mediterranean fish and benthic data: ongoing.

- We are approaching the project www.iris-ses.eu project where an assessment was made on monitoring in the Mediterranean linked to the MSFD. However the report does not reveal clear references to the data.

Indicator 4 - Volume of each type of data and of each data product downloaded from the portal

Between 01-09-2014 and 01-09-2015 **1840 data downloads have been registered**. 1607 times the user requested to download a complete dataset, available at the data portal. A dataset represent a collection of data, following the same sampling methodology and implying the same data policy. This can be the result of one cruise, but can also be a combination of cruises or sampling events, as part of a time series. 201 times the user performed a taxonomic query on multiple datasets. Furthermore 19 data layers were also downloaded. We can thus say, that for this reporting period we received on average **153 data request per month**. The month August, was exceptional with 1129 downloads, of which about 1000 downloads were performed by one research group. So if we don't take this specific user into account we can still say that we have an average of 65 downloads per month (compared to 50 per month during the last reporting period).

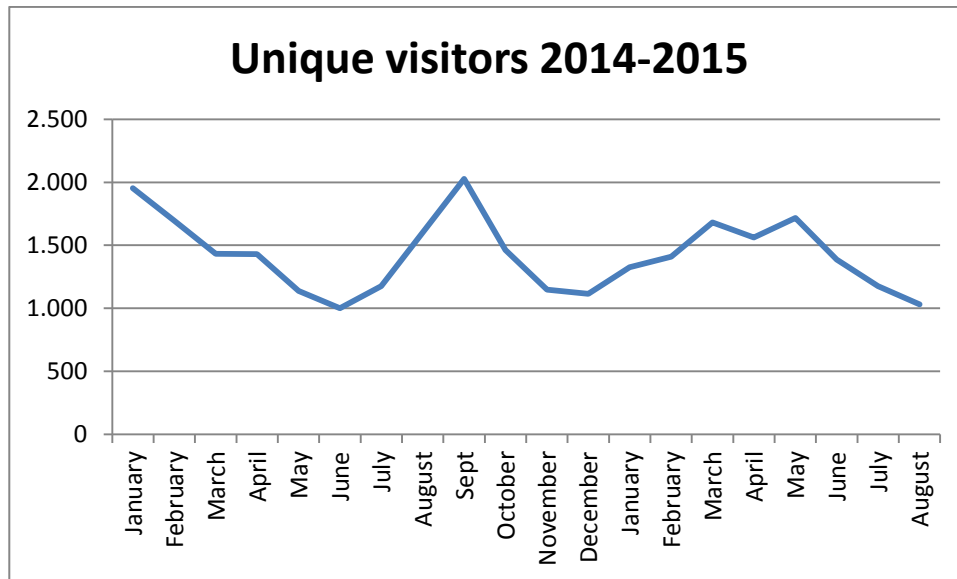


Indicator 5 - Organisations that have downloaded each data type

Indicator 6 - Using user statistics to determine the main pages utilised and to identify preferred user navigations routes

<i>Month</i>	<i>Unique visitors</i>	<i>Hits</i>	<i>Number of visits</i>	<i>Pages</i>	<i>Bandwidth</i>
Sep 2014	2,027	3,638	33,414	62,903	2.04 GB
Oct 2014	1,462	2,862	15,046	42,296	1.56 GB
Nov 2014	1,149	1,936	9,026	23,574	866.05 MB
Dec 2014	1,116	1,866	7,523	20,042	784.60 MB
Jan 2015	1,326	2,764	13,901	28,730	965.37 MB
Feb 2015	1,409	2,641	15,155	26,926	1.67 GB
Mar 2015	1,681	3,287	14,961	37,505	1.38 GB
Apr 2015	1,563	3,060	16,519	38,574	1.38 GB
May 2015	1,717	2,881	14,972	99,518	2.81 GB
Jun 2015	1,386	2,783	12,117	95,319	2.31 GB
Jul 2015	1,176	2,854	10,596	69,321	1.81 GB
Aug 2015	1,032	2,632	12,877	54,621	1.88 GB

Table 13: Visitors, hits, visits on www.emodnet-biology.eu



The graph shows the unique visitors since 2014 for the EMODnet Biology Portal and website. We observe on average about 1500 unique visitors per month. Since 2015 we observe drops during typical holiday seasons (December, July-August), which are normal trends.

A unique visitor is a person or computer (host) that has made at least 1 hit on 1 page of your web site during the current period (a month). If this user makes several visits during this period, it is counted only once. Visitors are tracked by IP address, so if multiple users are accessing your site from the same IP (such as a home or office network), they will be counted as a single unique visitor.

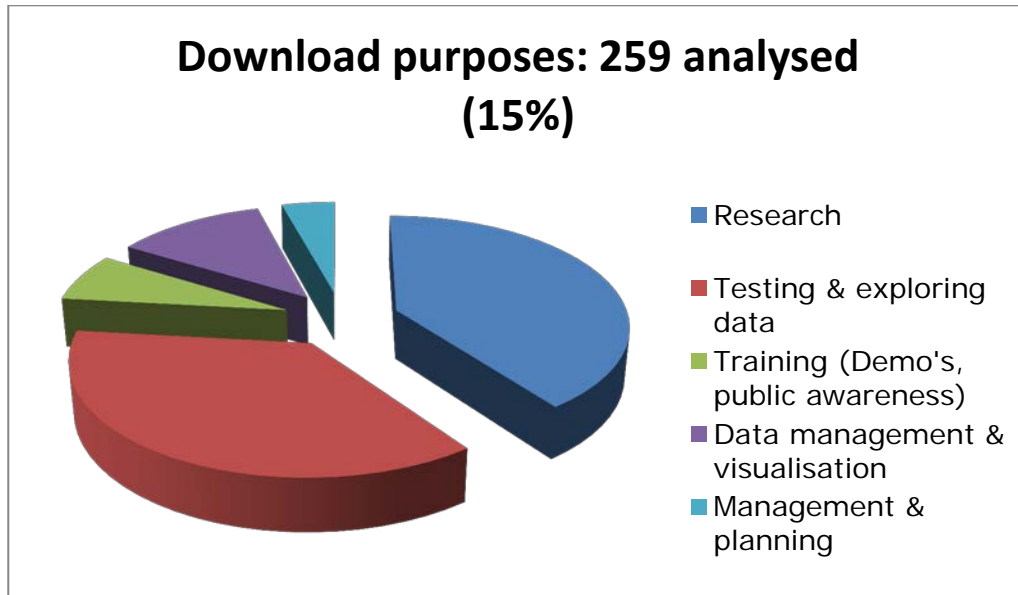
Hits: Any files requested from the server (including files that are "Pages") except those that match the config parameter.

