Marine Strategy Framework Directive (MSFD)

Common Implementation Strategy

12th meeting of the
Working Group on Data, Information and Knowledge Exchange (WG DIKE)

0900-1730: 12 October 2015

Conference Centre Albert Borschette, Room AB/5B, Rue Froissart 36, B-1040 Brussels

Agenda item:	6
Document:	DIKE_12-2015-05a
Title:	Marine Pilot - MSFD spatial data requirements mapped to INSPIRE data models
Prepared by:	JRC
Date prepared:	07/10/2015
Background:	This report is meant to help stakeholders of the Marine Strategy Framework Directive 2008/56/EC (MSFD) understanding how the INSPIRE data standards (i.e., the package of the relevant legislative acts, framework documents, technical guidelines and supporting tools) can be best used to document and share data coming from the MSFD monitoring programmes. The report focuses on the semantics (the meaning) of data. The report is intended for people involved in marine data management. The concepts and data models described in this report will be further used and tested by the INSPIRE marine pilot project partners for the sharing and re-use of chlorophyll-a data using the INSPIRE infrastructure.

WG DIKE is invited to:

a. Take note of the report;

b. Send any comments in writing to JRC by 27/11/2015.

EUROPEAN COMMISSION
JOINT RESEARCH CENTRE

Institute for Environment and Sustainability (Ispra)
Digital Earth and Reference Data Unit

Marine Pilot

D2.0 MSFD spatial data requirements mapped to INSPIRE data models

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Contents

Terms and definitions

For the purposes of this document, the following terms (abbreviated or not) and definitions apply.

AM	Area management/restriction/regulation zones and reporting unit (INSPIRE theme)
AU	Administrative units (INSPIRE theme)
DG	Directorate General
DIKE	Data, Information and Knowledge Exchange
EEA	European Environment Agency
EF	Environmental monitoring facilities (INSPIRE theme)
EIONET	European Environment Information and Observation Network
E-PRTR	European Pollution and Transfer Register
EULF	European Union Location Framework
GES	Good Environmental Status
HB	Habitats and biotopes (INSPIRE theme)
HELCOM	Baltic Marine Environment Protection Convention (Helsinki Commission)
INSPIRE	Infrastructure for Spatial Information in the European Community (Directive 2007/2)
ISA	Interoperability Solutions for European Public Administrations
JRC	Joint Research Centre
MPA	Marine Protected Area
MDI	Marine Data Infrastructure
MS	Member State
MSFD	Marine Strategy Framework Directive 2008/56/EC
NSDI	National Spatial Data Infrastructures
O&M	Observation and Measurements, ISO 19156:2011
OF	Oceanographic geographical features
OSPAR	Oslo/Paris convention for the Protection of the Marine Environment of the North-East Atlantic
PoM	Programme of Measures
PS	Protected Sites (INSPIRE theme)
RSC	Regional Sea Convention
ROD	Reporting Obligation Database
SD	Species distribution (INSPIRE theme)
SDI	Spatial Data Infrastructure
TG	Technical Guidance
WFD	Water Framework Directive 2000/60/EC
WG	Working Group
WISE	Water Information System for Europe

Purpose of this document and intended readership

This report is meant to help stakeholders of the Marine Strategy Framework Directive 2008/56/EC (MSFD) understanding how the INSPIRE data standards (i.e., the package of the relevant legislative acts, framework documents, technical guidelines and supporting tools) can be best used to document and share data coming from the MSFD monitoring programmes. The report focuses on the semantics (the meaning) of data. The report is intended for people involved in marine data management.

This report builds on – and complements – the *Analysis of requirements that link INSPIRE and MSFD* [1] which is focusing more on the legal and organizational aspects of marine data management.

The INSPIRE marine pilot is an activity under the European Union Location Framework (EULF) Action of the Commission-driven Interoperability Solutions for European Public Administrations (ISA) Programme. The pilot runs from August 2014 until mid-2016, and aims to provide guidance and tools for INSPIRE-based marine data management in support of the MSFD reporting.

1. Introduction

1.1. INSPIRE marine pilot

The Marine Strategy Framework Directive makes explicit reference to the INSPIRE Directive (2007/2/EC) in Article 19(3). There are discussions ongoing in MSFD Working Group "Data Information and Knowledge Exchange" (WG DIKE) concerning the interpretation of Article 19(3). It was pointed out in [1] that marine data are in the scope of INSPIRE, and that – in principle – INSPIRE obligations apply independently of the interpretation of Art. 19(3).

In order to facilitate the INSPIRE-related obligations, it is necessary to understand the requirements of the MSFD and INSPIRE Directives and to develop processes which accommodate their respective needs. The aim of the INSPIRE marine pilot is to help improve the understanding of INSPIRE in the management of MSFD-related spatial information, and to provide guidance and tools that facilitate the mentioned obligations.

Involved in the pilot are staff members of the Commission (DG Environment, DG Joint Research Centre), the European Environment Agency (EEA), contractors, and initially a few interested Member States. The practical experiences gained from this Pilot will inform participants about the INSPIRE requirements within MSFD data management and aim to increase the uptake of INSPIRE within the MSFD implementation process. Further details about the pilot are available in project charter documents publicly available on the CIRCABC website, in the 10th DIKE meeting folder[1].

This paper focuses on the semantics (the meaning) of data. These semantics can be described using so-called data models, and INSPIRE offers data modelling solutions that can be used to document and share MSFD-relevant marine data with other communities.

The report builds on – and complements – the *Analysis of requirements that link INSPIRE and MSFD* [1] which is focusing more on the legal and organizational aspects of marine data management.

1.2. Semantic matters

Exchange of and access to spatial data is the principal objective of a Spatial Data Infrastructure (SDI), and therefore also of a marine SDI. The data, which are a representation of the real world, are at the heart of the infrastructure [2]. This representation – also called model – is developed according to well defined methodologies described in standards and the INSPIRE framework documents [3,4], and made explicit through a concise description of what are called data specifications.

These specifications can then be used to develop new datasets or to transform existing datasets to the specifications by mapping the existing model to the model described in the specifications. In this way, semantic interoperability can be achieved: i.e. different datasets can be used together and be understood in the same way by different users and over long periods of time. Metadata are part of the datasets and should get proper attention during the data modelling. Metadata will play a crucial role in documenting and understanding the content of the data model and data product specification, and in achieving technical interoperability. The semantic and technical interoperability are further supported by registries (e.g. of coordinate reference systems and code lists).

[1] https://circabc.europa.eu/w/browse/bc33dff1-0f8c-467a-8382-7724c5f79d45

INSPIRE has defined a number of data specifications covering a wide range of application domains, resulting in hundreds of definitions of spatial objects and their attributes. This report will point the reader to the tools to navigate through this large library of definitions, meanings, and codes, and suggest how existing definitions can be combined to describe data of MSDF monitoring programmes.

The marine pilot will also pay attention to the tools that can be used building common models, and for transforming local data models to a common data model.

What is presented in this report is a first draft mapping, that needs to be further discussed with the pilot project partners and with the marine data community. Comments on this version of the report are welcome and can be forwarded to any of the authors.

1.3. Structure of report

Chapter 2 gives an introduction to the harmonization and interoperability of spatial data sets. The chapter puts semantic interoperability in a wider context, and provides pointers to the standards, INSPIRE framework documents, technical guidance, and tools that support semantic interoperability. Chapter 3 lists GES 11 quality descriptors, related criteria/spatial data required, within identified INSPIRE data themes. This chapter contains analysis on the on type of data required by MSFD monitoring programmes and short description of identified INSPIRE themes. Following chapters describe the INSPIRE technical solutions related to the identified type of MSFD data: time series; bio-data and for areas with common characteristics. All three technical solutions identify required INSPIRE application schema(s) needed for the type of MSFD data, number the MSFD QD indicators/ MSFD sub-programmes on which should be applied technical solution, if there is a need for extension or modifications and available supporting resources.

The report also includes two annexes, related to the semantic solutions for MSFD data management:

Annex I - Making data available - standards for exchange of MSFD supporting data and information
Annex II - Guidance on the usage of BODC parameter vocabularies

2. Semantic interoperability: data at the core of marine spatial data infrastructures

Exchange of and access to spatial data is the principal objective of a Spatial Data Infrastructure (SDI), and therefore also of a marine SDI. The data are at the heart of the infrastructure [2]. The (spatial) data are a representation of the real world. This representation is called a data model in the ISO 19100 series of standards and INSPIRE speak, and is developed according to well defined methodologies described in standards, and made explicit through a concise description of what are called data specifications.

Figure 1 explains this process in more detail. If two systems, system A (for instance, the German Marine SDI) and system B (for instance the Dutch Waterhouse), need to exchange data or share their data with a third party in a meaningful way, both systems need to transform their data to a common data model (application schema C). This common application schema is used by both systems to determine the transformation rules (M) between the internal schemas and the common schema. Then, by using an agreed encoding (for instance GML), the data can be transformed and shared.

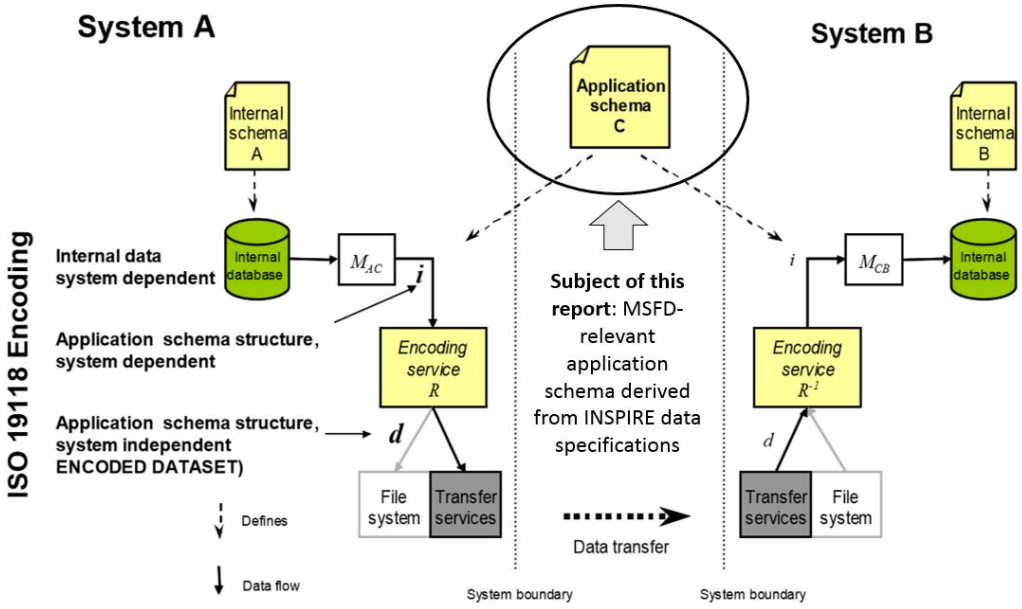


Figure 1 - Preserving semantics between systems (adapted from: CEN TR 15449:2011 [2]).

The subject matter of this report is the common application schema, which should be based whenever possible on the INSPIRE data specifications. The aspects of the data transformation and the services are covered by other activities in the marine pilot, notably in the on-line training modules.

INSPIRE data specifications can be used to develop new datasets or to transform existing datasets to the specifications by mapping the existing model to the model described in the specifications. In this way, semantic interoperability can be achieved: i.e. different datasets can be used together and be understood by different users and over long periods of time in the same way. Metadata are part of the datasets and should get proper attention during the data modelling. Metadata will play a crucial

role in documenting and understanding the content of the data model and data product specification, and in achieving technical interoperability (c.f. Fig. 2).

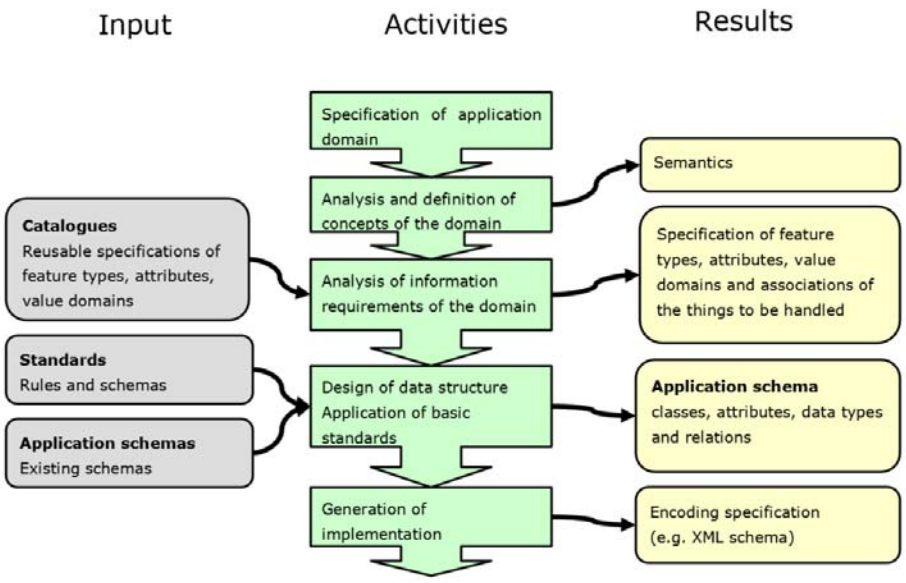


Figure 2. From specification to application (from CEN TR 15449-3:2011)

INSPIRE has defined a large number of data specifications, which constitute a library of spatial objects and their definitions.

