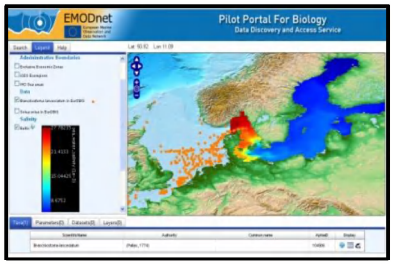
2010

Workshop Report



Building a European Marine Observation and Data Network 'EMODnet': Biological Data Products Workshop

VLIZ Special Publication 45

25 – 26 February 2010

Flanders Marine Institute

Innovocean Site

BE- Oostende

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1. Summary

From 25 till 26 of February 2010, the Flanders Marine Institute (VLIZ) organized a workshop on biological data products in Oostende, Belgium. This workshop was organized within the framework of the upcoming European Marine Observation and Data Network, EMODnet, launched by the Maritime Policy of the European Commission. 57 participants from 42 excellent institutes involved in marine biological data collection, marine research and marine policy across Europe attended the workshop.

The workshop had three main objectives: (1) to discuss the marine biological data availability and gaps in Europe, (2) to demonstrate the prototype of the EMODnet biological data portal to different user groups and (3) to define a set of derived biological data products relevant for private bodies, public authorities and researchers.

A huge amount of reliable European marine biological data and information was presented to the public. These data are available and despite some temporal, spatial and taxonomic limitations, data are already very useful for analyses. There was a consensus amongst workshop participants that the look and feel and functionalities of the EMODnet biological prototype portal, visualizing both data observations and data products, were meeting the requirements.

Although the user groups were very diverse, being people from the scientific community, people involved in the European marine policy and coastal and marine practitioners, a number of striking similarities amongst data products were found. In the different user discussion groups, four different sets of marine biological data products were identified as priority biological data products being: (1) species distribution maps and trends, (2) species sensitivity and vulnerability maps, (3) species attributes (functional groups, HAB's, invasive species, red list or protected species) and (4) biodiversity indices.

Within the biological EMODnet preparatory action, a few data analysis workshops will be organized in the near future (2011) to produce some of the data products identified during this workshop. The same community and other relevant stakeholders, identified during the meeting will be involved in this process.

2. Institutional representation

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European Commission; Directorate-General for Research, SDME 7/15, Wetstraat 200, 1049 Brussel, Belgium

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3. Introduction

In October 2007, the European Commission presented its vision for an Integrated Maritime Policy for the European Union. This vision is based on the clear recognition that all matters relating to Europe's oceans and seas are interlinked, and that sea-related policies must develop in a joined-up way. The **Maritime Policy Blue Book**, welcomed by the European Council, announced that the European Commission would take steps to set up a **European Marine Observation and Data Network** to improve access to high quality marine data for private bodies, public authorities and researchers. In April 2009, a roadmap was published outlining the measures that would be taken to meet this objective. Since then, a set of **preparatory actions on biological data, hydrographic data, chemical data, geological data and broad scale habitats** has been launched for a limited set of Sea Basins. They aim at gathering experience for a later permanent operational system.

The preparatory action for Biological data, coordinated by the Flanders Marine Institute (VLIZ), started in May 2009. Based on the experiences in the development of marine biological datasystems like **EurOBIS** (European Ocean Biogeographic Information System) and **WoRMS** (World Register of Marine Species), VLIZ and its project partners (ICES, GBIF, IBSS, MarBEF, PANGAEA, Seadatanet, OBIS, IOC-IODE, ESF-Marine Board) started the development of the **biological components for a future EMODnet**. In parallel with the development of an **online data portal** allowing free access to several biological data types (presence, biomass, abundance, diversity indices), the biological preparatory action also performs a **data inventory and gap analysis** and identifies and compiles value-added biological **data products of European marine biological data** to become freely available through EMODnet for different user communities.

The data products workshop had three main goals:

- ✓ discuss the marine **biological data availability and gaps** in Europe
- ✓ **demonstrate the prototype of the EMODnet biological data portal** to different user groups
- ✓ **define a set of derived data products** relevant for private bodies, public authorities and researchers

and resulted in a set of **key-recommendations** that will be implemented in the further development of the preparatory action for biological data. They will be communicated to the maritime policy of the European Commission. Based on the identification of relevant data products, **targeted data analysis workshops** will be organised in the near future.

4. Data availability across Europe and visualization of data and data products

✓ **Data availability across Europe**

Traditionally, marine researchers collect data in their own field of expertise, often with a confined temporal and spatial range. Data are used in a rather limited context, they have confined temporal and spatial ranges and are mostly stored in the institute or university responsible for its collection. This leads to marine data and information being scattered around Europe, without a complete overview of what exists and what is available.

The Biological Lot of EMODnet aims to identify these scattered datasets and to describe them in a central system, a metadata catalogue freely consultable on the web. Describing and archiving scattered data will prevent future data loss or corruption and will thus safeguard the documented observations for future usage. The identification of existing datasets takes place on both a national and regional level within Europe and the compilation of this inventory of marine biological datasets is still an ongoing task.

Up till now, over 100 questionnaires were sent out to partners and possible data contributors. This questionnaire contained a list of 472 marine biological datasets already known to European marine biology metadata catalogues compiled during previous and ongoing European and international projects (Biomare, 2000-2002; MarBEF, 2004-2009; EurOBIS; OBIS; GBIF). The list was accompanied by the following questions: (1) to complete the presented inventory with additional datasets and (2) to inform us whether the identified data can be made available to EMODnet. Through this survey, almost 100 new datasets were identified and described and a number of institutes have agreed to deliver their metadata on marine datasets soon. This metadata catalogue can be consulted at http://bio.EMODnet.eu/data-catalog

Next to contacting the partners of our EMODnet Biological Network to complete this inventory with more research-oriented datasets, we undertook an additional search for long-term biological monitoring data. Here, we focused on both national and regional biological monitoring data and we limited ourselves to the assigned geographical area defined in the EMODnet tender, being The Bay of Biscay, Iberian coast and the Greater North Sea, including Kattegat and the English Channel. In our search, all countries bordering these sea-regions were contacted.

An overview of the national and regional monitoring activities we have so far identified is presented in the following table.

Country	Groups	Temporal scope
Sweden	benthos, plankton, mammals	1971 – present
Denmark	benthos, plankton, algae	1979 – present
Germany	benthos, plankton, birds, mammals, algae	1973 – present
Netherlands	benthos, plankton, birds, plants, mammals, bacteria	1948 – present
Belgium	benthos, birds	1979 – present
United Kingdom	Benthos, birds, macroalgae, plants	1970's – present
Ireland	plankton, mammals	1990's – present
France	benthos, plankton	1987 – present
Spain	plankton	1987 - present
Portugal	*No specific national monitoring programme*	

	Groups	Temporal scope
HELCOM	benthos, plankton, chlorophyll	1979 – present
EEA	chlorophyll	1980 – present
ICES	benthos, plankton, fish	1950 - present

This overview is still a work in progress, but already clearly shows that very few countries seem to have a holistic approach, meaning they monitor all the groups mentioned in the EMODnet-tender (benthos, plankton, birds, mammals, reptiles, macro-algae, chlorophyll). We can also observe that most national monitoring programmes start around the end of the 1970's and the 1980's and that real historical data (pre-1950's) are rare. If we want to integrate the national monitoring programmes it will be key to identify the used sampling methodologies in order to know if the data can be compared across nations. This is an argument for fine tuning of national programmes at European level.

On regional level, data are sometimes gathered in a more aggregated way. This aggregation of data on a more general level than 'species' increases the possibility of adding duplicate information to the system and will decrease the taxonomic precision. To prevent this duplication or to reduce such errors, regional instances are asked to document in detail where all their data come from. If possible, we will give priority to the most detailed data and information, likely to come from the national level. On the metadata level, a thorough documentation of the data will be given, indicating that certain data are both available from the national provider as through the regional instances. If duplicate entries would go unnoticed in the metadata control, an additional check will be done within the database, where queries will identify possible duplicates.