Number of visits made by all visitors.: Think "session" here, say a unique IP accesses a page, and then requests three other pages within an hour. All of the "pages" are included in the visit, therefore you should expect multiple pages per visit and multiple visits per unique visitor (assuming that some of the unique IPs are logged with more than an hour between requests).

Pages: The number of "pages" viewed by visitors. Pages are usually HTML, PHP or ASP files, not images or other files requested as a result of loading a "Page" (like js,css... files).

Bandwidth: Total number of bytes for pages, images and files downloaded by web browsing.

Indicator 7 - List of what the downloaded data has been used for (divided into categories e.g. Government planning, pollution assessment and (commercial) environmental assessment, etc.)



Between 01-09-2014 and 01-09-2015 1840 data downloads have been registered. For 259 data downloads we received the purpose of download (15 percent). We created 5 main categories to group the download purposes. **The most common purpose (40%) was for research** (Master's thesis, PHD thesis, Analysis of community structure, validation of models), **training** (training demonstrations, public awareness) counted for 7%, **testing and exploring** of the system, by external people and EMODnet partners, counted for 36% of the downloads, **Management and planning** (Cable Route Design, Development of zooplankton indicators for MSFD, Development of UK Cetacean Management Options) counted for 4%, while **data management and visualisation** purposes accounted for 12% of the downloads.

Indicator 8 - List of web-services made available and user organisations connected through these web-services

1. WMS & WFS Services of qualitative and quantitative species observations – client EMODnet Central Portal

WMS request (GetMap):

Taxon observations within a radius of 1000 meter

http://geo.vliz.be/geoserver/Eurobis/wms?service=WMS&version=1.1.0&request=GetMap&layers=Eurobis:eurobis_points&styles=&bbox=-10.2767171859741,45.5488891601562,14.0799999237061,62.2492446899414&width=512&height=351&srs=EPSG:4326&format=application/openlayers

WMS request (GetFeatureInfo):

http://geo.vliz.be/geoserver/wms?TRANSPARENT=true&LAYERS=Eurobis:eurobis_points&VIEWPARAMS=AphiaID:141433&STYLES=Points_orange&SERVICE=WMS&VERSION=1.1.1&REQUEST=GetFeatureInfo&FORMAT=image/png&SRS=EPSG:900913&EXCEPTIONS=application/vnd.ogc.se_xml&BBOX=-3711.442373,6579201.245941,225599.642451,6709144.194007&X=276&Y=108&INFO_FORMAT=text/html&QUERY_LAYERS=Eurobis:eurobis_points&FEATURE_COUNT=50&WIDTH=750&HEIGHT=425&server=geo

WMS request (GetMap)

Taxon observations within a grid cell (6 minutes resolution)

http://geo.vliz.be/geoserver/Eurobis/wms?service=WMS&version=1.1.0&request=GetMap&layers=Eurobis:eurobis_grid&styles=&bbox=-10.0,45.0,15.0,63.0&width=512&height=368&srs=EPSG:4326&format=application/openlayers

WFS request (GetFeature):

http://geo.vliz.be/geoserver/wfs?service=wfs&version=2.0.0&request=GetFeature&typeName=Eurobis:eurobis_points&count=10&VIEWPARAMS=AphiaID:141433

Note: You can use 'viewparams' to select taxa eg.: VIEWPARAMS=AphiaID:141433.

2. WMS and WFS services of gridded data products of zooplankton abundances– client ICES - OOPS

OOPS product per region. All data for OOPS are available in one layer: Emodnetbio:OOPS_products

http://geo.vliz.be/geoserver/Emodnetbio/wms?service=WMS&version=1.1.0&request=GetMap&layer=Emodnetbio:OOPS_products&styles=&bbox=-4.95,48.05,12.25,60.75&width=512&height=378&srs=EPSG:4326&format=application/openlayers&viewparams=scientificName:Large%20copepods;season:1;AphiaID:1080;startYearCollection:1958;endYearCollection:1967

OOPS summaries: Average abundance (and standard deviation) for each oops region per timeframe.