The INSPIRE website (http://inspire.ec.europa.eu) gives access to information and tools that make the use of INSPIRE – and in particular the INSPIRE data specifications – easier:

- The INSPIRE thematic cluster on marine and athmosphere[2] , is a single entry point for INSPIRE implementers and users to share experiences, best practices, raise questions and resolve issues in their thematic domains;
- The INSPIRE interactive data specifications[3] site offers data providers with all resources/tools related to the implementation of the INSPIRE data specifications.
- The website of the INSPIRE marine pilot, which will give access to software, tools, and guidelines for MSFD-related marine data management based on INSPIRE.

On top of the data, and by making use of the metadata, services make the data accessible through the web. From a technical point of view, INSPIRE has identified a number of components that support the so-called Publish – Find – Bind" pattern. The owner of a data set publishes the data (using the metadata, discovery, view and download service components of INSPIRE), and a user is able to find a data set or service (using the INSPIRE geoportal), and "bind" the data set or service to his or her application, which can be anything from a web application to a desktop GIS.

This report focusses on the semantic aspects of the data.

[2] https://themes.jrc.ec.europa.eu/groups/profile/213/marine-and-atmosphere-cluster
[3] http://inspire-regadmin.jrc.ec.europa.eu/dataspecification/

3. Mapping spatial data related to the MSFD monitoring programmes & Article 19 requirements to INSPIRE data models

3.1. Introduction

The MSFD and the associated Commission Decision 2010/477/EU, make very precise reference to observations, related criteria and methodological standards linked to the state of the marine environment and GES. Each of the 11 quality descriptors links to monitoring programmes and associated sub-programmes for the assessment of the marine environment. Data coming from the monitoring programmes/sub-programmes should be available and discoverable, through INSPIRE services, no later than six months after establishing environmental survey of marine area. The definition of data and the interpretation of Art. 19(3) are still under discussion. The deadline for the establishing integrated monitoring programmes was in July 2014 which defines the date to make the spatial data available (at least six months later)[4]. The INSPIRE Directive defines spatial data as any data with a direct or indirect reference to a specific location or geographical area, so this applies on observations provided by all 11 integrated monitoring programmes and associated sub-programmes.

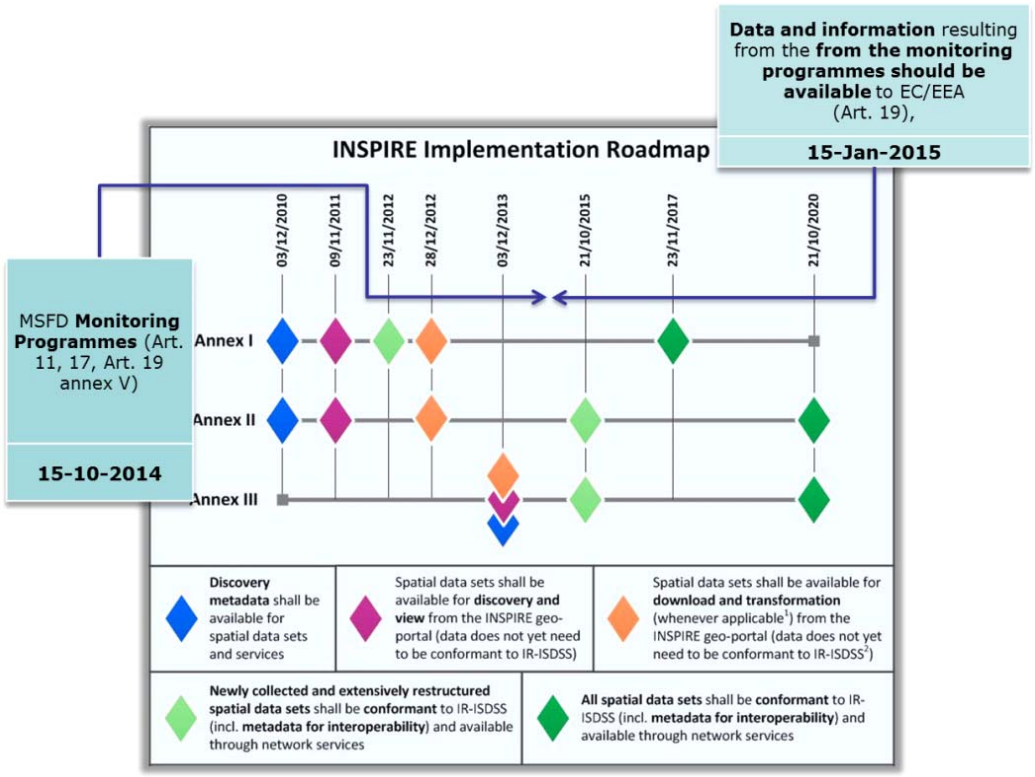


Figure 1 -INSPIRE roadmap & Article 19 requirement regarding the monitoring programmes

[4] This interpretation of the Article 19 stated in the document does not need to be a final one. As discussions on the interpretation of the requirements regarding the Article 19 are still ongoing, this document could possibly be modified during the project time period.

Data from the monitoring programmes have to be available to EEA starting from the 15th January 2015 “In accordance with Directive 2007/2/EC” - MSFD Article 19. By that time the INSPIRE roadmap requires conformant metadata, conformant network services and after 21st October 2015 conformance with the INSPIRE data model given in the Implementing Rule for the Interoperability of Spatial Data Sets and Services (IR-ISDSS)[5]. MSFD descriptors and related criteria (listed in the Commission Decision 2010/477/EU) for the purpose of this report are linked to required spatial data and related INSPIRE theme (see Table 5 – Initial analysis of 11 descriptors (MSFD Annex I) and related criteria (Com. Dec. 2010/477/EU) in relation to spatial data. Some indicators for the assessment of the descriptors/criteria need to be further clarified and links with potential spatial data are difficult to define.

The interpretation of the MSFD Article 19 is still an ongoing process and is being discussed under the MSFD common implementation strategy at WG DIKE meetings. Reacting to interpretation of the MSFD Article 19 and related discussions are not in the scope of the Marine pilot and this process will not have any implications on the project development.

The INSPIRE roadmap requires MS at the beginning of the 2015 to provide INSPIRE conformant metadata and related conformant network services, that will enable to discover, view and download data through the INSPIRE Geoportal and through the national SDI.

[5] COMMISSION REGULATION (EU) No 1253/2013 of 21 October 2013 amending Regulation (EU) No 1089/2010 implementing Directive 2007/2/EC as regards interoperability of spatial data sets and services, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:331:0001:0267:EN:PDF

3.2. GES Monitoring data vs INSPIRE data themes

Descriptors and related criteria are listed in the in the Commission Decision 2010/477/EU. For the purpose of this report, the spatial data related to the MSFD indicators are mapped to the relevant INSPIRE data themes (see Table 1).

Descriptor	Criteria	Spatial data regarding the GES criteria	Relevant INSPIRE themes
1.Biological diversity	Species distribution	Species distribution map	Species distribution
	Population size		
	Population condition		
	Habitat distribution	Habitats and biotopes distribution map	Habitats and biotopes
	Habitat extent		
	Habitat condition		
	Ecosystem structure	Assessment map regarding species and habitat distribution	Sea Regions
2.Non-indigenous species (abundance and env. Impact)	Abundance and state characterisation	Non-indigenous species distribution map	Species distribution
	Environmental impact of invasive non-indigenous species	Non-indigenous species Impact Assessment map	Sea regions
3.Populations of all commercially exploited fish and shellfish	Level of pressure of the fishing activity	Maps of area with fishing mortality value	Sea Regions
	Reproductive capacity	Species distribution map, including data on reproductive activity	Species distribution
	Population age and size distribution	Species distribution map, including data on population and age	Species distribution
4.Elements of the marine food webs	Productivity of key species	Species distribution map, including data on productivity	Species distribution
	Proportion of selected species	Species distribution map, including data on proportions	Species distribution
	Abundance/distribution of key species	Species distribution map	Species distribution
5.Human-induced eutrophication	Nutrients levels	Nutrients concentrations time series - related to the monitoring stations	Environmental monitoring facilities, Oceanographic geographical features
	Direct effects of nutrient enrichment	Chlorophyll a & water transparency time series data-related to the monitoring stations; opportunistic species distribution maps	Environmental monitoring facilities, Oceanographic geographical features, Species distribution
	Indirect effects of nutrient enrichment	Dissolved oxygen time series data - related to the monitoring stations; distribution map of seagrasses	Environmental monitoring facilities, Oceanographic geographical features, Species distribution
6.Sea-floor integrity	Physical damage	Maps with extent of biogenic substrate; Maps with seabed areas significantly affected	Sea regions
	Condition of benthic community	Maps of tolerant/sensitive species distribution	Species distribution
7.Permanent alteration of hydrographical conditions	Spatial characterisation of permanent alterations	Maps of areas affected by permanent alterations	Sea regions
	Impact of permanent hydrographical changes	Maps of affected habitats	Habitats and biotopes

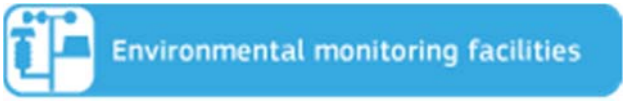
Descriptor	Criteria	Spatial data regarding the GES criteria	Relevant INSPIRE themes
8.Concentrations of contaminants	Concentration of contaminants	Concentrations of contaminates (e.g. priority substances) time series (for water, sediment, biota)	Environmental Monitoring Facilities, Oceanographic Geographical Features
	Effects of contaminants	Contaminants Impact Assessment Maps; Map of occurrence/origin of pollution events	Sea regions
9.Contaminants in fish and other seafood	Levels, number and frequency of contaminants	Time series of the amount (mass or moles) of the contaminates per unit weight of the specified organism.	Environmental Monitoring Facilities, Oceanographic Geographical Features
10.Properties and quantities of marine litter	Characteristics of litter	Maps with identified levels of pressure for sea area, coast line or water column.	Sea regions
	Impacts of litter	Maps of the litter Impact Assessment	Sea regions
11.Introduction of energy	Distribution in time and place of loud, low and mid frequency impulsive sounds	Noise map distribution (various levels)	Sea regions
	Continuous low frequency sound	Noise map distribution	Sea regions

Table 1 - 11 descriptors and related criteria (Monitoring programmes/sub-programmes) and expected spatial data. Some quality descriptors/criteria are still in the development and the relevant spatial data is difficult to define.

Analysis relieves that spatial data and information coming from the monitoring programmes could be divided in three broad classes:

1. Time series (e.g. concentrations of Chl a, nutrients, priority substances …)
2. Bio-data (e.g. invasive species distribution, affected habitats maps….)
3. Sea areas with common characteristics (e.g. seabed areas significantly affected maps, area impacted by the noise…)

This broad classification of the type of data coming from the monitoring programmes was needed for identification of the proper INSPIRE application schema and data model. Mapping the QD/Criteria/spatial data we used five INSPIRE data themes:

a) 

(EF)

EF theme includes two main aspects; the first is the environmental monitoring facility as a spatial object, the second is the data obtained through observations and measurements taken at this facility, encoded using the ISO 19156 standard. This information is complemented by further administrative information pertaining to the facility and activities undertaken there such as networks or monitoring programmes. The Environmental Monitoring Facilities theme is cross-cutting to environmental domains; thus, the generic model allows the necessary freedom to bring in thematic specific needs while keeping a shared data structure.

b) 

(OF)

Represents the (physical or chemical) properties of a Sea Region. This type of information is essentially a coverage describing the ocean and could be presented as a set of point data, gridded data, but also as vertical profiles through ocean depths and trajectories along the ocean surface. The Ocean Geographical Features theme employs the ISO 19156 Observations and Measurements standard for consistent encoding of measured, modelled or simulated data.

c) 

(SR)

2D geometry of an area or line with common (physical or chemical) characteristics that is covered by an ocean, sea or similar salt water body. The model allows the concept of named seas, as well subdivisions and aggregation of seas according to physical or chemical properties. The Sea Regions theme provides mechanisms to describe both the sea bed and sea surface as well as inter-tidal areas and the shoreline.

d) 

(SD)

SD is a biodiversity theme focused on geographical distribution of occurrence of biological organisms aggregated by grid, region, or any administrative or analytical unit. Distributions may be represented in a wide range of formats, such as points, grid cells at different scales or polygons of specifically defined areas. To achieve harmonization EU-Nomen is the preferred reference list for species (taxon) names to be used, the second choice is European Nature Information System and finally Natura2000.

e) 

(HB)

Biodiversity theme that deals with habitats and biotopes as areas and their distinct boundaries. Spatial data model provides characterisation of geographical areas being functional for living organisms: biotopes being the spatial environment of a biotic community; habitats being the spatial environment of specific species. To achieve harmonization on local, national and international level, habitat types should refer to the European Nature Information System habitat classification.