Locating existing marine biological datasets is just a first step within EMODnet. There is also the need to make these data publicly available, either directly by making the data itself accessible, or indirectly through derived data products such as maps with aggregated data and graphs. And this information is also part of the 'data availability'. One needs to know what kind of information is available within the dataset and whether this data can be used for other purposes (e.g. research, dissemination, development of derived products) and within other initiatives. Does the data contain species information or higher taxon level information, does it represent raw data or are the data aggregated in some way? If so, what was the aggregation method applied? Are we dealing with presence data only, or is absence information also documented? Is the abundance and/or biomass information available? All these questions in a way relate to the 'data availability' of a dataset and need to be answered and documented with great care, again emphasizing the need to have a central system to archive and describe data as implemented within the EMODnet Biological Lot.

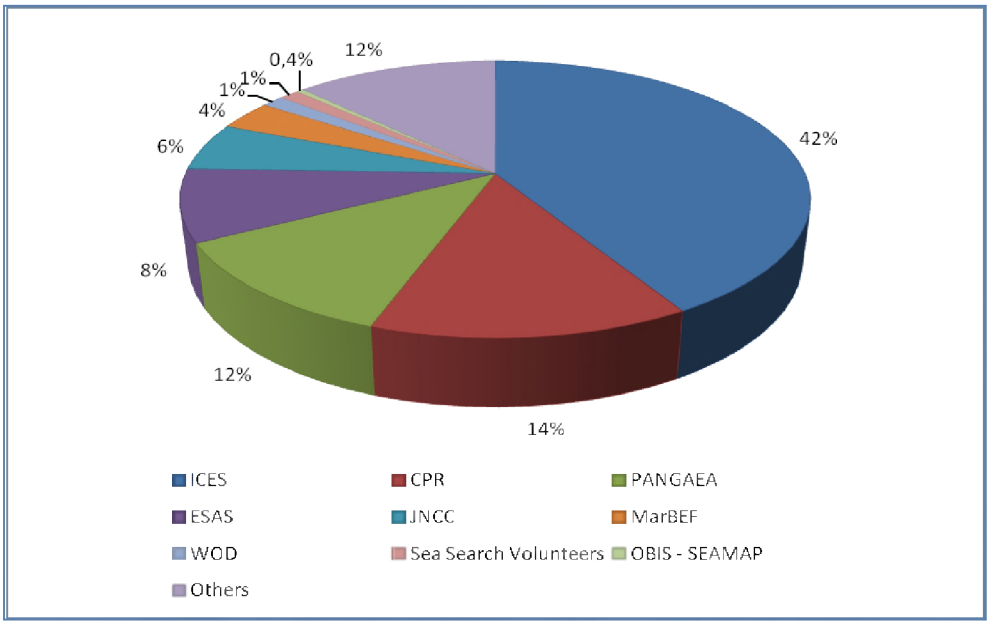
✓ **EurOBIS content and gap analysis**

Since the launch of the EMODnet tender in 2008, the number of distribution records freely available within the EurOBIS datasystem has been growing steadily. Currently (July 2010), a total of 13.6 million distribution records can be consulted through EurOBIS, derived from 228 datasets. The following table shows the evolution in available data.

Period	# datasets	# distribution records
2008 – launch of tender	119	3.6 million
2009 – summer (EurOBIS gap analysis)	214	8.5 million
2010 – year 1 EMODNET (May)	220	13.3 million

The following diagram shows the relative contribution of the large data providers to EurOBIS. The majority of the data are delivered through ICES, followed by the Continuous Plankton Recorder data from SAHFOS. Data providers are many in numbers and taxonomical range of data they provide. Where

ICES and PANGAEA for example provide mixed data (benthos, fish,…), the data of a number of providers are limited in taxonomical range, for example CPR (plankton) and ESAS (seabirds). Data from a single provider representing less then 1% of the total amount of data available in EurOBIS were grouped together as 'others' making up a total 12%.

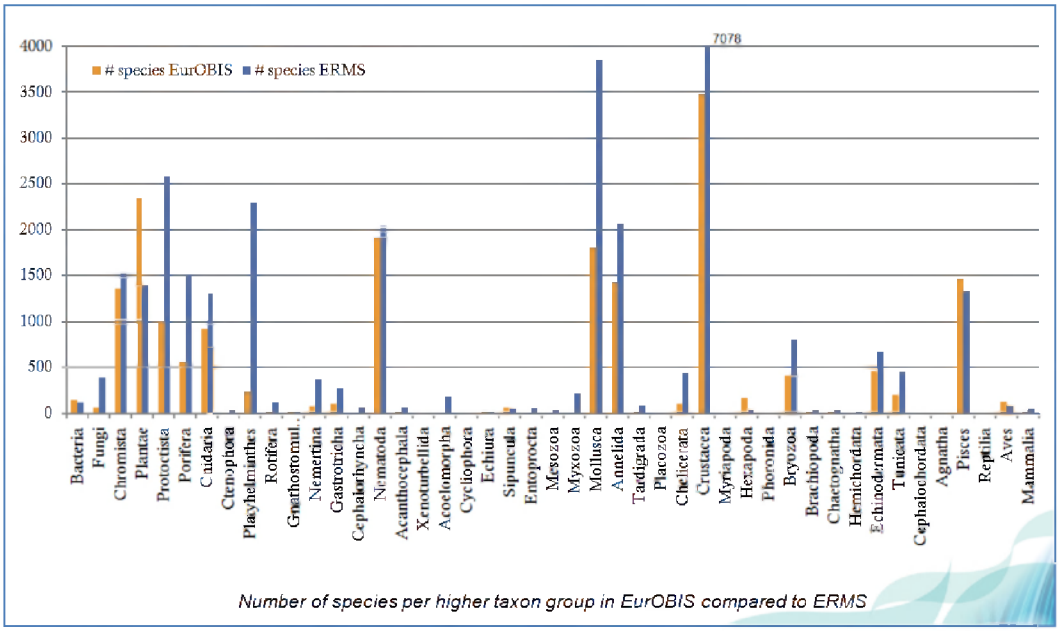


Relative contribution of the large data providers to EurOBIS.

Once data have been made publicly available, the identification of possible shortcomings can start. These gaps in the data are mainly situated on three levels: (1) taxonomic, (2) geographical and (3) temporal. A first gap analysis was performed late 2009, when EurOBIS contained 214 datasets, representing over 8.5 million distribution records. A revised gap analysis is in progress, which will take into account this large data growth. The main findings of the first gap analysis (late 2009) will be discussed below, the results of the revised gap analysis (summer 2010), will be submitted for publication soon.

***Taxonomy*:**

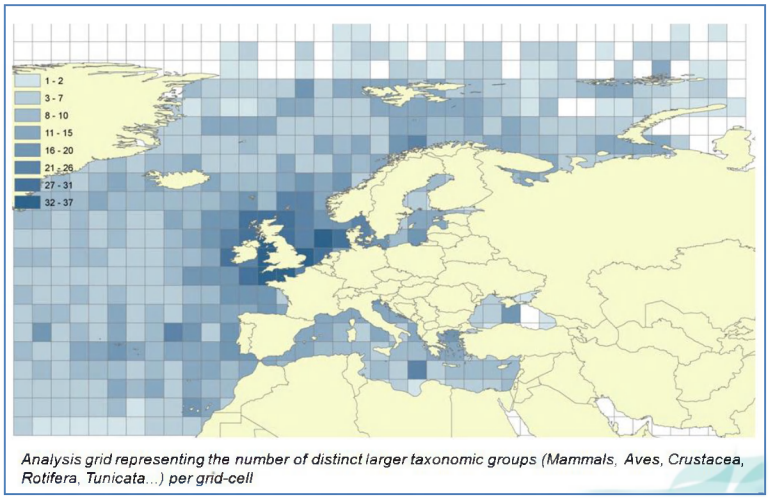
A number of taxonomic groups have not yet been covered (e.g. Myxozoa, Mesozoa, Cephalocarida and Remipedia), while the European Register of Marine Species (ERMS) confirms the presence of representative species within European waters. Other groups are represented (Platyhelminthes, Protoctista, Mollusca), but with very few species compared to what can occur in European marine waters according to ERMS. This can be explained by the large diversity within these taxonomic groups. A number of groups seems to be "over-represented" (Pisces, Aves), which can be explained by the broader scope of EurOBIS compared to ERMS or the fact that these species have been found in European marine waters but this has not yet been documented in ERMS.