WFS (geojson, csv, ...)

http://geo.vliz.be/geoserver/Emodnetbio/ows?service=WFS&version=1.0.0&request=GetFeature&typeName=Emodnetbio:OOPS_summaries&outputFormat=csv

11. Additional User Statistics

There are no additional user statistics

Annex 1: List of available data products

species	species group	Sea Basin	Period	# time slices	Data source	Seasonal
Cyanobacteria	Microorganisms	North Sea	2007-2008	NIOZ	NIOZ	Yearly
Picoeukaryotes	Microorganisms	North Sea	2007-2009	NIOZ	NIOZ	Yearly
Nanoeukaryotes	Microorganisms	North Sea	2007-2010	NIOZ	NIOZ	Yearly
Bacteria	Microorganisms	North Sea	2007-2011	NIOZ	NIOZ	Yearly
Viruses	Microorganisms	North Sea	2007-2012	NIOZ	NIOZ	Yearly
Chlorophyll a concentration	Phytoplankton	North Sea	1974-2014	160	RWS	Seasonal
<i>Dynophysis</i> spp.	Phytoplankton	Atlantic and Mediterranean (France)	1995-2014	72	IFREMER	Seasonal
Harful/(harmful+Harmless)	Phytoplankton	Atlantic and Mediterranean (France)	1995-2015	72	IFREMER	Seasonal
Taxa richness	Phytoplankton	Atlantic and Mediterranean (France)	1995-2016	72	IFREMER	Seasonal
Total diatoms	phytoplankton	Atlantic, North Sea	1958-2012	184	SAHFOS	yes
Total dinoflagellates	phytoplankton	Atlantic, North Sea	1958-2012	184	SAHFOS	yes
<i>Calanus finmarchicus</i>	zooplankton	Atlantic, North Sea	1958-2012	184	SAHFOS	yes

<i>Calanus helgolandicus</i>	zooplankton	Atlantic, North Sea	1958-2012	184	SAHFOS	yes
<i>Acartia</i> spp.	zooplankton	Atlantic, North Sea	1958-2013	188	SAHFOS (OOPS)	Seasonal
<i>Calanus finmarchicus</i>	zooplankton	Atlantic, North Sea	1958-2012	184	SAHFOS (OOPS)	Seasonal
<i>Calanus helgolandicus</i>	zooplankton	Atlantic, North Sea	1958-2012	184	SAHFOS (OOPS)	Seasonal
Large copepods	zooplankton	Atlantic, North Sea	1958-2013	188	SAHFOS (OOPS)	Seasonal
<i>Metridia lucens</i>	zooplankton	Atlantic, North Sea	1959-2013	188	SAHFOS (OOPS)	Seasonal
Copepods Large/(large+small)	zooplankton	Atlantic, North Sea	1958-2013	188	SAHFOS (OOPS)	Seasonal
Small copepods	zooplankton	Atlantic, North Sea	1958-2013	188	SAHFOS (OOPS)	Seasonal
<i>Temora longicornis</i>	zooplankton	Atlantic, North Sea	1958-2013	188	SAHFOS (OOPS)	Seasonal
<i>Oithona</i> spp.	zooplankton	Atlantic, North Sea	1958-2013	188	SAHFOS (OOPS)	Seasonal
<i>Marenzelleria</i>	benthos	Baltic	1987-2013	24	SMHI, SYKE, Aarhus University	No
<i>Abra prismatica</i>	benthos	North Sea	1986	1	NSBS	No
<i>Amphiura filiformis</i>	benthos	North Sea	1986	1	NSBS	No
<i>Bathyporeia elegans</i>	benthos	North Sea	1986	1	NSBS	No
<i>Chaetozone setosa</i>	benthos	North Sea	1986	1	NSBS	No
<i>Echinocardium cordatum</i>	benthos	North Sea	1986	1	NSBS	No
<i>Goniada maculata</i>	benthos	North Sea	1986	1	NSBS	No
<i>Harpinia antennaria</i>	benthos	North Sea	1986	1	NSBS	No
<i>Lunatia poliana</i>	benthos	North Sea	1986	1	NSBS	No

<i>Mysella bidentata</i>	benthos	North Sea	1986	1	NSBS	No
<i>Nephtys hombergii</i>	benthos	North Sea	1986	1	NSBS	No
<i>Nephtys longosetosa</i>	benthos	North Sea	1986	1	NSBS	No
<i>Ophelia borealis</i>	benthos	North Sea	1986	1	NSBS	No
<i>Ophiura albida</i>	benthos	North Sea	1986	1	NSBS	No
<i>Owenia fusiformis</i>	benthos	North Sea	1986	1	NSBS	No
<i>Scoloplos armiger</i>	benthos	North Sea	1986	1	NSBS	No
<i>Spiophanes bombyx</i>	benthos	North Sea	1986	1	NSBS	No
<i>Spio filicornis</i>	benthos	North Sea	1986	1	NSBS	No
<i>Spiophanes kroyeri</i>	benthos	North Sea	1986	1	NSBS	No
<i>Gadus morhua</i>	fish	North Sea	1965-2012	39	ICES	No
<i>Clupea harengus</i>	fish	North Sea	1965-2012		ICES	no
<i>Engraulis encrasicolus</i>	fish	North Sea	1965-2012		ICES	no
<i>Sandeel</i>	fish	North Sea	1965-2012		ICES	no
<i>Scomber scombrus</i>	fish	North Sea	1965-2012		ICES	No
<i>Sprattus sprattus</i>	fish	North Sea	1965-2012		ICES	no
<i>Alca torda</i>	birds	North Sea	1980-2010	92	JNCC	yes
<i>Fulmarus</i>	birds	North Sea	1980-2010	92	JNCC	yes
<i>Larus argentatus</i>	birds	North Sea	1980-2010	88	JNCC	yes
<i>Morus</i>	birds	North Sea	1980-2010	92	JNCC	yes