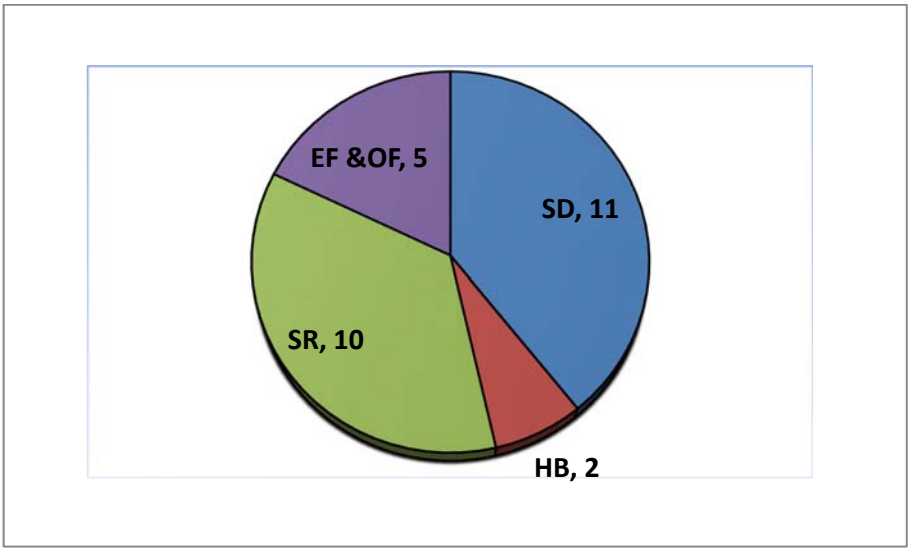


Figure 2 - Number of GES criteria's related to INSPIRE data themes

For mapping was used Commission Decision 2010/477/EU document on GES that describes within certain level of details the indicators that should be used in the MSFD monitoring. This document is currently on in the revision process, as during the MSFD implementation and reporting process were identified issues related to the deficiencies in the quality of the information reported, consistency related to the indicators and methodological standards, etc. Analyzing the MS reports on Initial assessment from 2012, related JRC report "In-Depth Assessment …"[6] it is clear that for the assessment does not exist common methodology or standards for any of QD/criteria or indictors. Due that MS assessment results and reports have lots of dissimilarities, and this can be reflected on the mapping with INSPIRE data themes. The INSPIRE mapping in relation of the indicators and required spatial data is done on the basis of the examples provided by the MS for the reporting on initial assessment form 2012 and publicly available reports (on CRICA BC [7])developed by Working Group on Good Environmental Status related to the QD development. Some of QD are still in the discussion within MSFD working groups (as WG GES …) and community, the indicators are not entirely developed, sometimes unclear how to apply it, and some even in the initial development (QD7) .

Biological diversity (QD1), Eutrophication (QD5) and Contaminants (QD8) are very well established as have been used for integrated coastal waters monitoring in the scope of the Water Framework Directive 2000/60/EC (WFD) and usually for a long time monitored. Due that these three QDs are proper to be included as a practical example in the Marine Pilot project.

[6] JRC scientific and policy report "In-Depth Assessment of the EU Member States' Submissions for the Marine Strategy Framework Directive under articles 8, 9 and 10" available at https://ec.europa.eu/jrc/sites/default/files/lbna26473enn.pdf

[7] Consultation related to the COM 2010/477/EC revision, on QD descriptions publicly available at https://circabc.europa.eu/w/browse/46d2b7ba-d2fd-4b3c-9eaf-18c7cb702b53

4. INSPIRE DATA MODEL – mapping the of criteria and methodological standards on Good Environmental Status

4.1. Time series - observation data

Time series information is required to provide a sequence of data points/areas, measurements made over a time interval, linked to the sampling station (or area divided into grid) within their location. Time series data linked to the monitoring station (or area) has unchanged location during monitoring period. Each monitoring station is related to at least one, but could be related to more than one monitoring programme/sub-programme. Same location could be used for sampling on various indicators releted to the different QD's as chlorophyll *a*, nutrients (sub-programmes of eutrophication-QD-5) and heavy metals (sub-programme of concentrations of contaminates QD-8).

Within time series group are identified indictors from three QD:

QD5 Human induced eutrophication:

- 5.1.1 Nutrients concentration
- 5.1.2 Nutrient ratios
- 5.2.1 Chlorophyll concentration
- 5.2.2 Water transparency
- 5.3.2 Dissolved oxygen

QD8 Concentrations of contaminants are at levels not giving rise to pollution effects

- 8.1.1 Concentration of the contaminants
- 8.2.1 Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups

QD9 Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.

- 9.1.1 Actual levels of contaminants

Data time series are required to provide information on QD-5 Human introduced eutrophication levels: Nutrient levels, Direct & Indirect effects of nutrient enrichment reflected to the chlorophyll *a*, water transparency and dissolved oxygen values. Concentrations of contaminants QD-8 should be described as time series, regarding monitoring, if the Environmental Quality Standards set within WFD are exceeded in water, sediment and biota. Data required for the QD9 contaminants in the fish and other seafood can be firmly linked to the data sampled for the QD8 related to biota (e.g. levels of the contaminants are analyzed in sampled fish – for QD8 it is analyzed concentrations of contaminants in the liver and assessed by WFD standards for biota; and for QD9 is analyzed concentrations of contaminants in the fillet assessed with European food health standards[8]). Nonetheless, for the QD9 data, if not linked to the QD8 monitoring programme, shall be possible, at least, to identify the FAO

[8] **Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs**

Fishing area [9]of the sample (e.g. fish or other seafood get on the market), in that case the different mapping shall be applied, using the model of Sea regions. If fishing location neither FAO Fishing area cannot be identified, this data is not in the scope of INSPIRE and most probably not in the scope of MSFD.

4.1.1. Oceanographic geographical features

These types of spatial data shall be modelled using application schema on *Oceanographic geographical features* (OF) that represents the physical or chemical (including chlorophyll *a*, as estimated on the physical property - ocean color) properties of a sea. The model OF is based on the ISO 19156 Observations and Measurements (O&M) framework for consistent encoding of measured, modelled or simulated data. For the purposes of interoperability in INSPIRE, the O&M model is profiled to add further precision about the types of processes, observable properties and features of interest that are used. The O&M, is profiled into *Specialized Observations Types* that differs grid, point, multipoint and trajectory observations, including the times series for each of sampling geometries, that are common to Atmospheric Conditions/ Meteorological geographical features theme and are part of INSPIRE Generic Conceptual Model (GCM).

[9] EC use the FAO area codes, http://ec.europa.eu/fisheries/documentation/publications/cfp_factsheets/fishing_areas_en.pdf

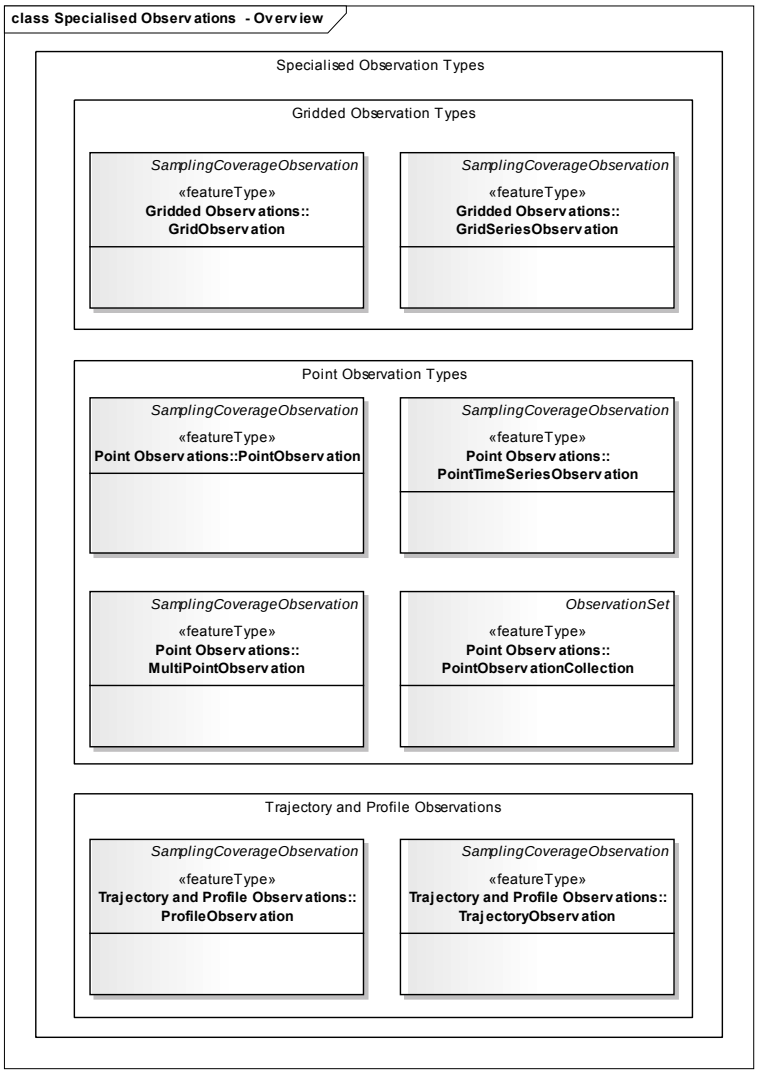


Figure 3 - Specialized observations - profiled INSPIRE O&M model

The OF model and schema itself is therefore minimal since most of the feature types are part of specialized observations (O&M) and itself only contains information about particular vocabularies (code lists, see Annex I & Annex II) which should be used when describing OF data.

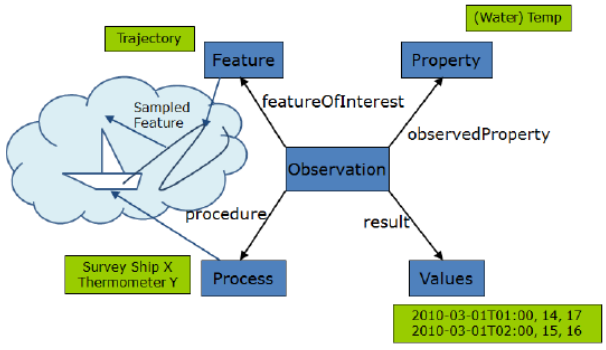


Figure 4 - type of Specialized observations - Trajectory observation

4.1.2. Environmental monitoring facilities

Environmental monitoring facilities (EF) is a theme that covers information related to the monitoring facilities, including the observations and measurements taken. The model gives the opportunity to provide information at the appropriate level of detail, describing aggregations/collections, organizational grouping and legal background at all levels from local to European. A relation from environmental monitoring facilities to environmental reporting is included in the model (e.g. EF application schema allows the link to the MS reporting sheet on *Monitoring programmes* that is publicly accessible on EIONET/REPORTNET). Correspondingly is supported ability to model information on legal context in which management and regulation of the monitoring/abstract object (facility/activity/(sub-)programme) is defined providing possibility to number more than one legal act. Within this attribute is possible to link one monitoring network to various EU directives, even international instruments that require monitoring of the same indicators (e.g. nutrient monitoring sub-programme required by MSFD, WFD, Nitrite Directive…).

The application schema is appropriate to describe relations between MSFD monitoring programme and sub-programmes (e.g. eutrophication monitoring programme integrates nutrients sub-programme, chlorophyll *a* sub-programme, dissolved oxygen sub-programme…), but also MSFD QD's monitoring programmes overlaps (e.g. monitoring station is used for sampling nutrients -QD5 eutrophication monitoring programme; and sampling priority substances - QD8 contaminants monitoring programme).
Model has ability to add/deduct monitoring (sub-) programmes modules, within the data update, and provides the possibility for including the monitoring information that is not in the scope of the Marine pilot project (Bathing Directive, Nitrate Directive…).

4.1.3. EF & OF application schema

Combining/integrating OF & EF application schemas we have complete information on the MSFD monitoring programme(s), sub-programmes, aggregations/collections, organizational grouping, legal background and the time series values data provided by the profiled INSPIRE O&M model (specialized observations).

For this pilot project we integrated these two application schemas into one, as a minimal extension/modification. Both application schemas include O&M model that models time series data. Form Generic conceptual model we included O&M profiled INSPIRE Specialized observations, that categorize type of observations (gridded observations, point observations, trajectory observations….) but the application schema is still same core O&M included in EF. The idea of extension/modification was to embed Specialized observations into EF model and to use parameter code lists required by OF (see Annex I & II).