Distinct valid species names per higher taxonomic group for EurOBIS and ERMS

***Geography*:**

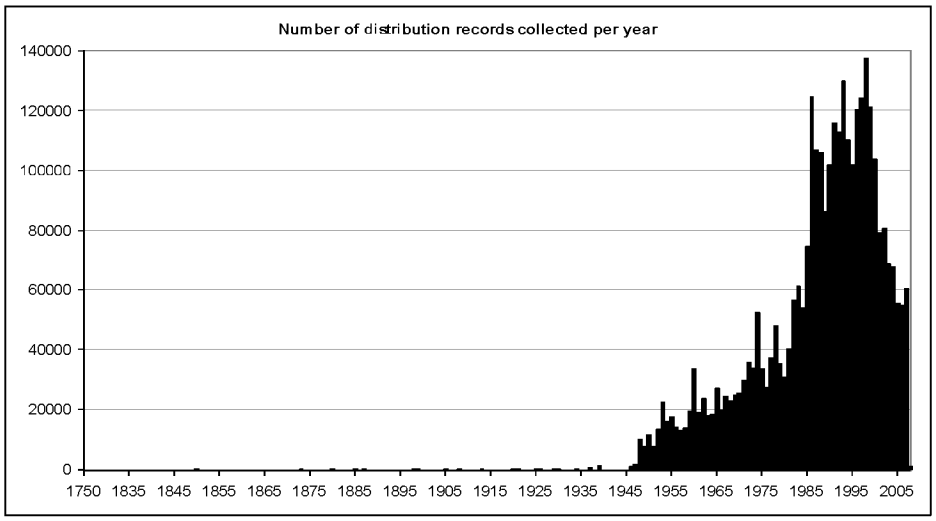
The North Sea, English Channel and North East Atlantic regions are very well documented within EurOBIS, whereas the Arctic Ocean has hardly any data represented. Differences in number of distribution records and number of distinct species are related to data gathering efforts, which differ strongly between regions, depending on their accessibility. The map below does not represent the general state of biodiversity across European marine waters, but should be seen as a proxy for the general data coverage so far available within EurOBIS.



Number of distinct larger taxonomic groups per grid-cell of 3 by 3 degrees.

***Time*:**

About 30% of the available species distribution records have no indication of time, which makes them unsuitable for temporal analyses. The proportion of unsuitable records becomes even larger (about 40%) when requiring information on sampling month and/or day, as needed to perform detailed temporal analyses, e.g. on a seasonal level. Of all time referenced species distribution records, only 1% has been collected prior to 1950. This does not mean data prior to 1950 are not available; they are just not available in a digital format.



Total number of distribution records collected per year

***Abundance & life stage*:**

Less than 15% of the available species records contain abundance information, e.g. stating how many individuals were found at a location. The other 85% of species distribution records only state that a species was present at a location. Although the lack of abundance data might pose problems when one wants to calculate certain diversity indices, the presence data can be equally valuable in the analysis of geographical patterns or of species richness. About 14% of the species distribution records contain relevant information on the life stage of the recovered species. This is a rather low number compared to the importance of this information: life stage is indispensable when subdividing marine taxa into so-called functional groups such as benthos or plankton. The lack of the life stage can result in exclusion of these records in such analyses.

All addressed issues can be dealt with in future data collation, by pointing out to data custodians that this information can be of the utmost importance to improve the quality of the system and the data it contains and it can give rise to more high-quality integrated analyses.

✓ **Gap analysis - in conclusion**

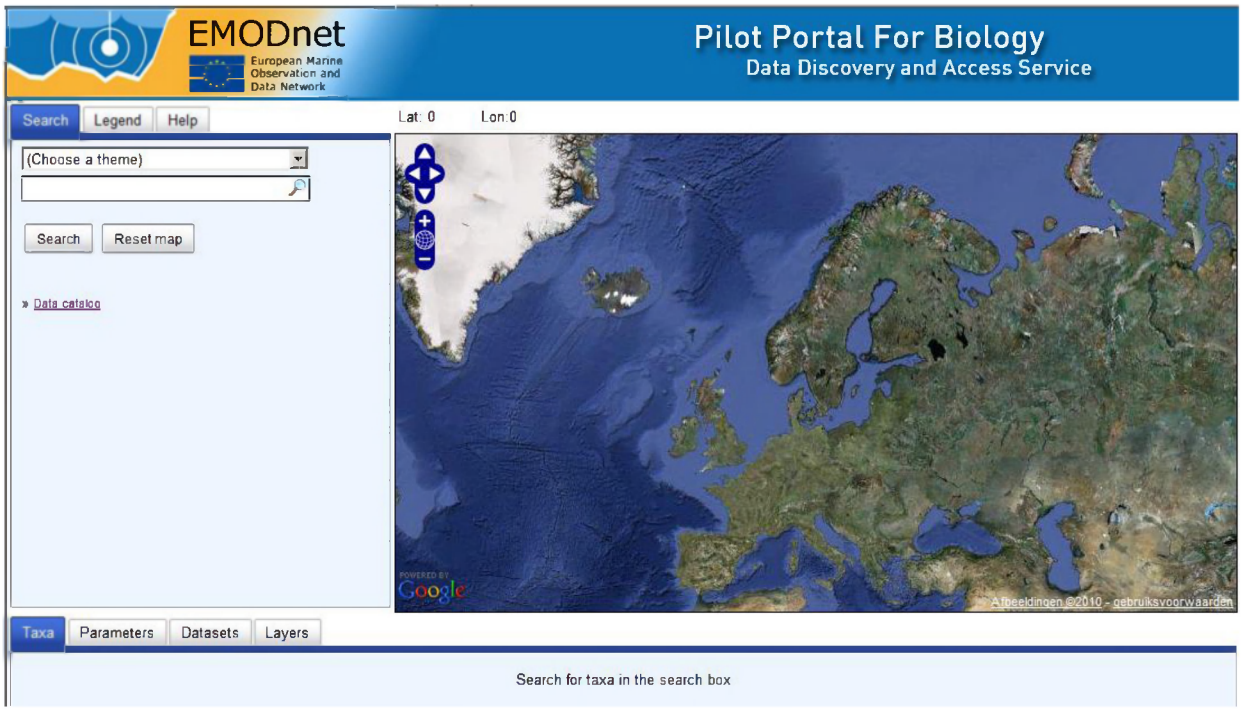
A huge amount of reliable data and information is already publicly available through EurOBIS. When putting the data to use, one however needs to be critical and realize that using all available data in one exercise is nearly impossible and thus sub-selections of data need to be made. Upon proper selection, the data can be used in an endless range of possibilities, going from presence-absence analyses to area comparisons and even the calculation of different diversity indices.

One does have to recognize a number of limitations of the data. The European seas for example are not represented evenly within EurOBIS, with especially an underrepresentation of data from the Mediterranean. Geographical information is not always exact, but can be derived or generalized, leading to less precision. Concerning temporal information, a lack of data pre-1950 and post-2002 is evident. And finally, one has to take into account the very diverse nature of the data: combining research and monitoring data is not always straightforward and the same applies to literature versus field data or species-related data versus more taxonomically aggregated data.