<i>Rissa tridactyla</i>	birds	North Sea	1980-2010	92	JNCC	yes
<i>Somateria mollissima</i>	birds	North Sea	1980-2010	92	JNCC	yes
<i>Stercorarius</i>	birds	North Sea	1980-2010	91	JNCC	yes
<i>Thalasseus sandvicensis</i>	birds	North Sea	1980-2010	92	JNCC	yes
<i>Larus cachinnans</i>	Birds	Atlantic (Azores)	2000-2004	27	POPA	Seasonal
<i>Calonectris diomedea</i>	Birds	Atlantic (Azores)	2000-2003	27	POPA	Seasonal
<i>Phocoena phocoena</i>	mammals	North Sea	1980-2010	92	JNCC	yes
Seal	mammals	North Sea	1980-2010	92	JNCC	yes
Whale	mammals	North Sea	1980-2010	23	JNCC	No
Dolphin	mammals	North Sea	1980-2010	22	JNCC	No
<i>Delphinus delphis</i>	Mammals	Atlantic (Azores)	1998-2006	11	POPA	Yearly
<i>Physeter macrocephalus</i>	Mammals	Atlantic (Azores)	1998-2005	11	POPA	Yearly
<i>Stenella frontalis</i>	Mammals	Atlantic (Azores)	1998-2007	11	POPA	Yearly
<i>Tursiops truncatus</i>	Mammals	Atlantic (Azores)	1998-2008	11	POPA	Yearly
<i>Caretta caretta</i>	Reptiles	Atlantic (Azores)	1998-2009	11	POPA	Yearly
Modelled <i>Posidonia oceanica</i> Distribution	Angiosperms	Mediterranean Sea	2013	1	Mediseh	
Current <i>Posidonia oceanica</i>	Angiosperms	Mediterranean			Mediseh	

distribution		Sea				
<i>Cymodocea nodosa</i> beds distribution	Angiosperms	Mediterranean Sea			Mediseh	
<i>Zostera</i> meadows	Angiosperms	Baltic Sea			HELCOM	
<i>Halophila stipulacea</i> beds distribution	Angiosperms	Mediterranean Sea			Mediseh	
Historical <i>Posidonia oceanica</i> distribution in the Mediterranean Sea	Angiosperms	Mediterranean Sea			Mediseh	
<i>Posidonia oceanica</i> meadows distribution - Current Distribution (points)	Angiosperms	Mediterranean Sea			Mediseh	
<i>Posidonia oceanica</i> meadows distribution - Historical Distribution	Angiosperms	Mediterranean Sea			Mediseh	
<i>Ruppia cirrhosa</i> beds distribution	Angiosperms	Mediterranean Sea			Mediseh	
<i>Ruppia maritima</i> beds distribution	Angiosperms	Mediterranean Sea			Mediseh	
<i>Zostera marina</i> beds distribution	Angiosperms	Mediterranean Sea			Mediseh	
<i>Zostera noltii</i> beds distribution	Angiosperms	Mediterranean Sea			Mediseh	
Modelled occurrence probability for coralligenous formations	Macroalgae	Mediterranean Sea			MediSeh	
Modelled occurrence probability for maerl beds	Macroalgae	Mediterranean Sea			MediSeh	
Occurrences of coralligenous outcrop	Macroalgae	Mediterranean Sea			MediSeh	
Occurrences of maerl beds	Macroalgae	Mediterranean Sea			MediSeh	
Predicted occurrence probability for coralligenous formations	Macroalgae	Mediterranean Sea			MediSeh	

Predicted occurrence probability for maerl beds	Macroalgae	Mediterranean Sea			MediSeh	
-------------------------------------------------	------------	-------------------	--	--	---------	--

Table 14: Overview of available gridded abundance data products

Data sources

AU, Aarhus University, Aarhus, Denmark

HELCOM, Baltic Marine Environment Protection Commission - Helsinki Commission

ICES, International Council for the Exploration of the Sea, Copenhagen, Denmark

IFREMER, French Research Institute for Exploitation of the Sea

JNCC, Jointed Nature Conservation Committee, UK

MEDISEH, Mediterranean Sensitive Habitats project

NIOZ, Netherlands Institute for Sea Research

NSBS, North Sea Benthos Survey (ICES, 1986)

POPA, Azores Fisheries Observer Programme, Portugal

RWS, Rijkswaterstaat: Dutch Ministry of Infrastructure and the Environment

SAHFOS, Sir Alister Hardy Foundation for Ocean Science, UK

SMHI, Swedish Meteorological and Hydrological Institute

SYKE, Finnish Environment Institute

Annex 2: List of new data sets available at the data portal

Dataset title	Number of records
Antipatharia distribution data from: Deep-sea fauna of European seas - an annotated species check-list of benthic invertebrates living deeper than 2000 m in the seas bordering Europe	29
Danish benthic marine monitoring data from ODAM	794717
Epibenthos and demersal fish monitoring at long-term monitoring stations in the Belgian part of the North Sea	6729
Echinodermata of Montenegro (South Adriatic)	308
Zooplankton monitoring RADIALES - section off A Coruña (NW Spain, Galicia); inner-shelf (station depth 77m)	4903
Zooplankton monitoring RADIALES - section off Gijón (N Spain, Cantabrian Sea); mid-shelf (station depth 130m)	315
Zooplankton monitoring RADIALES - section off Santander (N Spain, Cantabrian Sea); oceanic (station depth 850m)	1631
Zooplankton monitoring RADIALES - section off Santander (N Spain, Cantabrian Sea); mid-shelf (station depth 110m)	2031
Zooplankton monitoring RADIALES - section off Santander (N Spain, Cantabrian Sea); coastal (station depth 30m)	1842
Zooplankton monitoring RADIALES - section off Vigo (NW Spain, Galicia); mid-shelf (station depth 97 m)	3608
Zooplankton monitoring RADIALES - section off Vigo (NW Spain, Galicia); coastal (station depth 39m)	3866
SHARK - Marine zooplankton monitoring in Sweden since 1979	60511
SHARK - Marine soft bottom macrozoobenthos monitoring in Sweden since 1971	233584
SHARK - Marine phytoplankton monitoring in Sweden since 1983	342647
SHARK - Marine bacterioplankton monitoring in Sweden since 1989	11756
Phytoplankton Adriatic-SESAME Project	1181
Phytoplankton monitoring RADIALES - Section off Gijón (N Spain, Cantabrian Sea); mid-shelf (station depth 108m); sampling depths 0, 35 and 70m	1371
Phytoplankton monitoring RADIALES - Section off Cudillero (N Spain, Cantabrian Sea); mid-shelf (station depth 130m); sampling depths 0, 5, 10,30, 40 and 70m	5465
Phytoplankton monitoring RADIALES - Section off Vigo (NW Spain, Galicia); mid-shelf (station depth 97m); sampling depths 0, 5, 10, 20 and 30m	7503
Phytoplankton monitoring RADIALES - Section off Vigo (NW Spain, Galicia); coastal (station depth 39m); sampling depths 0, 5, 10 and 30m	7419