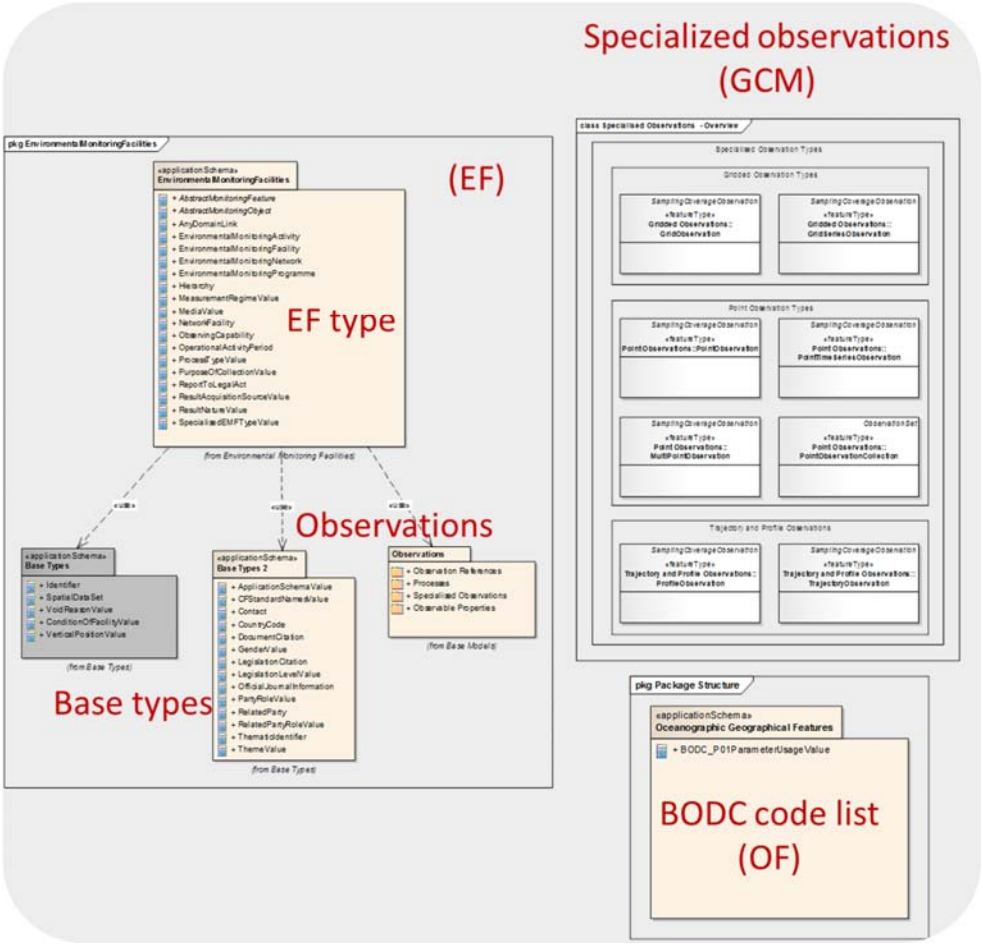


Figure 5- Environmental monitoring facilities, Specialized observations and Oceanographic geographical features code list – application schema used for the MSFD monitoring data

These two application schemas could be integrated or could be modelled and served separately, linked within the mechanism for linking between Environmental Monitoring Facilities and Observations, described in the framework document on Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE Annex II and III data specification development[10]

[10] Available at:
http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/D2.9_O&M_Guidelines_v2.0.pdf

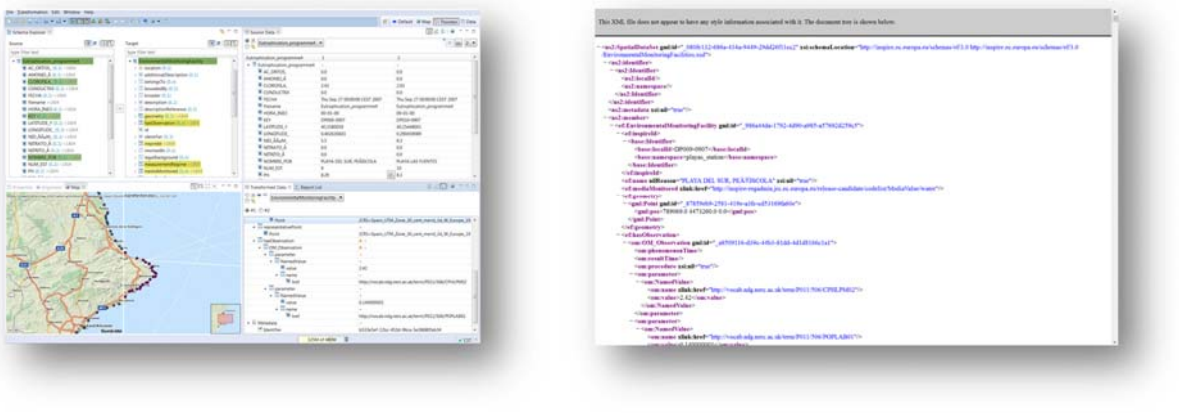


Figure 6 - Snapshots of Humboldt Alignment Editor – transformation from shp. file to the INSPIRE GML

Concept of modelling time series data is tested with historical data of coastal waters (Valencia/Spain) monitoring in the scope of the WFD implementation. The data from the historical data base is successfully transformed in the EF & OF data model, applying it, for the time series of chlorophyll *a* and total phosphorus. Other parameters (nitrogen, silica, or even dissolved oxygen) rest of the historical time series modules, sub-programmes can be included after.

4.1.4. Supporting resources regarding the EF&OF:

1. INSPIRE Generic Conceptual Model
2. Guidelines for the use of Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE Annex II and III data specification development
3. INSPIRE Data Specification for the spatial data theme Environmental Monitoring Facilities
4. INSPIRE Data Specification on Oceanographic geographical features – Technical Guidelines
5. Integrated EF&OF application schema

4.2. Bio-data

QD1 -Biological diversity, linked to the occurrence of habitats and the distribution of species should be mapped/modelled by INSPIRE application schemas *Species distribution* and *Habitat and biotopes distribution*. To cover all QD1 indictors, related to the species and habitat level, both data models need to be extended (Figure 7).

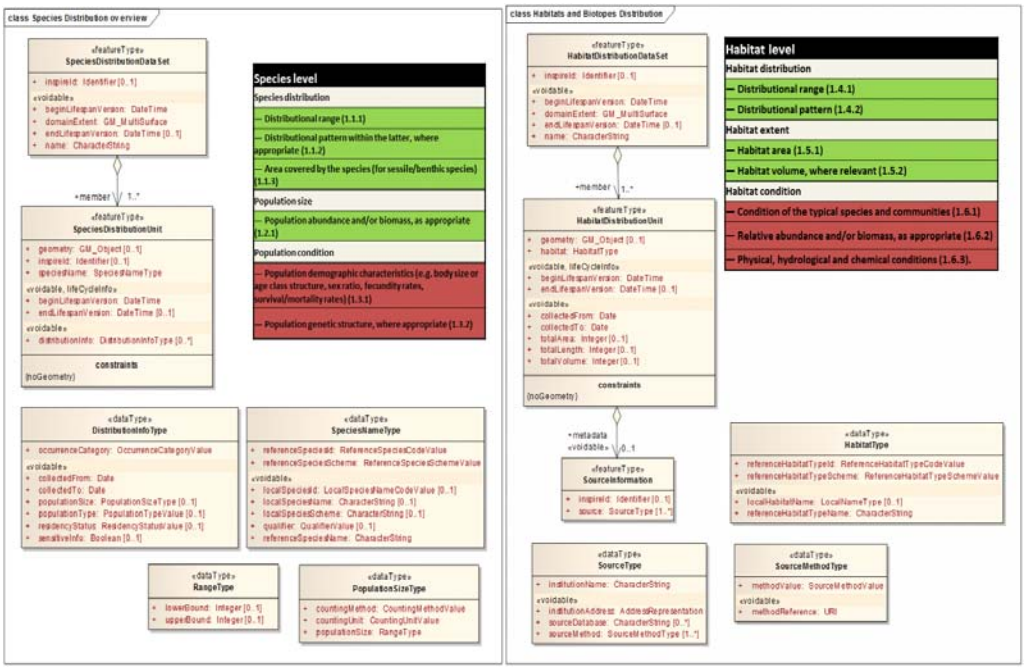


Figure 7 – INSPIRE data models *Habitat and biotopes distribution* & *Species distribution* VS criteria on Habitat level & Species level. QD1 Indicators (species and habitat level) with a red background, not covered by INSPIRE data model

For extending the HB model it is required extensions related to the QD1 and QD7. QD1 habitat level criteria's contains 7 indictors, form which four are covered by core data model and three on habitat condition requires extension (see Figure 7):

- Condition of the typical species and communities (1.6.1)
- Relative abundance and/or biomass, as appropriate (1.6.2)
- Physical, hydrological and chemical conditions (1.6.3).

Second QD7 criteria on Impact of permanent hydrographical changes also require extension:

- Spatial extent of habitats affected by the permanent alteration (7.2.1)
- Changes in habitats, in particular the functions provided (e.g. spawning, breeding and feeding areas and migration routes of fish, birds and mammals), due to altered hydrographical conditions (7.2.2).

With *Species distribution* it is related most of MSFD criteria/indicators (Figure 2), to cover requirements, we need to extend SD data model with two possible approaches:

1. Extension on SD model done for each quality descriptor separately (Figure 7), extending on the MSFD indicators that are not covered by INSPIRE data model.
2. Extension of the INSPIRE data model that cover needs for all quality descriptors that are identified as should be modelled by SD (Table 2).

4.2.1. Extension of the Species distribution model

Table 2 includes 6 quality descriptors/ 11 criteria and 24 related indicators that are identified as should be modelled using *Species Distribution* INSPIRE data theme. All 24 indicators, that should be developed as attributes, are classified into five classes - Distribution, Population and abundance, Population attributes, Re-productivity and Biodiversity indexes. First two classes are covered by INSPIRE data model and marked into Table 2 with green fields.

	1. Biological diversity Species level	2. Non-indigenous species introduced by human activities	3.Populations of all commercially exploited fish and shellfis	4. Elements of the marine food web	5. Human-induced eutrophication	6. Sea-floor integrity
Distribution	Species distribution	2.1. Abundance and state characterisation of non-indigenous species				6.2. Condition of benthic community
	— Distributional range (1.1.1)	— spatial **distribution (2.1)**				— Presence of particularly sensitive and/or tolerant species (6.2.1
	— Distributional pattern within the latter, where appropriate (1.1.2)					
	— Area covered by the species (for sessile/benthic species) (1.1.3)					
Population size & abundance	Population size			4.3. Abundance/distribution of key trophic groups/species	5.2. Direct effects of nutrient enrichment	
	— Population abundance and/or biomass, as appropriate (1.2.1)	— Trends in abundance, temporal occurrence (2.1)		— Abundance trends of functionally important selected groups/species (4.3.1	— Abundance of opportunistic macroalgae (5.2.3)	— Proportion of biomass or number of individuals in the macrobenthos above some specified length/size (6.2.3)
					— Species shift in floristic composition such as diatom to flagellate ratio (5.2.4	
					5.3. Indirect effects of nutrient enrichment	
					— Abundance of perennial seaweeds and seagrasses (5.3.1)	
population atributes	Population condition		3.3. Population age and size distribution	4.2. Proportion of selected species at the top of food webs		
	— Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)		— Proportion of fish larger than the mean size of first sexual maturation (3.3.1)	— Large fish (by weight) (4.2.1).		— Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community (6.2.4).
	— Population genetic structure, where appropriate (1.3.2)		— Mean maximum length across all species found in research vessel surveys (3.3.2)			
			— 95 % percentile of the fish length distribution observed in research vessel surveys (3.3.3).			
			— Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation (3.3.4) secondary indicator			
Re-productivity			3.2 Reproductive capacity of the stock	4.1. Productivity (production per unit biomass) of key species or trophic groups		
			- Spawning Stock Biomass (3.2.1) - primary indicator	— Performance of key predator species using their production per unit biomass (productivity) (4.1.1)		
			- Biomass indices (3.2.2) secondary indicator			
Indexes						— Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species (6.2.2)

Table 2 – 1, 2, 3 ,4,5, 6 quality descriptors/criteria VS Species Distribution model (white filed = criteria, green filed = indictor covered by Species distribution model, red = not covered by Species distribution model).

Population attributes, Re-productivity and specific marine ecology Indexes are classes (indictors in red fields) not included into INSPIRE SD data model and to cover requirement for all criteria and related indicators, SD need extension. Extension of the data model should include:

1. Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1; Population condition)
2. Population genetic structure, where appropriate (1.3.2; Population condition)
3. Spawning Stock Biomass (3.2.1; Reproductive capacity of the stock) - primary indicator
4. Biomass indices (3.2.2; Reproductive capacity of the stock) secondary indicator
5. Proportion of fish larger than the mean size of first sexual maturation (3.3.1; Population age and size distribution)
6. Mean maximum length across all species found in research vessel surveys (3.3.2; Population age and size distribution)
7. 95 % percentile of the fish length distribution observed in research vessel surveys (3.3.3; Population age and size distribution)
8. Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation (3.3.4; Population age and size distribution) secondary indicator
9. Large fish (by weight) (4.2.1; Productivity (production per unit biomass) of key species or trophic groups).
10. Performance of key predator species using the production per unit biomass (productivity) (4.1.1)
11. Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species (6.2.2; Condition of benthic community)
12. Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community (6.2.4; Condition of benthic community).

Due the revision of COM 2010/477/EU, current development of some indicators, the final extension of the SD and HB INSPIRE data models, cannot be concluded. Due that the extension of the models are done on level of the feature, adding the complex attributes types, within conceptual level of details (see Figure 8). Second option is to develop structure for the Species distribution monitoring that would be based on the O&M framework(see Figure 9). Within this framework, indicators that are not included in basic INSPIRE data model could be defined as a parameter code list mechanism, that is partially supported by number of vocabularies (see Annex I, Table 5.1). This approach would require extension of the controlled vocabularies, as e.g. BODC P01.