Despite these limitations, the data are already very useful for analyses, one just needs to be critical and selective.

✓ **Visualization of data and data products**

Within the Biological Lot, a portal was developed to visualize metadata, data and data products. The portal is online available http://bio.EMODnet.eu/portal. It complies with Open Geospatial Consortium (OGC) standards. All GIS layers can be made available via OGC Web Map Services (WMS). The OGC compliancy allows interoperability with other data catalogues: the Biological Portal of EMODnet will for example be able to display data layers compiled by other lots.



First prototype Biology portal, available at http://bio.EMODnet.eu/portal

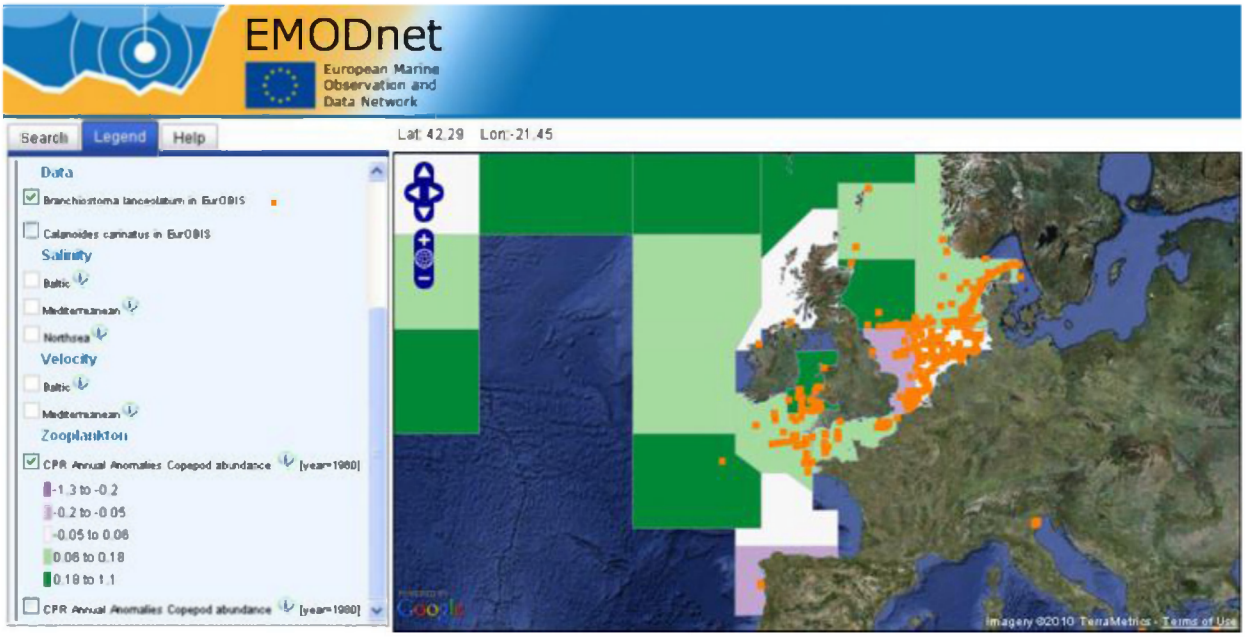
The metadata catalogue provides an overview of inventoried datasets and indicates whether the data are available through the portal or not. This catalogue is ISO19115 compliant and contains information on the geographic, taxonomic and temporal cover of the data, the collected parameters, who has collected the data and a precision and resolution of the data. The portal contains all biogeographic datasets available through EurOBIS and several GIS layers. The catalogue itself can be searched at http://bio.EMODnet.eu/data-catalog.

The available data can be queried in several ways. Taxonomic queries allow the user to look for data on specific species or species groups like zooplankton, phytoplankton, birds, … All species names are

matched to the World Register of Marine Species standard (WoRMS, www.marinespecies.org), adding to the quality control of the system. Additionally, the user can define boundaries on three dimensions: time, geographical space and water depth.

After defining the selection(s), results are given in four different 'modules'. The first module 'taxa' lists the observation data for the selected taxon. The second module - parameters – shows information on biological parameters such as abundance, biomass and chlorophyll a data. All datasets containing (part of) the requested taxonomic data are listed in a third module. A fourth module lists information on aggregated biological data available as GIS layers.

The portal can map both observational data and aggregated data in an online Geographic Information System. The system allows the user to zoom, pan and look at the attributes such as values, latitude, longitude, data, station name and a link to the metadata of the mapped data. A legend is displayed for all the selected GIS layers.



Mapping of both species observations and aggregated data layers (GIS layer)

5. User needs for data products for different user communities

One of the main goals for organizing the workshop was to define a set of derived marine biological data products that are relevant for different user groups. EMODnet is a user driven process, priorities and targets need to be set by those who require the data and it is the user who must decide where EMODnet can provide added-value to what already exists. Therefore, several representatives from different user communities where invited to participate in discussions focusing on the needs for specific biological data products for different user groups and purposes. Four different user groups where identified:

1. Science: understanding the system
2. Policy: monitoring the system, long-term changes (making the right decisions)
3. Practitioners: activities at sea (short-term impacts)
4. Dissemination, education and raising of awareness.

Every discussion was introduced by a presentation on possible data products for each user group.

✓ **Science: understanding the system**

Plenary presentation: Scientific use of biodiversity databases (Peter M.J. Herman and Mark J. Costello)

Peter M.J. Herman (top) and a happy chair, Iain Shepherd

Using current databases, monitoring programmes and scientific knowledge, the scientific community is looking for **indices that indicate the status and future evolution of marine ecosystems in Europe**. By doing so, they assist in managing the future of the European seas. Potential indicators include species richness, trophic structures, eutrophication indicators or the spatial structure of communities.

Data on species presence, abundance and biomass at different scales and **functional and structural species attributes** (trophic role, reef forming) are critical to come to these indicators but also environmental and biogeochemical data at different scales are needed. Important is to create data products that aim at **temporal scales justified by the data**.

For regional seas (North Sea) a decadal time scale with a 10 km spatial scale is probably the maximum attainable. Coasts and estuaries will probably require a higher resolution. Data products should also make use of both **point data and models** to interpolate between data points. Taxonomic, habitat and parameter **standards** are necessary for biological data management, however exchange tools for biological data can still be improved based on the experiences from the physical oceanography.

The overall aim is to come towards **an ecosystem product combining structural environmental data, oceanographic data, habitat data and biological data**. Also the biogeochemistry gaps should be filled.

Plenary group(top) and Mark J. Costello (bottom)

Discussion group: ***Peter Herman, Mark Costello****, Volodymyr Vladymyrov, Oleksandra Sergeyeva, Kees Camphuysen, Bengt Karlson, Ward Appeltans, Francisco Hernandez, David Remsen, Jessie Bluvias, Leen Vandepitte, Stéphane Pesant, Matteo Vinci, Todd O'Brien, Pascal Legrand, Daniel Hallam, Fabio Bulleri, Christos Arvanitides, Guy Bachelet, Alexander Mikaelyan, Dan Lear, Tim Dunn*

Within the science oriented discussion group the current **'hot issues'** that should be considered as the drivers for the development of biological data products were first identified. Eight issues were listed that should be seen as the drivers for the creation of value added biological data products: **climate change and its influence on the temperature and acidification, invasive species, regime shifts (trophic levels), eutrophication, harmful algal blooms, community stability, biodiversity loss and marine litter and contaminants**.

Based on the available data, three kinds of data products were identified, listing the data that is needed to compile these products and the outputs these data products should deliver.

- ✓ ***Species distribution maps***: these products should include information on **presence and absence** of marine species and should provide **interpolated** information between the data points. Ideally the maps should have **a seasonal resolution and include depth information**. Additional important environmental variables are temperature, oxygen and chlorophyll. These maps will allow observing trends and changes in species distribution and unravelling climate change impacts. Focus should go to **protected species in areas sensitive to particular threats**.