COLETA - IMAR/DOP-UAc Reference Collection from 1977 to 2012	7270
Microzooplankton North Adriatic-Gulf of Trieste LTER time-series	3943
Macrobenthos North Adriatic-INTERREG-FVG Project	1131
Zooplankton monitoring in the Belgian Part of the North Sea between 2009 and 2010	3708
POPA- Fisheries Observer Program of the Azores: Marine mammal sightings in the Azores between 2004 and 2013 recorded by Biosphere Expedition	600
POPA- Fisheries Observer Program of the Azores: Seabird sightings in the Azores tuna fishery from 2000 to 2013: during navigation or search mode	44130
POPA- Fisheries Observer Program of the Azores: Accessory species caught in the Azores tuna fishery between 2000 and 2013	381
POPA- Fisheries Observer Program of the Azores: Discards in the Azores tuna fishery from 1998 to 2013	728
POPA- Fisheries Observer Program of the Azores: Fish caught to be used as bait in the Azores tuna fishery from 1998 to 2013	5747
POPA- Fisheries Observer Program of the Azores: Marine mammal sightings in the Azores tuna fishery from 1998 to 2013: during navigation or search mode	23517
POPA- Fisheries Observer Program of the Azores: Seabird sightings in the Azores tuna fishery from 1998 to 2013: during the capture of live bait	3261
POPA- Fisheries Observer Program of the Azores: Sea turtle sightings in the Azores between 2004 and 2013 recorded by Biosphere Expedition	97
POPA- Fisheries Observer Program of the Azores: Turtle sightings in the Azores tuna fishery from 2000 to 2013: during navigation or search mode	3404
POPA- Fisheries Observer Program of the Azores: Sea bird sightings in the Azores between 2004 and 2013 recorded by Biosphere Expedition	357
POPA- Fisheries Observer Program of the Azores: Tuna species caught in the Azores tuna fishery from 1998 to 2013	27024
POPA- Fisheries Observer Program of the Azores: Marine mammal sightings in the Azores tuna fishery from 1998 to 2013: while fishing	1583
POPA- Fisheries Observer Program of the Azores: Seabird sightings in the Azores tuna fishery from 1998 to 2013: while fishing	33616
POPA- Fisheries Observer Program of the Azores: Marine mammal sightings in the Azores tuna fishery from 1998 to 2013: during the capture of live bait	50
Macrobenthos monitoring in function of the Water Framework Directive	3455
Epibenthos and demersal fish monitoring in function of wind energy development	2184
Demersals survey in the Azores between 1996 and 2013	9837

Microzooplankton North Adriatic-INTERREG Project	5562
Monitoring of birds in the Voordelta	15191
Mesozooplankton South Adriatic-PRISMA1-Flussi Project	680
Microphytobenthos North Adriatic-INTERREG Project	1386
Macrobenthos North Adriatic-ALPE ADRIA Project	3118
Picoplankton North Adriatic-Gulf of Trieste LTER time-series	1087
Phytoplankton North Adriatic-Gulf of Trieste LTER time-series	11336
Data collected during the expeditions of the e-learning projects Expeditie Zeeleeuw and Planeet Zee	416
Cetacean sightings along the central Catalan coast made during surveys of the Associació Cetàcea	11
Diveboard - Scuba diving citizen science observations	22628
Aegean macrobenthic fauna	7277
Laspibay-Black Sea	689
Macrofauna Bahia de Blanes	3754
IMR Macroplankton surveys	4477
IMR Juvenile fish monitoring	5613
MAREANO - Base-line mapping of hyperbenthic crustacea fauna obtained with RP-sledge	5765
MAREANO - Base-line mapping of fauna obtained with grab	14037
MAREANO - Base-line mapping of epifauna obtained with Beamtrawl	8525
IMR Zooplankton Norwegian Sea	78689
IMR Zooplankton North Sea	8048
IMR Zooplankton Barents Sea	21193
Polish Monitoring Programme - Monitoring of the Baltic Sea: zooplankton	14222
Allis Shad (<i>Alosa alosa</i>) distribution for Scotland, historical to present	234
University of Málaga: MGC - Algae	628
Collection Bryozoa SMF	7474
Collection Polychaeta SMF	664
Collection Cnidaria SMF	2339
Collection Echinodermata SMF	338