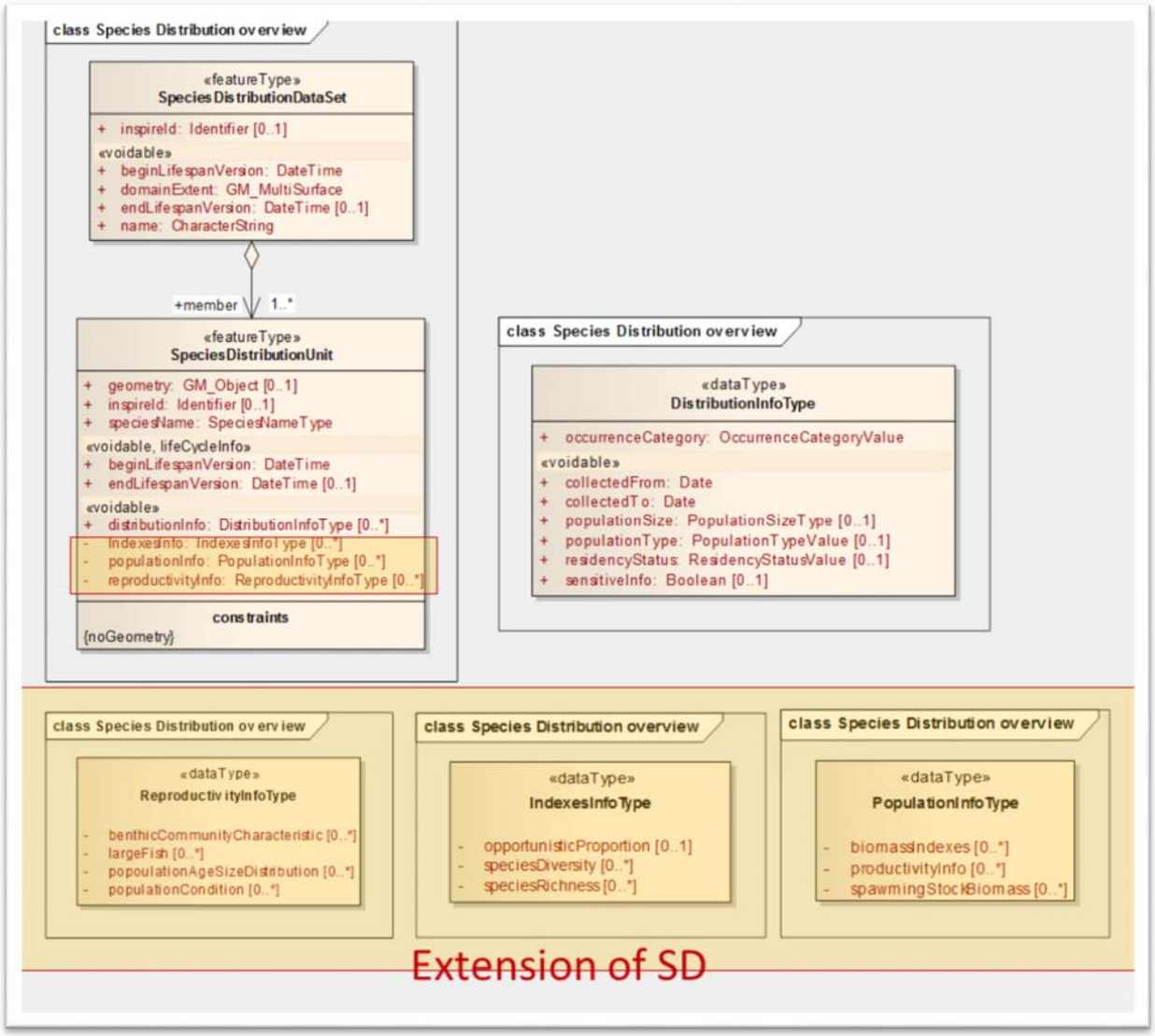


Figure 8 - Extensions of Species Distribution model for MSFD monitoring programmes

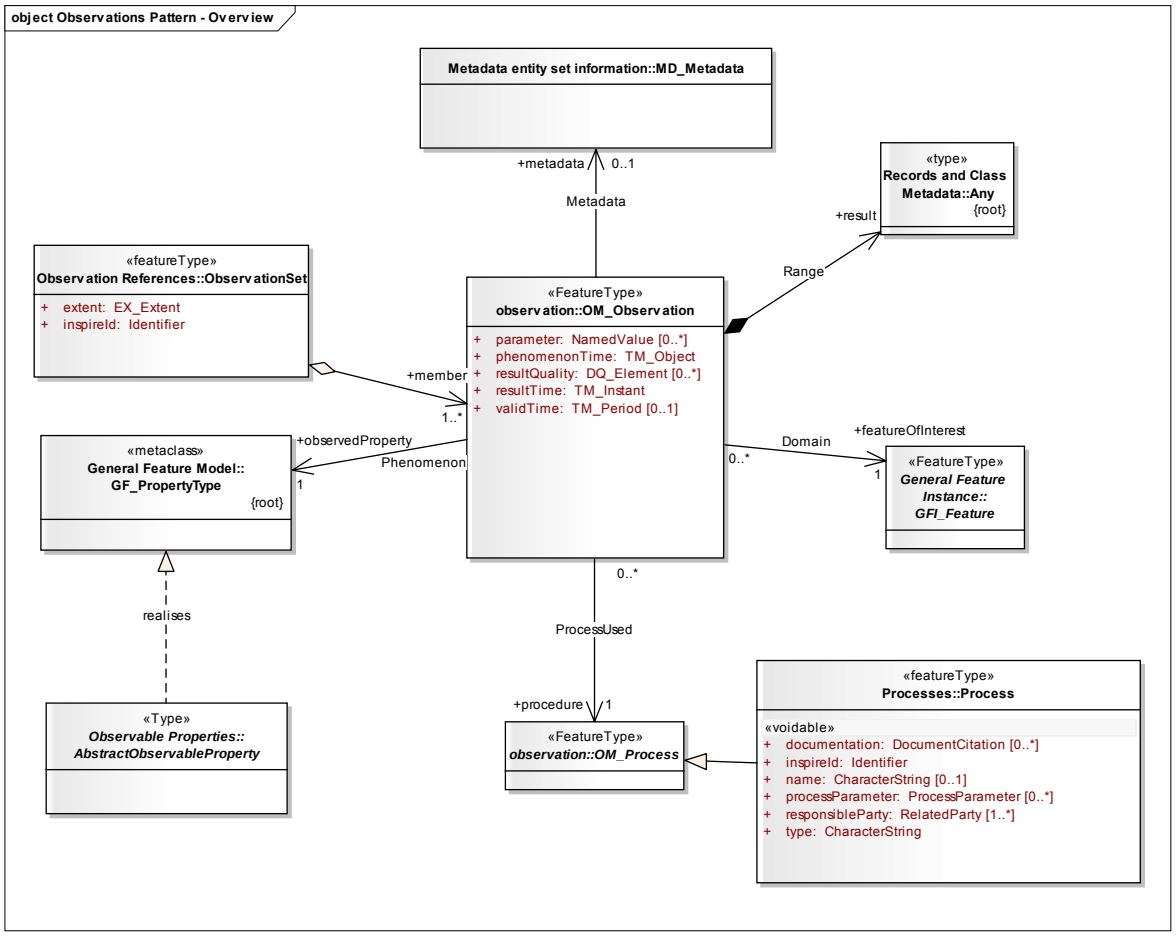


Figure 9 – 2nd approach - all 22 indictors related to the SD can be easily described using the O&M frmaework, fullfiling the requirment to extend controlled vacabulaires as BODC –parmeter:NamedValue, see Annex I, table 1.1

4.2.2. Supporting resources regarding SD and HB:

1. INSPIRE Data Specification on Species Distribution – Technical Guidelines
2. INSPIRE Data Specification on Habitats and Biotopes – Technical Guidelines
3. Endorsed SD application schema (XSD)
4. Endorsed HB application schema (XSD)

4.3. Areas with common characteristics.

Spatial data on areas with common characteristics (e.g. areas with permanent alterations of the hydrographical conditions) should be modelled using the *Sea regions* data model. The INSPIRE *Sea regions* theme describes what most people would refer to as ―the sea‖ and ―the coastline. The model provides a generic framework for describing subdivisions and aggregation of seas according to physical or chemical properties, with a mechanism that can refer to the sea bed or sea surface. The Sea Regions (SR) theme is closely related to the OF theme. A SR is a defined area of common characteristics and OF represents the (physical or chemical) properties of the Sea Region.

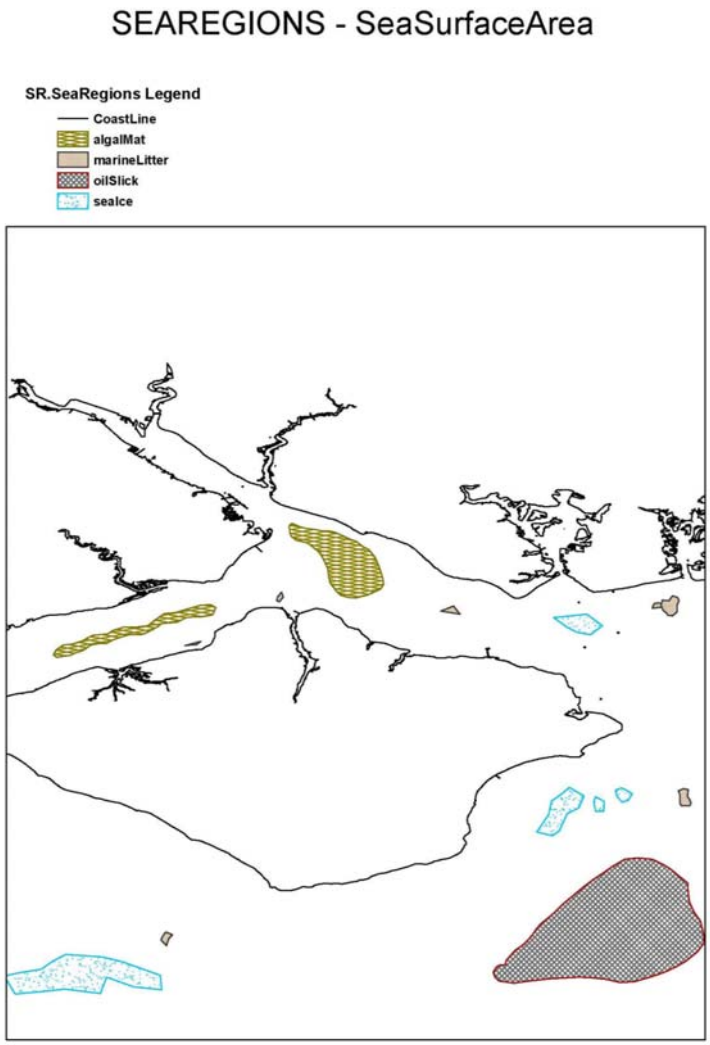


Figure 10 - Example of use of SR model (includes litter area QD10)

A Sea Region is a 2D geometry of an area that is covered by an sea and it can be refereed to sea surface, sea bad or even water column. Its boundaries are attributed to common characteristics and due that is appropriate to model:

QD2: Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem.

- Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible (2.2.2).

QD6: Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

- Extent of the seabed significantly affected by human activities for the different substrate types (6.1.2).

QD7: Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.

- Extent of area affected by permanent alterations (7.1.1)

QD8: Concentrations of contaminants are at levels not giving rise to pollution effects.

- Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil and oil products) and their impact on biota physically affected by this pollution (8.2.2).

QD10: Properties and quantities of marine litter do not cause harm to the coastal and marine environment.

- Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1)
- Trends in the amount of litter in the water column (including floating at the surface) and deposited on the sea-floor, including analysis of its composition, spatial distribution and, where possible, source (10.1.2)
- Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro-plastics) (10.1.3)
- Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis) (10.2.1).

QD11: Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

- Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured (11.1.1).
- Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1µPa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate (11.2.1).

Numbered MSFD indictors the SR application schema, covers without any need of model extension. The primary class in the Sea Regions model is the SeaArea. A SeaArea is quite literally an area of sea, that shall be defined by parameter values that describe common properties of the sea. Parameter values should be added using the parameterValue attribute, within mechanism on codelists for parameters in the OF (BODC P01 Parameter Usage) and the value of the observed parameter.

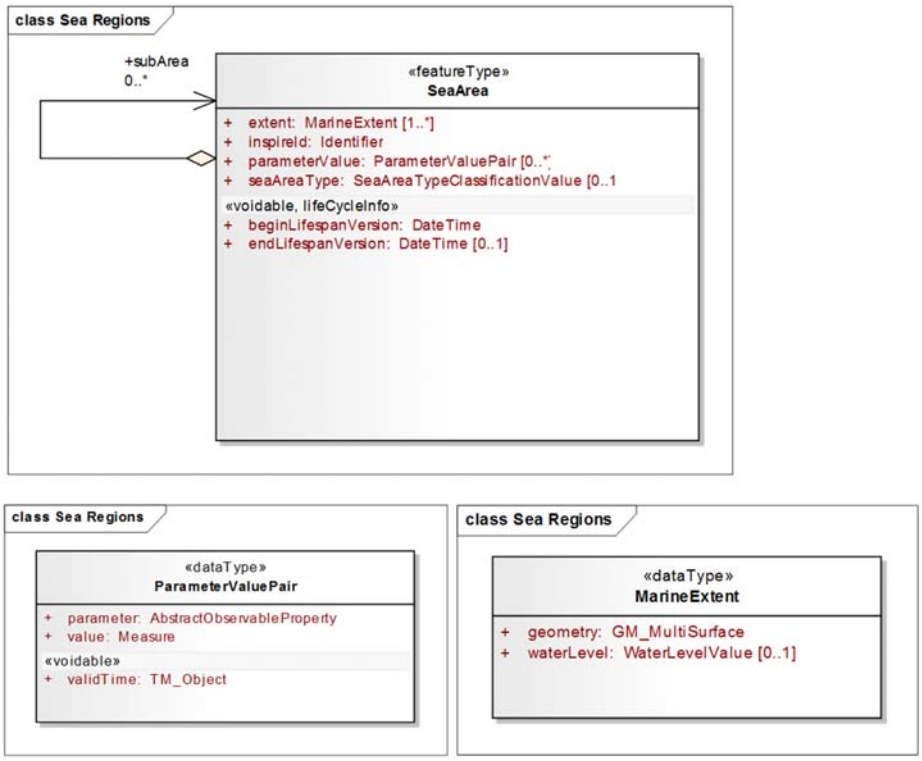


Figure 11 - SeaArea feature type (Sea Regions application schema)

As SR theme covers wider scope of the OF and the BODC P01 do not cover criteria/indicators related to the sea regions (see Annex I, Table 5.1), we propose the code list for the paramrterValue attribute (AbstarctObservableProperty), based on the MSFD critera, extendable with MSFD indicators child values names given by Commission Decision 2010/477/EU document:

EcosystemStructure (1.7)
EnvironmentalImpactOfInvasiveNon-indigenousSpecies (2.2)
LevelOfPressureOfFishingActivity (3.1)
PhysicalDamageHavingRegardToSubstrateCharacteristics (6.1)
SpatialCharacterisationOfPermanentAlterations (7.1)
EffectsOfContaminants (8.2)
CharacteristicsOfLitterInMarineAndCoastalEnvironment (10.1)
ImpactsOfLitterOnMarineLife (10.2)
DistributionInTimeAndPlaceOfLoudLowAndMidFrequencyImpulsiveSounds (11.1)
ContinuousLowFrequencySound (11.2)

4.3.1. Supporting resources regarding SR:

1. INSPIRE Data Specification on Sea Regions – Technical Guidelines[11]
2. Endorsed SR application schema (XSD)[12]

[11] http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_SR_v3.0.pdf
[12] http://inspire.ec.europa.eu/schemas/sr/4.0/SeaRegions.xsd

5. Conclusions

This study showed that the data and information coming from the MSFD monitoring programmes can be mapped onto INSPIRE data models without having to extend the INSPIRE core data models. The 11 descriptors and the related monitoring programmes can be modelled using the Oceanographic geographical features, Environmental monitoring facilities, Sea regions, Habitat and biotopes and Species distribution applications schemas.