- ✓ ***Species attributes***: species should be categorised using specific attributes like their **trophic level**, **the habitat** in which they occur, their **life history**, if they are **invasive**, if it's **HAB**, if it's a **specific indicator species for OSPAR, the bird or habitat directive**. The ERMS/WoRMS marine species register should be used as the taxonomic backbone for the attributes. Maps and graphs of these categorised species could be linked with the specific ecosystem functions.

- ✓ ***Abundance and biomass data***: data products visualizing the abundance and biomass are essential to visualize the productivity of an area or ecosystem. These products should integrate data on chlorophyll, phytoplankton, zooplankton and benthic fauna. Both size and functional groups are important elements.

✓ **Policy: monitoring the system, long-term changes (making the right decisions)**

Plenary presentation: How to optimize measurement and monitoring the environmental system: need of public authorities for specific derived data products (Gert Verreet)

Based on scientific advice, the **ecosystem based approach** has now been recognized by policy makers and will be adopted within the marine strategies. This is a very important element in the question on the **need for data products** and the question how **measurements and monitoring could be optimized**.

Gert Verreet, outlining the need of biological data products within the policy context

Traditionally, countries monitor and generate data to **assess the environmental status of the waters**. Known examples are the OSPAR and HELCOM monitoring of the eutrophication of the marine waters. While the **OSPAR eutrophication assessment** compiles national assessments of nationally held data, the **HELCOM eutrophication assessments** is based on a common assessment. In both assessments a varying degree of biological datasets are used by countries but the latter provides evidently a more robust basin wide outcome.

Now, **new levels of sophistication are put into the development of the assessments**. While OSPAR is working towards an overall monitoring and assessment strategy, the overall biodiversity assessment of HELCOM resulted in a call to improve the underlying set of biodiversity indicators. An "initial assessment", an application of the "good environmental status" was formulated including data flows, historical data, the ability to process data in multiple ways and the linking of biodiversity data with pressures. **An improved and comprehensive set of indicators covering the main ecosystem** components was proposed in the OSPAR quality status reports, 2010. Also **HELCOM will work on a core set of biodiversity indicators for the Baltic Sea**, with the specific aim of collecting data that are needed to assess the conservation status of Baltic biodiversity.

Beyond the regional seas, at European level, the recently launched **Marine Strategy Directive** enforces member states to take the necessary measures to achieve or maintain **good environmental status (GES) in the marine environment by the year 2020** at the latest. After an initial assessment of the state of the environment in 2012, precise objectives, targets and indicators will be established. New targeted monitoring programmes and programmes of measures are foreseen in 2014, 2015. To achieve these indicators **EMODnet should provide the link to the raw monitoring data, the raw satellite observation data and the raw model output and should be aggregated by monitoring station.**

The Joint Assessment and Monitoring Programme (JAMP) by OSPAR performs continuous monitoring and data reporting activities and regular thematic assessments. A **review of JAMP**, to get in synchronization with the Marine Strategy Framework Directive, is outlined in the Quality Status Report 2010. Here, **stronger emphasis is given on biodiversity monitoring and assessments** through the subgroup ICG COBAM (Intersessional Correspondence Group on the Coordination of Biodiversity Monitoring and Assessment).

To conclude, we can say that it are exciting times. **New biodiversity indicators are and will be developed, both on regional and on a broader European scale to monitor and assess the environment using an ecosystem based approach**. The existing **monitoring programmes** are being reviewed, with a **stronger emphasis on biodiversity monitoring**. Gathering data and the development of data products should take these processes into account.

David Conner, attending the policy discussion group

Discussion group: ***Gert Verreet****, Neil Holdsworth, Aurélien Carbonnière, Simon Claus, David Conner, Jan Mees, Audrey Baconnais- Rosez, Minna Pyhala, Eric Stienen, Jan Vanaverbeke, Franciscus Colijn, Paul Whomersley, Sabine Roscher, Alexei Birkun, Geert Raeymaekers, Violeta Velikova, Antoine Huguet, Antonio Bode, Nathalie De Hauwere*

The policy group first formulated a few **general considerations** about data products for the use in a policy context, before examples of data products were discussed.

- ✓ Important is to **start from the basics**. The EU policy instruments require **basic biological data layers** (Habitat Directive, Environmental Impact Assessment Directive, MSFS, Marine Spatial Planning…). While identifying data products, participants were aware of the **existing indicators and data products**, including the work done in the different conventions and acknowledging the regional differences. Typical useful products are **distribution maps (habitat forming species), red list species and temporal trends of these species**.

- ✓ It is important to consider **all steps in creating products**. Data attributes must be functional in the process from **data to product to user**. **Metadata** are key and will ultimately determine the user's limitations. It is important that users are able to **determine the strength and the weaknesses of the EMODnet data products** in their application.

- ✓ There should be a clear link between EMODnet and the indicator specifications that are developed externally. EMODnet however should be able to **provide information that can contribute to the creation of the indicators**.

Within the policy context, different **functions or purposes of possible data products** were discussed. The table below shows the different functions specific data products can have. Users need **metadata** or qualitative attributes for the analysis. **Hazard maps** will require a combination of different data types and explication of assumptions. Also **absence data and data on the intensity of observation effort** may be needed. The coverage products reflect the possibility that EMODnet could **focus on extending existing national data products**, e.g. taking a national data product and trying to expand it beyond its national borders. An example of this is filling gaps in existing indicators (cf. context process 'Streamlining European Biodiversity Indicators' (SEBI), such as trophic index (EEA)).

	Basic knowledge	Normative GES	Status&trends	Pressures
Distribution	x			
Changes (space, time)			x	x
Functional traits			x	x
Meta-info				
Hazard maps	x			x
Coverage				

Taking the specific function into account, a few concrete examples of data products were formulated by the policy group:

- ✓ **Biodiversity mapping and integration of biodiversity value** (selected indices)

- ✓ **Data products on alien species** (DAISIE database can provide reference of 'alien' attribute) & geographical distribution shifts of indigenous and non-indigenous species. Relate to indicator needs on regional basis, scope possibility of an early warning tool

- ✓ **Phytoplankton**: normalized distributions taking account coastal waters classification system of the WFD (but check MSFD descriptor on eutrophication development)

✓ **Practitioners: activities at sea (short-term impacts)**

Plenary presentation: How to improve data driven assessments of short term impacts: needs for specific derived biological data products (Charlotte O'Kelly)

Charlotte O'Kelly, CEO from TechWorks Marine, representing the maritime sector

From the perspectives from the private sector, Techworks Marine focused on the data needs for 'biological' activities at sea like **water quality monitoring, aquaculture, marine renewables, coastal engineering and jellyfish forecasting**. Real time water quality monitoring is used for fish farms, engineering works, offshore energy and EU, regional and national monitoring purposes. The aquaculture sector is looking for tools that can **manage the risks**. These tools can reduce overhead costs by providing accurate information on feed quantities and reducing mortalities due to stress and environmental change. **Information on algal bloom events, historical data on fish mortality links to water quality and information on the occurrence and blooms of jellyfishes and marine mammals** are important for the sector.

The renewable energy and coastal engineering sector often need data on marine mammals or birds in order to assess if there equipment will not be a hazard and threat to the populations. Jellyfish blooms can have a massive economic impact on tourism (Spain, Australia) and on aquaculture (Northern Ireland, Scotland). Therefore forecasting tools need in situ data validation and "visual observations". Finally, for private companies data access is a major issue. A data policy must be in place for the commercial sector to use such information for "downstream service" provision or even R&D.

Dissemination, education and raising of awareness

Plenary presentation: How to optimize awareness from the public? Needs for specific derived biological data products for information and educational purposes (Jan Seys)

Jan Seys mentions the importance of ocean literacy

There is **natural interest** for marine biodiversity and ecosystems by the public at large; there is however a lack of **ocean literacy** which is of extreme importance if policy wants to promote a maritime policy. By providing **exciting data products like descriptive visuals and tools**, the scientific community can trigger extra interest for the natural marine system and its diversity. It is important to **engage the public** (volunteers) and to try to keep it as simple as possible.