Observations of three Idotea species (<i>I. balthica</i> , <i>I. chelipes</i> and <i>I. granulosa</i>) in Northern Europe, including the Baltic Sea - field data	21
Observations of three Idotea species (<i>I. balthica</i> , <i>I. chelipes</i> and <i>I. granulosa</i>) in Northern Europe, including the Baltic Sea - data derived from museum collections	320
IMR Herring larvae monitoring	4497
Picoplankton Adriatic-SESAME Project	320
Phytoplankton North Adriatic-ALPE ADRIA Project	6030
Netplankton North Adriatic-ALPE ADRIA Project	3139
Microzooplankton North Adriatic-ALPE ADRIA Project	495
Microphytobenthos North Adriatic-Gulf of Trieste LTER time-series	1389
Mesozooplankton North Adriatic-INTERREG Project	426
Mesozooplankton North Adriatic-Gulf of Trieste LTER time-series	4228
IMR Capelin larvae monitoring	2899
Meiobenthos North Adriatic-INTERREG-FVG-Projects	362
Kyklades	882
Strelbay	297
SARONIKOS	2050
Mytilini	4634
MegFeod-Black Sea	169
Kerkyra	1015
Kalamitsi	2037
Jalta-Black Sea	308
Benthos Cretan Continental Shelf	2670
Aegean Polychaetes	2215
Benthic communities in Amvrakikos Wetlands: Mazoma, Tsopeli, Tsoukalio, Rodia and Logarou lagoons (September 2010 – July 2011)	718
Records of fish species in coastal lagoons that belong to Municipality of Arta, for the period 1999-2011	411
Records of fish species in coastal lagoons and sea shore that belong to Municipality of Preveza, for the period 2002-2011	248
Eastern Mediterranean Syllidae from three locations in Crete and Israel	1123

Polychaetes from two subtidal rocky shores of the North coast of Crete, collected for the NaGISA project 2007-2008	1359
Harpacticoida from a scientific cruise of the R. "Akademik" in the western part of the Black Sea	120
Occasional sampling of Harpacticoida in Gulf of Kandalaksha (White Sea)	13
Total	1,957,215

Table 15: List of new data sets available at the data portal

Appendix 3: Script automatic workflow for creation gridded abundance dataproducts using DIVA

Listing 1: Script doMARdiva direct.R

```

1 # #####
2 ##### INPUT SECTION #####
3 # #####
4 #
5 # define the directory structure of input , output and work
6 #
7 scriptdir <-" / home / peter / Dropbox / projectdata / Marenzelleria / MarOct / Rscripts /"
8 divadir <-" / home / peter / diva -4.6.5 / DIVA3D / divastripped /"
9 datadir <-" / home / peter / Dropbox / projectdata / Marenzelleria / MarOct / divadats /"
10 datfilpatt <-" . txt "
11 paramdir <-" / home / peter / Dropbox / projectdata / Marenzelleria / MarOct / param /"
12 outdir <-" / home / peter / Dropbox / projectdata / Marenzelleria / MarOct / output /"
13 gebcofile <-" gebco - export - DKSEFI . asc "
14 obsdatafile <-" Marenzell _all .txt"
15 outpdf <-" Mar _all_ diva .pdf"
16 outgif <-" Mar _all_ diva .gif"
17 #
18 elevoffset <-20 #all depths increased by 20 m to displace coastline behind
barriers
19 #
20 neededfiles <-c(" coast . cont ", " param . par ", " topo . grd ", " TopoInfo .dat")
21 optfiles <-c(" coast . cont . dens ", " UVinfo .dat", " Uvel . dat ", " Vvel . dat ", " sources .
dat ", " RL . dat ", " RLinfo . dat ")
22 #
23 params <-list (lc =0.5 , icoordchange =1, ispec =11 , ireg =0, xori =6.0042 , yori
=53.0042 ,
24 dx =0.0415 , dy =0.041466 , nx =600 , ny =312 , valex = -99 , snr =10 , varbak =1)
25 #
26 # plotparameters
27 errcrit <-0.5 # critical error value for masking out values
28 # plotting limits
29 xmin <-6
30 xmax <-31
31 ymin <-53
32 ymax <-66
33 #
34 datmax <-4 # factor for scaling symbols of data points
35 rastmax <-1 # max scale for raster shades of grey
36 colscheme <-'matlab ' # color scheme for plots ; one of c('gray ','matlab ','
terrain ')
37 #
38 # #####
39 ##### REQUIRED PACKAGES #####
40 # #####
41 #
42 require ( maps )
43 require ( maptools )
44 require ( mapdata )
45 require ( sp )
46 require ( raster )
47 require ( ncdf4 )
48 require ( stringr )
49 require ( animation )
50 #
51 #

```

```

52 # #####
53 # ##### PREPARE DIVA DIR #####
54 # #####
55 #
56 # empty diva input directory and make backup
57 #
58 divinput <-paste ( divadir , " input " ,sep ="" )
59 if( file . exists ( divinput )){
60 lfil <-list . files ( path = divinput , recursive =T, full . names =T)
61 i <-1
62 divinputi <-paste ( divinput ,i, sep ="" )
63 while ( file . exists ( divinputi )){
64 i <-i+1
65 divinputi <-paste ( divinput ,i, sep ="" )
66 }
67 dir . create ( divinputi )
68 file . copy ( lfil , divinputi , recursive =T)
69 file . remove ( lfil )
70 } else dir . create ( divinput )
71 #
72 # #####
73 # ### PREPARE TOPOGRAPHY #####
74 # #####
75 #
76 source ( paste ( scriptdir , " prepgebc0 .R" ,sep ="" ) )
77 #
78 # #####
79 # ### PREPARE INPUT FILES #####
80 # #####
81 #
82 source ( paste ( scriptdir , " prepinput .R" ,sep ="" ) )
83 #
84 # #####
85 # ##### DO THE ANALYSES #####
86 # #####
87 #
88 # function to diva - analyse one inputfile
89 wb <- function (titel , datadir , DIVAdir ,outdir , filein , fileout ){
90 system ( paste ( " echo ` doing " ,titel ,"\` " ))
91 system ( paste ( " cp " ,datadir , filein , " " ,DIVAdir , " input / data . dat " ,sep ="" ) )
92 system ( paste ( " cd " ,DIVAdir , " ; export PATH = $ PATH . : ; ./ divadress " ,sep ="" ) )
93 system ( paste ( " cp " ,DIVAdir , " output / ghertonetcdf / results . nc " ,outdir ,
fileout , sep ="" ) )
94 system ( paste ( " echo ` finished " ,titel ,"\` " ))
95 }
96 # execute diva commands
97 setwd ( divadir )
98 for ( i in 1 : nfiles ) wb( basnams [i] , datadir , divadir ,outdir , nams [i] , ncnams [i] )
99 #
100 #
101 # #####
102 # now make plots of the results #
103 # #####
104 #
105 # plotting function
106 source ( paste ( scriptdir , " plotstanddat .R" ,sep ="" ) )
107 #
108 setwd ( outdir )
109 # produce pdf output of maps
110 # open pdf file for output
111 pdf ( file = outpdf )
112 #
113 for ( i in 1 : nfiles ){
114 # read species data and store as SpatialPointsDataFrame
115 amfi <-read . table ( file = paste ( datadir , nams [i] , sep ="" ) ,header =FALSE , sep ="" )