This study is based on the Commission Decision on criteria and methodological standards on good environmental status of marine waters 2010/477/EC, which is currently being revised. Possible amendments to this Decision can have impact on this report and that could be modified if needed during the project time period.

The integration and combination of the INSPIRE Oceanographic geographical features and Environmental monitoring facilities is a powerful means to describe how the monitoring is organized, what the legal context is, and how the data are linked to reporting sheets. It also allows to model time series data, needed for analysis of environmental trends and assessment of the environmental status. However, it is also important to point out that the use of these specifications will need to be complemented with MSFD-specific guidelines and code lists, for instance on the use of units of measure, to make data integration easy from a user perspective.

Sea region model covers all the indictors that present area or coast line with common characteristics. This data model does not need any extension, but requires extension of the controlled vocabularies (e.g. BODC…) to cover 11 criteria indicators required by MSFD and related to the Sea Regions.

The Species Distribution data model has to be extended, as currently covers only part of the MSFD requirements related to the information on species distribution. In this study the extension of Species Distribution model was done only at the conceptual level: a number of indicators are still under the development. These extensions are also linked to the revision of COM 2010/477/EC.

This report – and the common data models that have been proposed as part of this study - will be used by participants of the Marine pilot project. At the same time this document can provides relevant information related to the implementation of the MSFD Article 19(3).

6. References

1) *Project Charter for the Marine pilot , [online]* https://circabc.europa.eu/w/browse/bc33dff1-0f8c-467a-8382-7724c5f79d45
2) [1] Abramic, A., Smits, P., and Nunes de Lima, V. (2015). Analysis of requirements that link INSPIRE and MSFD. DIKE_11-2015-06
3) [2] CEN/TR 15449-3:2012 Geographic information - Spatial data infrastructures - Part 3: Data centric view
4) [3] INSPIRE Generic Conceptual Model
5) [4] INSPIRE methodology for data specifications
6) EC, Common Implementation Strategy: Reporting on monitoring programmes for MSFD Article 11;2014
7) EC, COMMISSION STAFF WORKING PAPER : Relationship between the initial assessment of marine waters and the criteria for good environmental status; 2011
8) European Environment Agency and European Topic Centre of Inland, Coastal and Marine Waters: MSFD reporting work flow Technical guidance on provision of spatial data for MSFD reporting; 2012
9) European Topic Centre on Inland, Coastal and Marine Waters and WG DIKE: MSFD article 19.3 analysis of 2013 notifications; 2013
10) COMMISSION DECISION on criteria and methodological standards on good environmental status of marine waters; 2010
11) Science and Policy Report by the Joint Research Centre: In - Depth Assessment of the EU Member States' Submissions for the Marine Strategy Framework Directive under articles 8, 9 and 10
12) European Union Habitats Directive (1992). Council Directives 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.
13) Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
14) Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy
15) Review of Commission Decision 2010/477/EU concerning MSFD criteria for assessing good environmental status

Annex I - Standards for exchange of MSFD supporting data and information

MSFD Article 19.3 requires that member states shall provide the Commission and the EEA with access and use rights to the data and information resulting from the initial assessments and from the monitoring programmes. For interoperability, these data should comply to international standards for file format, discovery metadata and explanatory metadata. Currently, national data are often described in national standards. A transformation to international standards using international standards for parameters code lists is needed in order to make the data useable in an international context. The analysis in this chapter aims to provide guidelines for the choice of code lists for the different types of data.

Metadata standards and data set discovery – INSPIRE and data holdings at Regional Sea Conventions (RSCs) and European initiatives

The Infrastructure for Spatial Information in Europe (INSPIRE) directive, aims to create an EU spatial data infrastructure to promote interoperability of geospatial data. The discovery of data is facilitated by a common format of metadata, based on the spatial ISO standards from the ISO191XX series (so based on GML). INSPIRE data are datasets that are published via the INSPIRE geoportal (http://inspire-geoportal.ec.europa.eu/)

Data access according to Article 19.3, in case of spatial data, will have to comply to INSPIRE. A parallel project funded by the Commission (INSPIRE Marine Pilot project) aims to define in more detail the requirements for data related to MSFD reporting in the scope of the INSPIRE directive. Report 2.1 from the INSPIRE marine pilot (Abramic et al., 2015) provides a first proposal of a mapping table between MSFD (Descriptors, criteria, indicators) and INSPIRE (themes) elements.

Within the Regional Sea Conventions (RSCs), namely OSPAR and HELCOM, INSPIRE metadata are developed for common indicator data.

For both OSPAR and HELCOM, a number of data sets for MSFD are held at contracted data centres, e.g. ICES, which hold data on contaminants and eutrophication as well as providing other data for use in common indicator assessments e.g. fisheries and other biodiversity aspects. These data are usually reported annually by Contracting Parties. Discovery of metadata of ICES build on ISO 191XX standards. Publication of these metadata via the INSPIRE portal therefore requires a small effort.

In addition to the data sets hosted by contracted data centers, RSCs have developed information systems for hosting, and making metadata and data openly available. HELCOM has developed the HELCOM Map and Data service and OSPAR is in the process of finalizing the OSPAR Data and Information System (ODIMS). Development of these systems is aiming for the highest possible compatibility with INSPIRE which is ensured e.g. by participation in the INSPIRE Marine Pilot project.

OSPAR data management is structured in a decentralised fashion. Data and data products developed under OSPAR will remain at the point of production wherever possible. All data and metadata will be made available via ODIMS, with links to other data portals made where available e.g. EMODnet.for seabed habitat related data. Dialogue is on-going between OSPAR and EMODnet (2nd EMODnet-MSFD Coordination Meeting[13]) regarding linking the data portals. EMODnet, using either Darwin Core or SeaDataNet data and metadata formats, builds upon ISO 191xx metadata standards.In section **Error! Reference source not found.** the use of EMODnet for MSFD data is further explored.

[13] https://webgate.ec.europa.eu/maritimeforum/fr/node/3714

Although major European initiatives work to make their metadata INSPIRE compliant, it is still under discussion how these initiatives should make their data discoverable through the INSPIRE portal (https://themes.jrc.ec.europa.eu/discussion/view/16155/does-emodnet-and-myocean-deliver-inspire-compliance-for-member-states).

Data standards and INSPIRE

INSPIRE requires standard formats for data. A parallel project ("The INSPIRE marine pilot") produces guidelines for mapping MSFD elements to INSPIRE themes. A first version of a mapping table has come available. In that project guidelines are developed and tested to include the INSPIRE data standards in the data underlying MSFD reporting elements. From the second deliverable (Abramic et al., 2015) of the project, it is stated that:

"

In October 2013, the EEA presented to WG DIKE a technical report on the implementation of Arti cle 19(3), which related to the initial assessment titled "MSFD article 19.3 analysis of 2013 notific ations". The report showed that there was a wide variation of metadata. Most information was in t he national languages. There was not enough information provided to locate the matching datase ts/reports.
If we go beyond the metadata and take a closer look at the other INSPIRE obligations that were already applicable at that time (c.f. Figure 3), we can see that the reporting process should have been supported by the national INSPIRE infrastructures in terms of metadata, discovery, view an d download services.

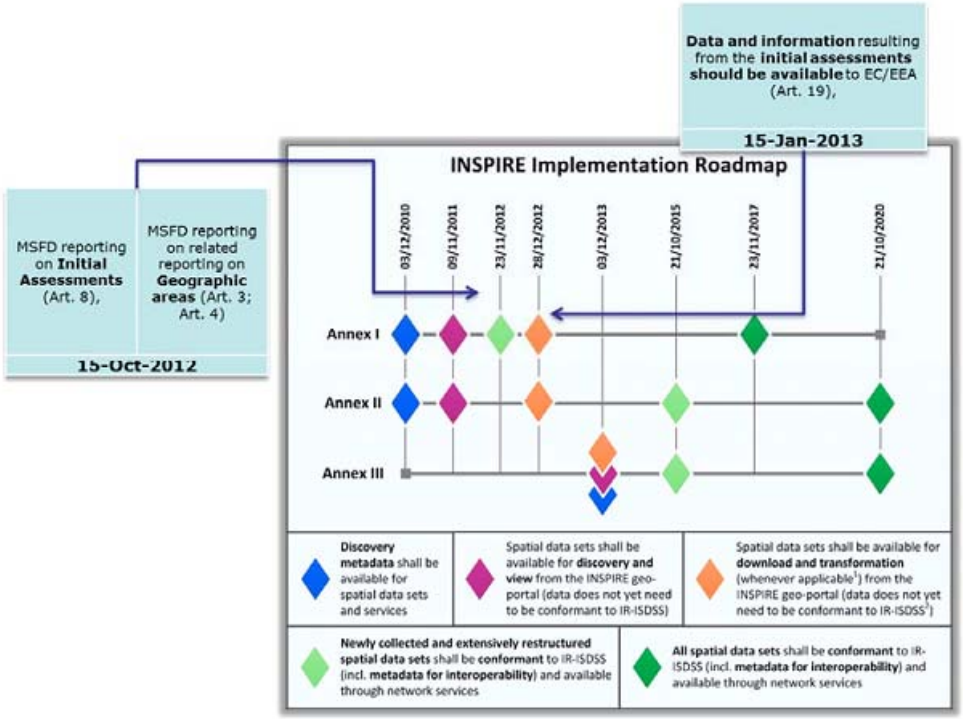


Figure 4 - INSPIRE roadmap & Article 19 requirement regarding the initial assessment

The deadline for making newly collected and extensively restructured data interoperable – i.e., co nformant to Regulations No 1089/2010, 102/2011, and 1253/2013 which are related to the INSPI RE data models) is 23 November 2012 (INSPIRE Annex I data themes) and 21 October 2015 (IN SPIRE Annex II and III), respectively. All data sets need to be made interoperable by 23 Novemb er 2017 (Annex I) and 21 October 2020 (Annex II and III)."

Parameter code lists

For interoperability purposes, INSPIRE prescribes that published data should use published code lists for the parameters that are presented. For the publication of marine data, a number of international standards are in place, each with their own set(s) of code lists. Standards that are commonly used for marine data in Europe are:

- BODC parameter vocabularies used by SeaDataNet
- Darwin Core (DC)ICES data format and parameter list used by the ICES data centre for storage of e.g. RSC reporting data from Contracting Parties.

Climate and Forecasting (CF) standard names (code list) for parameters developed by the NetCDF community. INSPIRE (COMMISSION REGULATION (EU) No 1253/2013) explicitly mentions the use of BODC and CF code lists to be used in the theme Oceanographic Geographical Features, but it is currently under discussion by the INSPIRE community to what level other lists can be used (https://themes.jrc.ec.europa.eu/discussion/view/24996/of-data-specification-use-of-codelists). Other code lists, that are more suitable, and/or relatively easy to map to the BODC parameter code list could be taken into account for some types of data sets. In case other code lists are used, it is important to to facilitate the interoperability of code lists for the different INSPIRE themes.

SeaDataNet (BODC) parameter vocabularies

SeaDataNet is a European data infrastructure and metadata service linking 45 institutes from 35 countries across Europe. Within SeaDataNet, standards are developed aiming to enhance interoperability of marine data. It uses code lists for parameters developed and maintained by the British Oceanographic Data Centre (BODC). Most EMODnet thematic portals build on the SeaDataNet infrastructure and code lists. SeaDataNet also develops guidelines and standards for file formats and metadata. Here, we focus on the parameter code lists that are in use within SeaDataNet. Recently, the parameter list has been extended with parameters for biological measurements.