A final statement was made that it may be time to create a possible **"Dow Jones index of European Marine Biodiversity".** This index should "quantify" the 'Panics' and 'Heights' of the European marine ecosystems & biodiversity, based upon scientific papers, new data. An easy to interpret value could be a helpful product to inform policy and the public by the general state of the environment, by integrating information on for example 30 key species, monitored on a monthly basis.

- ✓ **Distributions of sensible and vulnerable species** and the protected status of taxa
- ✓ **Distribution maps of birds, fish and mammals**; species-specific purpose-fit baseline density maps; presence/absence maps; access to data products from other lots
- ✓ **Expert interpreted summarizing maps** (biological value maps and vulnerability maps)

Discussion group: ***Charlotte O' Kelly*** *, Jan Seys, Lars Johan Hansson, Kris Hostens, Bart Vanhoorne, Dick Schaap, Ian Sheppard, Herman Hummel, Klaas Deneudt, Boris Trotsenko*

Different maritime sectors were identified like the renewable energy sector, the oil and gas industry, the transport, shipping and port sector, exploitation of living resources, marine biotechnology, aquaculture, recreation and tourism, coastal protection, military, exploitation of non-living resources. Three main types of biological data products were identified (text box left).

The media are looking for extraordinary events, attractive images and charismatic species, but also want to know about the sensitivity or vulnerability of species. For educational purposes, information on life cycles, food webs, taxonomy, human impacts may be interesting. Both media and education would probably require graph and map material and derived products such as posters or web pages.

6. Priority observations for different species groups

After the identification of useful data products for different user groups, the following day discussions focused on how some of these data products could be implemented. Sessions were organized based on the main taxonomic groups, being mammals, reptiles and birds, benthic organisms including macroalgae and higher plants and zooplankton and phytoplankton. Within these break-out sessions, focus was put on the data products discussed the previous day and three questions were put forward:

- ✓ What are the priority observations to address (target or pilot species, target parameters)?
- ✓ What are the main gaps in the existing research and monitoring data?
- ✓ Where should observations be made, what frequency and duration?

Data and observations phyto- and zooplanktonic organisms

The plankton discussion group and plenary feedback from Stéphane Pesant (chair)

Discussion group: ***Stéphane Pesant****, Franciscus Colijn, Violeta Velikova, Antonio Bode, Francisco Hernandez, Dick Schaap, Bengt Karlson, Volodymyr Vladymyrov, Oleksandra Sergeyev, Matteo Vinci, Minna Pyhala, Todd O'Brien, Alexander Mikaelyan, Simon Claus, Bart Vanhoorne, (Martin Edwards)*

The plankton group divided its discussion into five parts, each time defining the data requirements for a certain data product, identifying the current gaps to come to that data product and how the gaps can be filled.

- ✓ When looking at **species attributes**, the plankton community requires information on the hierarchy and size of species. This varies from the global range in size to the typical sizes of species. The sensitivity of species needs to be identified, as well as their trophic level and whether they are harmful algae (HABs) or what their functional type is (PFT). Information on resting stages is needed, what their specific habitat (salinity and biogeographic limitations) and feeding behaviour is and whether they belong to the mero- or holoplankton.

Additionally, pictures and video material can give better insights in e.g. their swimming behavior. Gaps have been identified for most of the above listed items, but might be covered by doing a thorough **literature search and consult with different expert groups** such as the ICES Working

Group on Zooplankton Ecology (ICES WGZE), the Working Group on Phytoplankton and Microbial Ecology (WGPME), the HELCOM Phytoplankton Expert Group (HELCOM PEG), HELCOM Zooplanktologist Expert Network (HELCOM ZEN) and the Black Sea Commission.

- ✓ To come to **expert derived indices** on e.g. the biological value and ecosystem sensitivity, researchers require a number of items: species diversity index, size and distribution ratios, trophic indices (based on biomass ratio, jellyfish information and total plankton information and data), sensitivity of the plankton species and the risk they pose to other animals/humans (fish kill, bloom, toxins, invasive …).

- ✓ Reliable information on the **general distribution of different plankton taxa** requires data and information on various levels of the taxonomic hierarchy. No gaps nor possible ways of filling the gaps were listed.

- ✓ To **identify trends in these distributions** – within time and space – data containing this information is needed. Data need to be focused on seasonality, abundance and biomass and related climatological information is necessary to derive trends in seasonal abundance and occurrence and to identify possible anomalies. In order to do this, there is a need for consistent (long-term) datasets. Data for these analyses can be gathered from different data providers and on different levels (institutes, projects, industry …). Data should be gathered in such a way that comparison between e.g. coastal and offshore coverage or depth coverage becomes possible. This can be accomplished by using data from both monitoring and research campaigns as well as making use of satellite data. What the plankton community is currently lacking are tools to analyze all these data in a consistent way.

- ✓ Finally, the **suitability of the data to support the development of expert derived indices** was discussed. For this purpose, researchers primarily need good metadata, where the sampling and analysis methods of the data are thoroughly documented and described. Gaps on this matter can be filled by consulting with the Group of Experts on Biological and Chemical Data Management and Exchange Practices (GEBICH-WG), the Scientific Committee on Oceanic Research (SCOR) and the Coastal and Oceanic Plankton Ecology, Production and Observation Database (COPEPOD).

Data and observations benthic organisms, including macro-algae

Discussion group: ***Paul Whomersley****, Dan Lear, Kris Hostens, Leen Vandepitte, Fabio Bulleri, Guy Bachelet Antoine Huguet, Christos Arvanitides, Daniel Hallom, David Connor,* Boris Trotsenko*, Lars Hansson, Jessie Bluvias, Herman Hummel*

Within the benthic discussion group, the first item brought forward is that it is hard to select one single target or pilot species and it would be better to **focus on communities instead of a single species** as single species might disappear from an area during monitoring. Prioritization of a species also largely depends on the actually available data. Species can only be selected if it is present in the available data. The question of equal weighting is also put forward: should macro-, meio- and microbenthos be weighed equally? It was concluded that all groups should be taken equally into consideration.

Tagging species with different categories (e.g. reef builder, red list, invasive, sentinel …) is very important. Once all species within datasets are labeled, there will be a better overview of what is available and what might be a good species or species group selection.

The benthic discussion group chaired by Paul Whomersley (top) and Todd ' Brien, Lars Hansson, Fabio Bulleri and Antonio Bode enjoying a glass of wine after a hard day of work

When looking for suitable data, **good metadata is essential**. Users need to have access to well documented data as this will help in the data selection process. Metadata make it possible to assess whether methods are comparable or not and thus whether it makes sense to combine certain data. On the data level, the **minimum requirement** would be the **availability of abundance and biomass data**, so community analysis can be done. Additionally, there is a **need for environmental data** (e.g. temperature, depth, sediment characteristics …) which can be linked with the biotic data, making better analyses possible. The general consensus is that there is especially a need for good data and not necessarily data products. Scientists can create their own products which can be further distributed, but good data are needed to get to good and relevant data products.

Identifying gaps in the available data was experienced as a rather tricky question. One needs to **consider why data are lacking**. Has sampling actually never been done in a certain area before or are the data lacking because the area cannot be sampled with the available techniques and sampling gear (e.g. certain areas in the North Sea are covered with cobbles and boulders instead of sand, making sampling with commonly used trawling nets difficult as the nets can be teared up). Another commonly quoted problem is that the data has already been collected, but access to the data or downloading the data proves to be very difficult. There is thus **a general request to more easy access to and download of data**.

Future monitoring and observations should continue with the existing monitoring programs. Where geographical gaps have been identified, target areas for additional monitoring can be designated. One can also follow a pressure-based approach, where maps indicate the pressures in certain areas (MSFD). It is important to indicate at what scale (e.g. North Sea versus Greater North Sea; monthly, seasonally or yearly) monitoring should be performed.