```

```

116 names ( amfi ) <-c('long ','lat ','pres ')
117 coordinates ( amfi ) <- ~ long + lat
118 #
119 projection ( amfi ) <-pro
120 title <- basnams [i]
121 #
122 # read DIVA result from netcdf file and store as raster
123 af <- raster ( ncnams [i], varname =" analyzed _ field ")
124 af <-max (af,0)
125 af <-min (af,1)
126 aferr <- raster ( ncnams [i], varname ="error _ field ')
127 aferr [aferr > errcrit ] <-NA
128 af <-mask (af , aferr )
129 projection (af) <-pro
130 af <-crop (af , extt )
131 #
132 # plot results , using plotting function plotrastanddat
133 plotrastanddat (amfi ,af ,extt ,pro , numdats =F, datmax , rastmax , colscheme , title )
134 }
135 dev . off ()
136
137 #
138 # produce animated GIF output
139 saveGIF ({
140 ani . options ( interval =1, outdir = outdir )
141 for ( i in 1: nfiles ){
142 # read species data and store as SpatialPointsDataFrame
143 amfi <-read . table ( file = paste ( datadir , nams [i], sep =""),header =FALSE , sep =""
)
144 names ( amfi ) <-c('long ','lat ','pres ')
145 coordinates ( amfi ) <- ~ long + lat
146
147 projection ( amfi ) <-pro
148 title <- basnams [i]
149
150 # read DIVA result from netcdf file and store as raster
151 af <- raster ( ncnams [i], varname =" analyzed _ field ")
152 af <-max (af,0)
153 af <-min (af ,1)
154 aferr <- raster ( ncnams [i], varname ="error _ field ')
155 aferr [aferr > errcrit ] <-NA
156 af <-mask (af , aferr )
157 projection (af) <-pro
158 af <-crop (af , extt )
159
160 # plot results , using plotting function plotrastanddat
161 plotrastanddat (amfi ,af ,extt ,pro , numdats =F,datmax , rastmax , colscheme ,
title )
162 }
163
164 }, interval =1, movie . name = outgif )
165
166 dev . off ()
167
168 #
169 # ALL DONE ! #

```

Listing 2: Script prepgebco.R

```

1 # prepare topogrid & coastline from gebco
2 #
3 # read GEBCO output file ( with header removed ) and prepare topo . gebco file
#
4 #
5 setwd ( paramdir )
6 geb <-read . table ( file = gebcofile )
7 geb $V3 <-geb $V3+ elevoffset
8 write . table (geb , file =" topo . gebco ",sep=" ",col . names =F, row . names =F)
9 #

```



```

10 # copy topo . gebco to diva input directory and process with diva tools
11 #
12 system ( paste ("cp ",paramdir," topo . gebco ",divadir," input/",sep=""))
13 cmddd <-paste (" export PATH =$ PATH :. && ",
14 "cd ",divadir," && ",
15 " gebco2diva 5 5 && ",
16 "cp ./ output / topo . grd ", paramdir , " && ",
17 "cp ./ output / TopolInfo . dat ", paramdir , " && ",
18 "cp ./ output / topo . grd ./ input / topo . grd && ",
19 "cp ./ output / TopolInfo . dat ./ input / TopolInfo .dat && ",
20 " divacont && ",
21 "cp ./ output / coast . cont ", paramdir , " coast . cont . org",
22 sep="" )
23 system ( cmddd )
24 #
25 # now coast . cont . org is in param directory . We will first clean it from
small islands and store as coast . cont
26 #
27 setwd ( paramdir )
28 conf <-file (" coast . cont . org ")
29 open (conf ,rw="r")
30 nisl <-0
31 nconts <-as. numeric ( readLines ( con =conf ,n =1) )
32 for ( i in 1: nconts ){
33 npairt <- readLines ( con =conf ,n =1)
34 npairs <-as. numeric ( npairt )
35 isl <- readLines ( conf ,n= npairs )
36 if ( npairs >20) nisl <-nisl +1
37 }
38 close ( conf )
39 conf <-file (" coast . cont . org ")
40 open (conf ,rw="r")
41 cono <-file (" coast . cont ")
42 open (cono ,"w")
43 writeLines (as. character ( nisl),cono )
44 # first <-TRUE
45 nconts <-as. numeric ( readLines ( con =conf ,n =1) )
46 for ( i in 1: nconts ){
47 npairt <- readLines ( con =conf ,n =1)
48 npairs <-as. numeric ( npairt )
49 isl <- readLines ( conf ,n= npairs )
50 if ( npairs >20) {
51 writeLines (npairt , cono )
52 writeLines (isl , cono )
53 # if( first ){
54 # first <-FALSE
55 # plot (t( matrix ( scan ( text = isl ),ncol = npairs )),type ="l", xlim =c(6 ,31) ,
ylim =c (50 ,67) )
56 # } else lines (t( matrix ( scan ( text = isl ),ncol = npairs )))
57 # }
58 }
59 }
60 close ( conf )
61 close ( cono )
62 #
63 # write param . par file , adjusted for extent of domain
64 #
65 ti <-scan ( paste ( paramdir , " TopolInfo . dat ",sep="" ),n =6)
66 params [5:10] <-ti
67 cono <-file ( paste ( paramdir , " param . par ",sep=""))
68 open (cono ,"w")
69 for ( i in (1:13) ){
70 writeLines ( paste ("#",names ( params )[i], sep="" ),cono )
71 writeLines (as. character ( params [i] ),cono )
72 }