SeaDataNet is a European infrastructure for sharing marine data including metadata services and parameter vocabularies. Parameter lists are organized in a hierarchical structure. P01 is the most detailed and rich set of parameter names, typically used on the level of data acquisition and is the recommended standard for INSPIRE theme Oceanographic features. P01 names could include the measured entity, method, matrix and other relevant characteristics. P35 is the most aggregated list with groups of parameters. Due to the very rich nature of the P01 parameter names, P01 contains 34 000 items. Therefore, for practical reasons, the parameter discovery list P02 has been used here to analyse suitability of the BODC parameter list for MSFD data reporting. In the annex MS-Excel table, a link is provided from each P02 name to the underlying P01 names.

Darwin Core

Darwin Core (DC) is a set of standards specifically developed and maintained by Biodiversity Information Standards and Taxonomic Databases Working Group (TDWG). Its aim is to share biodiversity-related geographic data and datasets meaningfully (Wieczorek et al., 2012). It has been adopted by many global and regional biodiversity initiatives. Darwin Core is for example used among others in the Ocean Biogeographic Information System (OBIS) and its European branch (EurOBIS) and Global Biodiversity Information Facility (GBIF). EMODnet biology builds heavily on the data already registered at EurOBIS. Thus, a large part of the biological data under EMODnet already complies with DC. During the second phase of EMODnet, ingestion of biological data into the portal using other standards was made operational, most notably using the SeaDataNet SDI using Ocean Data View (ODV) file format and BODC parameter vocabularies. Mappings are available between the SeaDataNet parameter names and the Darwin Core terms (see table A.1 in the Annex).

From the Web page on Darwin Core (http://rs.tdwg.org/dwc/):

"The Darwin Core is a body of standards. It includes a glossary of terms (in other contexts these might be called properties, elements, fields, columns, attributes, or concepts) intended to facilitate the sharing of information about biological diversity by providing reference definitions, examples, and commentaries. The Darwin Core is primarily based on taxa, their occurrence in nature as documented by observations, specimens, samples, and related information. Included are documents describing how these terms are managed, how the set of terms can be extended for new purposes, and how the terms can be used. The normative document for the terms [RDF-NORMATIVE] is written in the Resource Description Framework (RDF) and is the definitive resource to understand the term definitions and their relationships to each other. The Simple Darwin Core [SIMPLEDWC] is a specification for one particular way to use the terms - to share data about taxa and their occurrences in a simply structured way - and is probably what is meant if someone suggests to "format your data according to the Darwin Core".

"The Simple Darwin Core is a predefined subset of the terms that have common use across a wide variety of biodiversity applications. The terms used in the Simple Darwin Core are those that are found at the cross-section of taxonomic names, places, and events that document biological occurrences on the planet. The two driving principles are simplicity and flexibility.

What makes it simple?

The Simple Darwin Core is simple in that it assumes (and allows) no structure beyond the concept of rows and columns, which might be thought of as attributes and their values, or fields and records. The words field and record will be used throughout the rest of the document to refer to the two dimensions of the Simple Darwin Core structure. Think of the term names as the field names. In other words, a Simple Darwin Core record could be captured in a spreadsheet or in a single database table.

What makes it flexible?

The Simple Darwin Core has minimal restrictions on which fields are required (none). You might argue that there should be more required fields, that there isn't anything useful you can do without them. That is partially true. A record with no fields in it wouldn't be very interesting, but there is a difference between requiring that there be a field in a record and requiring that a particular field be in all records. By having no required field restriction, the Simple Darwin Core can be used to share any meaningful combination of fields - for example, to share "just names", or "just places", or observations of individuals detected in the wild at a given place and time following a method (an occurrence). This flexibility promotes the reuse of the terms and sharing mechanisms for a wide variety of services."

ICES parameter code lists

ICES is a data repository for a large number of data sets, ranging from oceanographic data to environmental contaminant concentrations and enzyme activities related to toxic effects. To accommodate these different types of data, ICES has developed a well-described and openly published set of code lists/vocabularies (http://ices.dk/marine-data/vocabularies/Pages/default.aspx). The vocabulary server on this page facilitates the discovery of code lists elements. In the current analyses, the vocabulary server was queried for the different types of data. For eutrophication and contaminants, the parameter code list was analysed.

Climate and forecasting (CF) parameter list

From the website: “The conventions for CF (Climate and Forecast) metadata are designed to promote the processing and sharing of files created with the NetCDF API. The CF conventions are increasingly gaining acceptance and have been adopted by a number of projects and groups as a primary standard. The conventions define metadata that provide a definitive description of what the data in each variable represents, and the spatial and temporal properties of the data. This enables users of data from different sources to decide which quantities are comparable, and facilitates building applications with powerful extraction, regridding, and display capabilities.”

The conventions are mostly used within physical and (biogeo)chemical oceanography and modelling. The CF standard names are less used by biologists and likewise have little support for publication of biological data.

Comparison between parameter code lists with regards to suitability for description of MSFD underlying data

The code lists of the above mentioned four standards differ in nature. CF and BODC standard parameter names typically contain information on substance, matrix, species, sometimes also methodology or other distinctive information. This results in a relatively high number of parameter names, which then need to be grouped in order to meaningfully aggregate data from multiple sources (and multiple parameter names for the same type of parameters). The use of externally maintained lists, e.g. species code lists, by Darwin Core and ICES reduces the number of parameters to be held by them and provides a more flexible basis for extension of parameter names code lists.

For the above four parameter code lists an analysis was made of the suitability for publication of data that are related to respective MSFD criteria.
Suitability was judged from by the current existence of parameter names that could be used to describe data for MSFD indicators. This was done for all MSFD criteria. The following levels were applied:

→ No standard names currently available in code list
→ Partly available OR further development is needed
→ Well-developed and suitable set of parameters in code list

This analysis was based on information available to the project as of 25th February 2015. CF, BODC, and ICES lists are easily extendible by applying for new codes. For Darwin Core, new elements could be incorporated freely, although it is recommended to use controlled vocabularies. The free application of e.g. “measurementType” in Darwin Core could be used for a variety of population condition parameters (e.g. ”blubber thickness”) even if it does not occur yet in a controlled vocabulary. Darwin Core is the most flexible standard to capture diverse biological observations, even if they do not consist of more standardized parameters like occurrence, size, age etc.

For biodiversity related data, all standards except CF are suitable, with the notification that Darwin Core provides the most flexible standard, which can store any biological characteristic without necessary extensions of the standard. BODC standard names containing species names will have to be based on external species lists (e.g. WoRMS), and occurrence of “new” species (with respect to BODC parameter list) cannot be done without extending the parameter code list. ICES applies external lists of species directly.

ICES is the data holder for a number of RSC and MSFD related descriptors, most notably related to eutrophication (D5), contaminants in water and biota and contaminants effects (D8/D9), as well as biological (fish, benthos, plankton) data (for D1, D4 and D6). This is reflected in their vocabulary. Furthermore, ICES holds data related to commercial fish stock assessments and commercial fisheries (D3), but at present, there is no common indicator agreed within OSPAR.

Table 0.1 Suitability of code lists for parameters of data used in MSFD assessments.

no suitable standard names readily available in code list
partly available OR further development is needed
well-developed and suitable set of parameters in code list
No common indicators/ not applicable for OSPAR data streams

	Quality descriptor	Criteria(s)	Spatial data regarding the GES criteria	Relevant INSPIRE themes	BODC	ICES	DC	CF	Other relevant code lists
D1	Biological diversity	Species distribution	Species distribution map	Species distribution					1
		Population size							
		Population condition	Condition of populations						
		Habitat distribution	Habitats and biotopes distribution map	Habitats and biotopes					2
		Habitat extent							
		Habitat condition							
		Ecosystem structure	Assessment map regarding species and habitat distribution	Species distribution & Habitats and biotopes					1,2
D2	Non-indigenous species (abundance and env. Impact)	Abundance and state characterisation	Non-indigenous species distribution map	Species distribution					1
		Environmental impact of invasive non-indigenous species	Non-indigenous species Impact Assessment map	Sea regions					1
D3	Populations of all commercially exploited fish and shellfish	Level of pressure of the fishing activity	TBD	TBD					
		Reproductive capacity	Species distribution map, including data on reproductive activity	Species distribution					
		Population age and size distribution	Species distribution map, including data on population and age	Species distribution					
D4	Elements of the marine food webs	Productivity of key species	Species distribution map, including data on productivity	Species distribution					1
		Proportion of selected species	Species distribution map, including data on proportions	Species distribution					1
		Abundance/distribution of key species	Species distribution map	Species distribution					1
D5	Human-induced eutrophication	Nutrients levels	Nutrients concentrations time series - related to the monitoring stations	Environmental monitoring facilities, Oceanographic geographical features					
		Direct effects of nutrient enrichment	Chlorophyll a & water transparency time series data- related to the monitoring stations; opportunistic species distribution maps	Environmental monitoring facilities, Oceanographic geographical features, Species distribution					
		Indirect effects of nutrient enrichment	Dissolved oxygen time series data - related to the monitoring stations; distribution map of seagrasses	Environmental monitoring facilities, Oceanographic geographical features, Species distribution					
D6	Sea-floor integrity	Physical damage	Maps with extent of biogenic substrate; Maps with seabed areas significantly affected	Sea regions					
		Condition of benthic community	Maps of tolerant/sensitive species distribution	Species distribution					1
D7	Permanent alteration of hydrographical conditions	Spatial characterisation of permanent alterations	Maps of areas affected by permanent alterations	Sea regions					
		Impact of permanent hydrographical changes	Maps of affected habitats	Habitats and biotopes					2
D8	Concentrations of contaminants	Concentration of contaminants	Concentrations of contaminates (e.g. priority substances) time series (for water, sediment, biota)	Environmental Monitoring Facilities, Oceanographic Geographical Features					3
		Effects of contaminants	Contaminants Impact Assessment Maps; Map of occurrence/origin of pollution events	Sea regions					
D9	Contaminants in fish and other seafood	Levels, number and frequency of contaminants	TBD	TBD					
D10	Properties and quantities of marine litter	Characteristics of litter	TBD	TBD					
		Impacts of litter	Maps of the litter Impact Assessment	Sea regions					
D11	Introduction of energy	Distribution in time and place of loud, low and mid frequency impulsive sounds	Noise map distribution (various levels)	Sea regions					
		Continuous low frequency sound	Noise map distribution	Sea regions					

1) Taxonomical lists, most notably World Register for Marine Species (WoRMS), International Taxonomy Information system (ITIS), World register for Invasive marine species (WRIMS), Algaebase

2) Habitat classification lists most notably European Nature Information System (EUNIS) and HELCOM Underwater Biotope and habitat classifi cation (HUB) (not open lists)

3) Chemicals names most notably CAS (not an open list)

Annex II - Guidance on the usage of BODC parameter vocabularies

BODC (NERC) parameter code lists

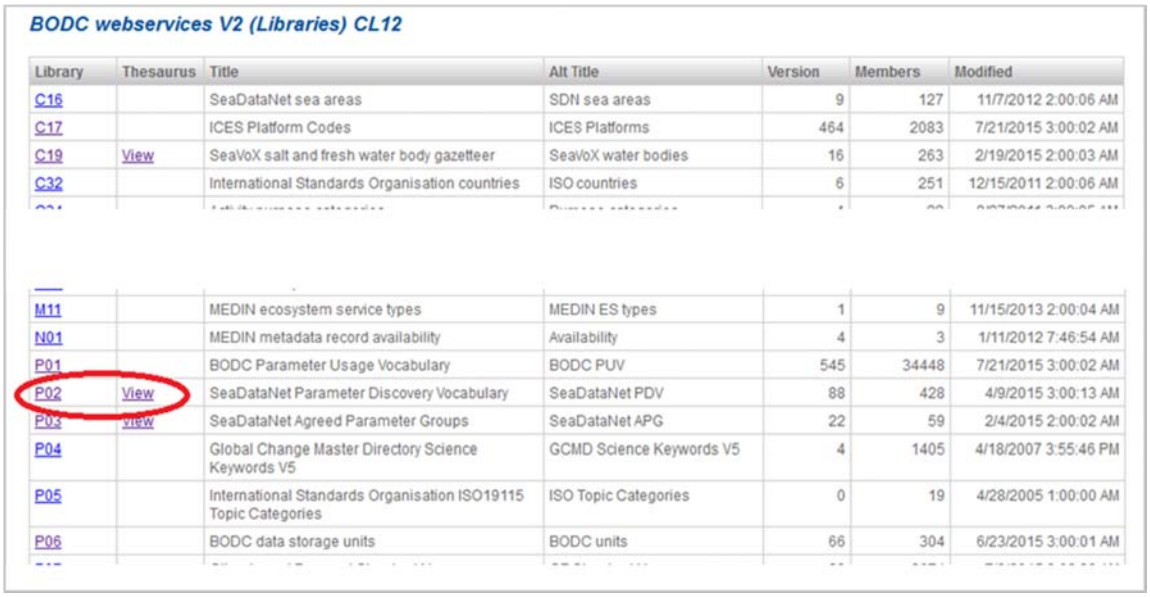
Since many years BODC has been deploying web services to provide access to lists of standard terms used for oceanographic metadata. These vocabulary lists are used by the SeaDataNet community – a network of 45 organisations from 35 countries – for the harmonisation of metadata from all European oceanographic data centres and data reporting institutions. Since then the lists have been immensely improved, updated and expanded through prevailing needs.

The new NERC Vocabulary Server version 2.0(NVS2.0) is in use by the SeaDataNet and EMODNet community since 2013. For more detailed information on the vocabulary version NVS2.0 see http://vocab.nerc.ac.uk/.