Data and observations marine mammals, birds and reptiles

The mammal/bird discussion group chaired by Kees Camphuysen (top) and comment from Tjess Hernandez, coordinator of the EMODnet Biology Pilot

Discussion group: ***Kees Camphuysen****, Eric Stienen, Jan Seys, Neil Holdsworth, Ward Appeltans, Audrey Baconnais-Rosez, Aurélien Carbonnière, Sabine Roscher, Audrey Baconnais- Rosez, Gert Verreet, Tim Dunn,Pascal Le Grand*

Participants of this break-out session identified **three possible goals** which can be accomplished if enough (high-quality) data are available: **(1) identify (trends in) spatial patterns/distributions, (2) identify (trends in) populations and (3) identify (trends in) demographic parameters**. The minimum threshold is information of high quality at the lowest possible resolution. The second part of the discussion tackled the identification of target or pilot species and parameters. The break-out session was concluded with an overview of the main gaps in existing data.

- ✓ A great number of data can be utilised to **identify (trends in) spatial patterns**: ship-based or aerial surveys, beached bird surveys, stranded mammal data, colony locations, logger data, haul-out locations … Important is that these data are collected in a standardised way and can be corrected for effort. When looking at spatial patterns and trends, it is however **important to consider the scale of observations**. One should always go for the smallest possible spatial unit, aggregation (e.g. season, year) can be done afterwards. Data and information on breeding distribution, (offshore) migratory pathways, (offshore) non-breeding distribution, (offshore) foraging grounds and (offshore) area sensitivity (e.g. for pollutants) can all contribute to this goal.

- ✓ A second goal is the **identification of (trends in) populations**. To get insights in these trends, researchers need **density data from the surveys at sea** (cetaceans, turtles, perhaps seabirds). Estimates from sea-going surveys are less desired, whereas estimates from colony counts of

seabirds and seals, haul-out sites (seals) and breeding beaches (turtles) are found very valuable. Also the (numerical) importance of certain stop-over sites, foraging areas and haul-out sites are considered important and useful in identifying populations and their trends. A problem put forward is how one should deal with migration patterns and fluxes and if and how sea watching data could be of use to deal with this issue (e.g. www.trektellen.nl). As with the spatial patterns, identifying population trends also need to take into account the frequency of observations. Harmonization and standardization are also here extremely important and are issues where EMODnet should play a role.

- ✓ An additional goal put forward during the discussions was to **identify (trends in) demographic parameters**. This should make it possible to follow up on a number of things, such as the reproductive success of species, recruitment, first breeding, annual survival and so on. It was indicated that perhaps this is only feasible for seabirds and seals.

During the discussion on **identifying indicator species**, the question was put forward on what exactly these species should indicate. If one considers oil pollution, OSPAR identifies the guillemot as an indicator species, whereas for plastic ingestion, the fulmar is more suitable. To monitor the environmental conditions, the kittiwake is a good candidate as it represents the sand eel community. For the current pilot project of EMODnet, a **consensus was reached to identify the following target species**:

- ✓ **Harbour porpoise**
- ✓ **Harbour seal**
- ✓ **Common guillemot**
- ✓ **Fulmar**
- ✓ **Loggerhead**
- ✓ **and the complete species list of the Habitat Directive Annex**

Main data products can thus be identified as **distribution maps, population maps and sensitivity maps** based on observed densities of sensitive species (surface pollutants, disturbance, windmill collisions, shell-fishing….). However complicated analysis is the work of experts and beyond the scope of EMODnet. EMODnet should deliver the ingredients. Simple maps e.g. simple oil-vulnerability-maps could be produced by EMODnet.

Concerning the **gaps in existing data**, the comment is made that expert should be consulted to help and identify missing data. An important factor to take into consideration is to **make sure connections between biotic and abiotic information can be established or facilitated**. The group also suggests checking the OSPAR Quality Status Report to identify missing data, as well as the HELCOM reports which show gaps. A lot of accumulated data are already available (e.g. TMAP, HMAP). Gaps in existing data do

not only apply to actually missing data, but also to missing information on data, e.g. the applied units or the necessity of standardisation in both data collection and database formats.

The issue of **sensitivity data** (e.g. fisheries data) should also be taken into account when identifying information gaps and – based on this – initiating further monitoring and data collection. Finally, not only research data needs to be inventoried, but data collected by the private sector should also be included.

7. Conclusions

In general we can say that there was a common agreement on the need for specific marine biological data products. Important within the framework of the European Marine Observation and Data Network is to produce interoperable products that can be produced for the different user communities. Therefore EMODnet needs to focus on the processes of data collecting, data integration, data standardization, data archiving and data delivery. There was a consensus amongst workshop participants that the look and functionalities of the EMODnet biological prototype portal, visualizing both data observations and data products, were meeting the requirements. Metadata are considered as important as the data and the standardizations of the data should be a key priority of EMODnet. The calculation and development of indicators that describe and monitor the natural system is a step beyond EMODnet.

However, the creation of biological data products could be developed as demonstration cases for these data driven processes. Although the user groups were very diverse, a number of striking similarities were found. In the different user discussion groups, four different sets of marine biological data products were identified

- ✓ **Species distribution maps and trends**
- ✓ **Species sensitivity and vulnerability map**
- ✓ **Species attributes (functional groups, HAB's, invasive species, red list or protected species)**
- ✓ **Biodiversity indices**

The feasibility of the creation of these data products was matched against the existing data and information during three discussion groups on planktonic organisms, on benthic organisms and on higher taxonomic groups. In most groups the creation of these products was considered as feasible, taking into account the serious effort that has already been undertaken by the EuroOBIS data integration, the marine biological data inventory and the gap analysis presented during the first section. However more different stakeholders, data owners and working groups, not present during the workshop should be contacted to create a critical amount of information. Specific target species could only be indentified amongst higher organisms (mammals, birds, reptiles). All groups highlighted the importance of the metadata and the use of data standards.

Appendices
Appendix A: Programme

Day I (25 February 2010)

9.30– 10.15 **Plenary I** – Introduction

- ✓ Welcome (Dr. Jan Mees, VLIZ 5')
- ✓ Introduction EMODNET, Biological Lot and goal of workshop (Mr. Francisco Hernandez, VLIZ 15')
- ✓ State of marine metadata catalogue. Data availability and gap analysis (Ms. Leen Vandepitte, VLIZ 25')
    - i. Identified monitoring and research data
    - ii. Data availability

10.15 – 10.35: **Plenary II** – User needs (Chair Mr. Iain Shepherd, EU DGMARE)

- ✓ Towards better science: the needs of the scientific community for specific derived biological data products (Prof Dr. Peter Herman, NIOO-CEME & Prof Dr. Mark Costello, University of Auckland 20')

11.00 – 13.00: **Continuation Plenary II** – User needs (Chair Mr. Iain Shepherd, EU DGMARE)

- ✓ How to optimize the measurements and monitoring of the environmental system: the needs from public authorities for specific derived data products (Mr. Gert Verreet, LNE 20')
- ✓ How to improve data driven assessments of short term impacts: needs for specific derived biological data products (Ms. Charlotte O'Kelly, Tec works Marine Ltd 20')
- ✓ How to optimize awareness from the public at large: needs for specific derived biological data products for information and educational purposes (Dr. Jan Seys, VLIZ 20')
- ✓ Demo EMODNET Bio 'Data and Data Product' Portal (Mr. Simon Claus, VLIZ 20')
- ✓ Discussions and introduction breakout sessions (40')

14.00 – 16.00: **Breakout Session 'Data Products for different user communities'** (120')

What data and metadata products should be created to serve:

a. the scientific community? (Chair Prof Dr. Peter Herman and Prof Dr. Mark Costello)
b. measurements and monitoring of the environmental system? (Chair: Mr. Gert Verreet)
c. impact assessments? (Chair: Ms. Charlotte O'Kelly)