```

```
73 close ( cono )
74 #
```

Listing 3: Script prepinut.R

```
1 # check existence of input files in paramdir and copy them to diva input
  directory
2 #
3 setwd ( paramdir )
4 for ( i in 1: length ( neededfiles )){
5 if( file . exists ( neededfiles [i])) file . copy ( neededfiles [i], divinput )
6 else stop ( paste ( " file ", neededfiles [i], " not found in paramdir " ))
7 }
8 for ( i in 1: length ( optfiles )){
9 if( file . exists ( optfiles [i])) file . copy ( optfiles [i], divinput )
10 }
11 # check existence of datadir and outdir and create when needed
12 #
13 if(! file . exists ( datadir )) dir . create ( datadir )
14 if(! file . exists ( outdir )) dir . create ( outdir )
15 #
16 # prepare datafiles
17 #
18 marocc <- read . table ( obsdatafile , header =T, sep ="\t")
19 marocc <- marocc [!is.na( marocc $ year ) ,]
20 marocc <- marocc [!is.na( marocc $ Idens ) ,]
21 marocc <- marocc [ marocc $year >1982 ,]
22 marocc <- marocc [ marocc $lat >53 ,]
23 marocc <- marocc [ marocc $lon >6 ,]
24 #
25 yrs <- unique ( marocc $ year )
26 yrs <- sort ( yrs )
27 #
28 for ( i in 1:( length ( yrs ) -1)){
29 recs <- which ( marocc $year <=( yrs[i ]+1) & marocc $year >=( yrs[i] -1))
30 mar <- marocc [recs ,-c(3 ,4 ,5)]
31 mar $ Idens <-1*( mar $Idens >0)
32 write . table ( mar , file = paste ( datadir , " mar ", yrs [i], ". txt ", sep =""), col . names =
  F, row . names =F)
33 }
34 #
35 # Read in the information on input files
36 #
37 nams <- list . files ( path = datadir , pattern = datfilpatt )
38 nfiles <- length ( nams )
39 dotpos <- str _ locate (nams ,"\. ")[ ,1]
40 basnams <- substr (nams ,1, dotpos -1)
41 ncnams <- paste ( basnams , ". nc", sep ="" )
42 #
```

Listing 4: Script plotrastanddat.R

```
1 # set map parameters
2 #
3 extt <- extent (c(xmin ,xmax ,ymin , ymax )) # extent of the map to be plotted
4 ext <- as . vector ( extt )
5 pro <- CRS ( "+ proj = longlat + datum = WGS84 " )
6 boundaries <- map ( 'worldHires ', xlim =ext [1:2] , ylim = ext [3:4] , fill =TRUE , plot =
  FALSE )
7 IDs <- sapply ( strsplit ( boundaries $names , ":"), function ( x) x [1])
8 boundaries <- map2SpatialPolygons ( boundaries ,IDs , proj4string = pro )
9 col <- rep ( 0 ,256)
10 l1 <- list ( 'sp . polygons ', boundaries , lwd =0.5 , first =F, fill = 'dark grey ' )
11 #
12 # define plotting function
13 #
14 plotrastanddat <- function (samps ,rast ,extt ,proj , numdats =TRUE , datmax , rastmax ,
  colscheme , title ){
```

```

15 rast <-crop (rast , extt )
16 ext <- as. vector ( extt )
17 boundaries <- map ('worldHires ',xlim =ext [1:2] , ylim = ext [3:4] , fill =TRUE ,
plot = FALSE )
18 lDs <- sapply ( strsplit ( boundaries $names , ":"), function (x) x [1])
19 boundaries <- map2SpatialPolygons ( boundaries ,lDs , proj4string = proj )
20 #
21 if ( colscheme == 'terrain '){
22 col <-(rev( terrain . colors (255) ))
23 prescol <-'black '
24 abscol <- 'red '
25 }
26 if ( colscheme == 'matlab '){
27 jet . col <- colorRampPalette (c(" #00007 F", " blue ", " #007 FFF ", " cyan ",
28 "#7 FFF7F ", " yellow ", "# FF7F00 ", " red ", "#7
F0000 "))
29 col <-jet . col (256)
30 prescol <-'black '
31 abscol <-'purple '
32 }
33 if ( colscheme !='terrain ' & colscheme !='matlab '){
34 col <-gray ( seq ( from =1, to =0, length =200) )
35 prescol <-'green '
36 abscol <-'dark blue '
37 }
38 #
39 l1 <-list ('sp. polygons ', boundaries , lwd =0.5 , first =F, fill ='dark grey ')
40 if( numdats ) l2 <-list ('sp. points ',samps ,pch =1, cex = samps $ dens / datmax +0.5 ,
col ='red ') else
41 l2 <-list ('sp. points ',samps , pch = samps $pres , col = ifelse ( samps $pres , prescol
, abscol ))
42 #
43 print ( splot (rast , at = seq (0, rastmax , length . out =100) ,col . regions =col ,
colorkey = list ( height =0.6) ,main =title ,sp. layout = list (l1 ,l2)))
44 }

```