16.30 – 17.30: **Plenary III**: Feedback breakout sessions (Chair Prof Dr. Mark Costello)

Closing day I, small drink and dinner

Day II (26 February 2010)

09.00 – 9.20: **Plenary IV**

- ✓ Marine Biology Research in Europe: the institutional context (Prof Dr. Herman Hummel, NIOO 'on behalf of Life watch and the European Network of Marine Research Institutes and Stations (MARS)' 20')

09.20 – 11.20: **Breakout Session 'Priority observations of species groups'** (120')

I. Priority observations to address (target or pilot species, target parameters)
ii. Existing data and monitoring: what are the main gaps in the existing data

Where should the observations be made, what frequency and duration

a. Data and observations phyto- and zooplanktonic organisms (Chair: Dr. Stéphane Pesant, CNRS, and Dr. Martin Edwards, SAHFOS)
b. Data and observations benthic organisms, including macro-algae and higher plants (Chair: Dr. Paul Whomersley, CEFAS)
c. Data and observations marine mammals, birds and reptiles (Chair: Mr. Kees Camphuysen, NIOZ)

11.40 – 13.00: **Plenary Session V**: Feedback breakout sessions, general discussion and recommendations

13.00 Closing workshop and lunch

Appendix B: Speakers and Chairs profile

Kees Camphuysen is associated with the Royal Netherlands Institute for Sea Research (Royal NIOZ) since 1992 and was the first to to assess the effects of fisheries on seabirds. Later his work focused mainly on natural aspects underlying the distribution of seabirds at sea, which culminated in EC funded projects in which complicated models of foraging decisions of seabirds were parameterised and tested. He formed a consultancy in 1995 (CSR Consultancy), closely associated with Royal NIOZ and IBN-DLO/Alterra (currently Wageningen IMARES) in which applied scientific questions are addressed, such as environmental impact assessments in the North Sea and Wadden Sea for governmental bodies, NGOs and oil companies. He has a permanent research position at Royal NIOZ since 2006.

Simon Claus has an MSc in Ecology from the Catholic University of Leuven and a Msc in Oceanography from the University in Liège. He is a scientific staff member of the data centre of the Flanders Marine Institute (VLIZ) involved in data management activities of several European Research projects (MarBEF, ENCORA, THESEUS) and in the implementation of the biological preparatory action of EMODnet.

Prof Dr. **Mark J. Costello** is an Associate Professor in marine ecology at the University of Auckland, New Zealand. Research interests span marine ecology, biogeography, and biodiversity informatics; and their application in conservation management. He is current Chair of the Society for the Management of Electronic Biodiversity Data (SMEBD) and the World Register of Marine Species (WoRMS) Steering Committee and was previously chair of the Ocean Biogeographic Information System (OBIS) (2000-2008), and coordinator of the European Register of Marine Species (ERMS) and BioMar-LIFE project (which started the classification of marine biotopes for Atlantic Europe). He published over 85 peer-reviewed papers.

Dr. **Martin Edwards** is an internationally recognised marine scientist whose primary research interest is on climate/environmental change impacts on marine ecosystems. He and his colleagues were the first to demonstrate marine species distributional and phenological changes and whole ecosystem regime shifts in response to climate change, while his more recent research has focused on global-scale changes in oceanic macroecology and biodiversity. He has written over 100 publications of which >50 are peer-reviewed papers and over 60 policy related reports and assessments. As well as contributing to high level science he has considerable knowledge in transferring science into policy and advice with many papers highly relevant to policy on marine environmental change, eutrophication, invasive species and Harmful Algal Blooms . He was a contributing author for the IPCC 4th Assessment Report on 'Changes in marine ecosystems and fisheries' in which the authors shared the 2007 Nobel Peace Prize; an author on Marine and Coastal Dimension of Climate Change in Europe: A report to the European Water Directors; and an author for the European Environmental Agency Report Impacts of Europe's changing climate. He sits on numerous national and international working groups and is currently involved with six European projects. At SAHFOS he is the Deputy Director, Chief PI as well as the Project Coordinator on SAHFOS contracts (internationally funded by a consortium of 10 countries; which has an annual turnover of approximately 3 million Euros).

Prof. Dr. **Peter Herman** (1956) is head of department ("Spatial Ecology) at the Netherlands Institute of Ecology, Yerseke, The Netherlands. He is a part-time professor at Radboud University Nijmegen ("Estuarine Ecology"). He graduated in 1982 at the University of Gent (Belgium) with a thesis about energy flow in meiobenthic populations. After a post-doc at the same University, he joined NIOO in 1987 as a mathematical ecologist. In 1992 he became a senior researcher in the department of ecosystem studies, focusing on the role of macrobenthos in estuarine dynamics. He studied exchange of food, nutrients and sediment particles between water and sediment, amongst others in several European research programmes. In particular during the ECOFLAT project, he became interested in how physical-biological interactions determine the spatial organization of landscapes. This is the main focus of the Spatial Ecology department, active since 2002. In 2008 he became a board member of the Wadden Academy, where he concentrates on the question how ecological research can serve the management of the Wadden Sea.

Francisco Hernandez has an MSc in Biotechnology, MSc in Environmental sciences and has over 20 years experience in bioinformatics and ICT projects. He is currently the head of the VLIZ data centre, and participates in networks, projects and expert workshops including WORMS, IODE, SEADATANET, EMODNET, GE-BICH and SCOR.

Prof. Dr. **Herman Hummel** is coordinator of the Monitor Taskforce at the Netherlands Institute of Ecology. He is professor in Estuarine Ecophysiology at the University of Gdansk, Poland. His specific aim is to understand the relation between fluctuations in environmental factors (salinity, tide, food, degree of pollution) and genetics, physiology and ecology (diversity, distribution, biomass, growth, condition, reproduction, reserve constituents) of estuarine macrobenthos. An important issue is to what degree bivalves, already living under extreme conditions, are sensitive to additional changes in their environment. He was the Executive Director of the Network of Excellence MARBEF "Marine Biodiversity and Ecosystem Functioning" with 95 participating European institutes and is Executive Secretary of the consecutive MarBEF+ Association. Moreover, he is executive secretary of the MARS Network, uniting the marine research stations of Europe. He is general coordinator of the COST Action EMBOS on a European Marine Biodiversity Observatory System, with the participation of more than 20 European countries. He published more than 195 papers of which 101 in refereed international scientific journals and books. He was involved in more than 60 multi-annual contracts with national governmental and international organizations and consultancies, attended more than 120 symposia and overseas seminars, and chaired or (co-)organised more than 60 networks, symposia and workshops, and obtained more than 55 grants from national and international organisations (a.o. the Council of Europe, the National Shellfisheries Association USA, UNESCO, NUFFIC, NERC Gr. Britain, EC (FAR, INTAS, 5thFW), NWO).

Charlotte O'Kelly has an honours degree in Environmental Resources and a Master's degree in Applied Oceanography. Since founding Techworks in 2002, she has been responsible for the development and growth of the company as well as product sales. Prior to this Charlotte was Project Manager for a Marine Company looking primarily after the operational projects of the company. These projects were

both national and international funded through EU research funds. Charlotte also has expertise in Data Management of Large EU research projects.

Dr. **Jan Mees** has an MSc in Zoology, an MSc in Environmental Sanitation (1987) and a PhD in Marine Biology (1994) from Ghent University, where he is part-time professor and has been teaching courses on data analysis, statistics, multivariate techniques, coastal ecosystems and fisheries. He worked as a marine scientific researcher from 1988 to 1999 (mainly benthic ecology, estuarine ecology, tropical fish). He is the author of more than seventy scientific publications, most of which in international journals with peer-review. Since its establishment in 1999, he is director of the Flanders Marine Institute (VLIZ) in Oostende, Belgium.

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