For the purpose of MSFD data reporting in the scope of the INSPIRE directive the BODC parameter lists P02, P01 and P35 are of particular relevance. In the following is a short review of the contents of these lists.

P02 - SeaDataNet Parameter Discovery Vocabulary

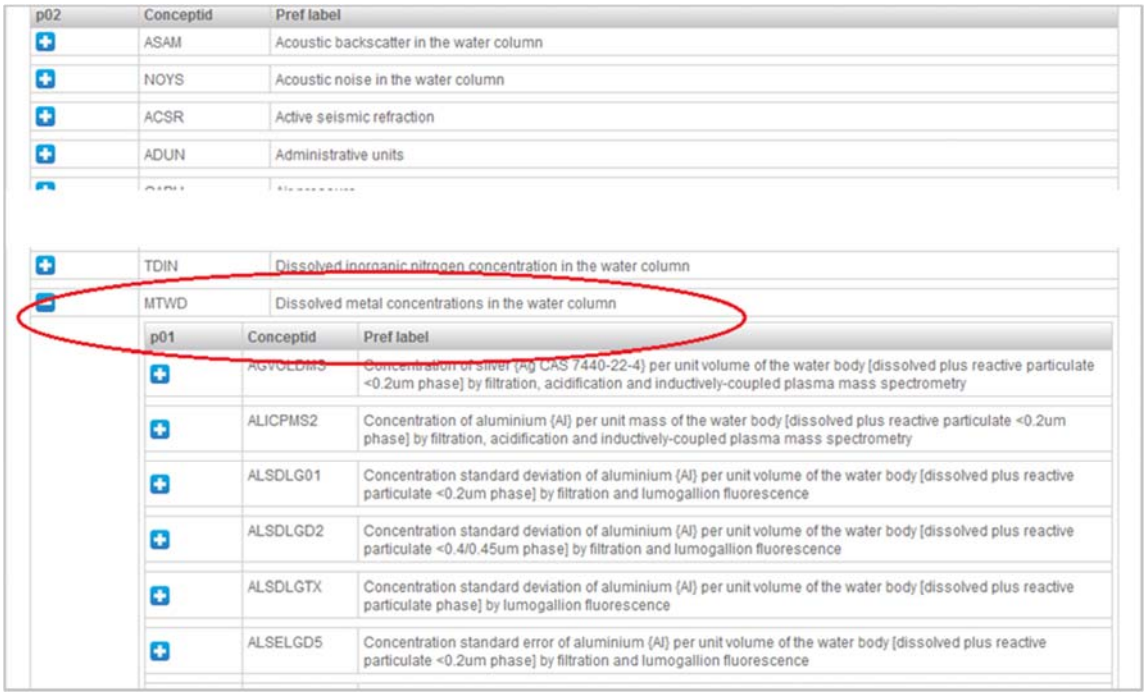
P02 (http://vocab.nerc.ac.uk/collection/P02/current/) is a generic term for groups of parameters. This list is essentially used for “data discovery”. The entries in P02 are much too coarse grained for the MSFD data reporting purposes. For example the P02 term ‘MTWD’ for ‘Dissolved metal concentrations in the water column’ comprises all metal parameters like cadmium, lead, mercury, zinc etc. Therefore P02 is not suitable for describing the actual parameters involved in the monitoring data. However P02 can be used to search for finer grained (narrower) P01 parameters. The SeaDataNet website for the BODC vocabularies (http://seadatanet.maris2.nl/v_bodc_vocab_v2/welcome.asp) helps the user to understand the relationship between P02 and P01. The “View” version on the SeaDataNet website offers a user friendly insight:



BODC webservices V2 (Libraries) CL12

Library	Thesaurus	Title	Alt Title	Version	Members	Modified
C16		SeaDataNet sea areas	SDN sea areas	9	127	11/7/2012 2:00:06 AM
C17		ICES Platform Codes	ICES Platforms	464	2083	7/21/2015 3:00:02 AM
C19	View	SeaVoX salt and fresh water body gazetteer	SeaVoX water bodies	16	263	2/19/2015 2:00:03 AM
C32		International Standards Organisation countries	ISO countries	6	251	12/15/2011 2:00:06 AM
M11		MEDIN ecosystem service types	MEDIN ES types	1	9	11/15/2013 2:00:04 AM
N01		MEDIN metadata record availability	Availability	4	3	1/11/2012 7:46:54 AM
P01		BODC Parameter Usage Vocabulary	BODC PUV	545	34448	7/21/2015 3:00:02 AM
P02	View	SeaDataNet Parameter Discovery Vocabulary	SeaDataNet PDV	88	428	4/9/2015 3:00:13 AM
P03	View	SeaDataNet Agreed Parameter Groups	SeaDataNet APG	22	59	2/4/2015 2:00:02 AM
P04		Global Change Master Directory Science Keywords V5	GCMD Science Keywords V5	4	1405	4/18/2007 3:55:46 PM
P05		International Standards Organisation ISO19115 Topic Categories	ISO Topic Categories	0	19	4/28/2005 1:00:00 AM
P06		BODC data storage units	BODC units	66	304	6/23/2015 3:00:01 AM

In the view version of P02 (http://seadatanet.maris2.nl/v_bodc_vocab_v2/vocab_relations.asp?lib=P02) every term fans out into a whole list of P01 parameters when the user clicks on the "+" sign. Using the P02 term 'MTWD' as an example more than 200 P01 terms will be displayed:



P01 - BODC Parameter Usage Vocabulary

Every term in the P01 parameter (http://vocab.nerc.ac.uk/collection/P01/current/) list gives a detailed description on the parameter together with methodologies, matrix and species etc. For example a concept for lead (PB) in biota

CBIOM004 **Concentration of lead {Pb CAS 7439-92-1} per unit wet weight of biota {Limanda limanda (ITIS: 172881: WoRMS 127139) [Sex: female Size: length 200-249mm Subcomponent: liver]}**

or for chlorophyll-a (CHLA)

CHACHPXT **Concentration of chlorophyll-a {chl-a} per unit dry weight of sediment by acetone extraction and high performance liquid chromatography (HPLC)**

The description (preferred label) of P01 is set together by text modules in the following order:

- Measurement: e.g. "Concentration" in 'CBIOM004', 'CHACHPXT'
- Substance: e.g. "lead" in 'CBIOM004'
- Measurement Matrix Relationship: e.g. "per unit wet weight" in CBIOM004
- Matrix: e.g. "biota" in 'CBIOM004'
- Matrix Subcomponent: e.g. "liver" in 'CBIOM004'
- Taxon: e.g. "Limanda limanda (ITIS: 172881: WoRMS 127139)" (contained in BODC vocabulary S25) in 'CBIOM004'
- Organism Name: e.g. "Limanda limanda" (contained in BODC vocabulary S25) in 'CBIOM004'
- Organism Specifics: e.g. "Sex: female Size: length 200-249mm" (contained in BODC vocabulary S25) in 'CBIOM004'

- Technique: e.g. “inductively-coupled plasma mass spectrometry” in ‘CHACHPXT’

On the SeaDataNet P01 vocabulary website (http://seadatanet.maris2.nl/v_bodc_vocab_v2/search.asp?lib=P01) it is quite simple to find the required parameter by entering into the ‘Free search’ field specific keywords separated by ‘%’ in the given order of the text modules.

For example entering “chlorophyll-a%water%filtration%HPLC” into the free search field returns only 41 instead of 291 entries for the keyword “chlorophyll”.

P01 (BODC Parameter Usage Vocabulary)

Overview| Export subset of list | Export full list | New query | Found 41 | Show (1-25) | Previous | Next 16

ConceptID	Preferred label	Alt label	Definition	Modified
CHLALISO	Concentration of chlorophyll-a +allomer-isomer per unit volume of the water body [particulate >GF/F phase] by filtration, acetone extraction and high performance liquid chromatography (HPLC)	chl-a+allomer-isomer_water>GF/F_HPLC	The amount (mass or moles) of the specified pigment determined by HPLC assay of a sample collected by dissolution in acetone of the residue collected by GF/F filtration of a known volume of any water body. The quoted value either results from a single determination or the average of replicate determinations.	3/12/2014 13:48:55
CLAAHPP1	Concentration of chlorophyll-a allomer per unit volume of the water body [particulate >GF/F phase] by filtration, acetone extraction and high performance liquid chromatography (HPLC)	chl-a_allomer_water>GF/F_HPLC	The amount (mass or moles) of the specified pigment determined by HPLC assay of a sample collected by dissolution in acetone of the residue collected by GF/F filtration of a known volume of any water body. The quoted value either results from a single determination or the average of replicate determinations.	4/9/2015 09:51:47
CLAAHPP5	Concentration of chlorophyll-a allomer per unit volume of the water body [particulate >0.2um phase] by filtration, acetone extraction and high performance liquid chromatography (HPLC)	chl-a_allomer_water>0.2um_HPLC	HPLC assay of acetone extraction (GF/F filtered)	4/9/2015 09:51:47
CLAAMHP1	Concentration of chlorophyll-a allomer per unit volume of the water body [particulate >GF/F phase] by filtration, methanol extraction and high performance liquid chromatography (HPLC)	chl-a_allomer_water>GF/F_HPLCmeth	The amount (mass or moles) of the specified pigment determined by HPLC assay of a sample collected by dissolution in methanol of the residue collected by GF/F filtration of a known volume of any water body.	4/9/2015 09:51:47

P35 - EMODNET chemistry lot aggregated parameter names

Already in 2011 the SeaDataNet and EMODNet Chemistry community realised that the former P011 (currently P01) list would become unmanageable once the biota parameters are added. The parameters and the species plus the associated methods would lead to an explosion of the number of P011 parameters. The idea to exclude the method from the parameter description evolved gradually. Together with the NVS2.0 the aggregated list P35 came into existence.

The P35 (http://vocab.nerc.ac.uk/collection/P35/current/) terms are an aggregation of the P01 parameters without differentiation in the methodologies. For example the P35 term “The amount of the pigment chlorophyll-a contained in the particulate material of a specified volume of any body of salt or fresh water” http://vocab.nerc.ac.uk/collection/P35/current/EPC00105/ has altogether 46 narrower P01 terms.

Similar to P02 the SeaDataNet view version of P35 (http://seadatanet.maris2.nl/v_bodc_vocab_v2/vocab_relations.asp?lib=P35) fans out into a whole list of relevant P01 parameters when the user clicks on the “+” sign.

Currently 6 MSFD chemical groups - acidity, chlorophyll, dissolved gases, fertilisers, heavy metals, silicate - have mappings to 136 P35 concepts. The next target of BODC is to extend the P35 list to the biota parameters with several hundred terms. Work on P35 goes on in parallel to P01 and the aim is to have as many of the EMODNET Chemistry Lot chemical themes (P36) mapped as possible.

Usage of NERC vocabulary service

The major positive characteristics of NVS2.0 are:

- the use of the World Wide Web Consortium's (W3C) Simple Knowledge Organisation System (SKOS) specification for encoding the data dictionaries and taxonomies
- the ability to serve multilingual titles and definitions for resources, the language definition is embedded in the SKOS-flag, e.g. <skos:prefLabel xml:lang="en">
- the provision for mappings to external resources enabling the results of ontology extension to be delivered

The NVS URLs are structured as follows:

To fetch the whole controlled vocabulary (list):
http://vocab.nerc.ac.uk/collection/LIST/VERSION/

To fetch a single concept (term):
http://vocab.nerc.ac.uk/collection/LIST/VERSION/CONCEPT/

The URL for the current contents of the 3 parameter vocabularies would be:
http://vocab.nerc.ac.uk/collection/P01/current/
http://vocab.nerc.ac.uk/collection/P02/current/
http://vocab.nerc.ac.uk/collection/P35/current/

The single concept URL can be applied in the INSPIRE format for the parameter description.

Here is an example to demonstrate the various degrees of complexity for the parameter "chlorophyll" in the 3 parameter lists:

1) The URL for the current version of the P02 term for "Chlorophyll pigment concentrations in the water column" is:
http://vocab.nerc.ac.uk/collection/P02/current/CPWC/
Essentially this URL resolves to an XML document with SKOS elements where all narrower (P01 parameters with full description, P07 Climate and Forecast standard names) and broader(P03 SeaDataNet parameter groups) resources are specified.

2) The URL for the current version of the P01 term for "Concentration of chlorophyll-a {chl-a} per unit volume of the water body [particulate >unknown phase] by in-situ chlorophyll fluorometer and manufacturer's calibration applied" is:
http://vocab.nerc.ac.uk/collection/P01/current/CPHLPM01/
This URL provides a full description of the parameter including unit, methodology and relationship to other controlled vocabularies like P35:

```
<rdf:RDF>
    <skos:Concept rdf:about="http://vocab.nerc.ac.uk/collection/P01/current/CPHLPM01/">
        <skos:prefLabel xml:lang="en">Concentration of chlorophyll-a {chl-a} per unit volume
        of the water body [particulate >unknown phase] by in-situ chlorophyll fluorometer and
        manufacturer's calibration applied</skos:prefLabel>
        <skos:altLabel                                          xml:lang="en">chl-
        a_water_ISfluor_manufctrcal_sensor1</skos:altLabel>
```

```
        <skos:definition xml:lang="en">In-situ fluorometer with manufacturer calibration applied.
        </skos:definition>
        <dc:identifier>SDN:P01::CPHLPM01</dc:identifier>
        <dce:identifier>SDN:P01::CPHLPM01</dce:identifier>
        <skos:notation>SDN:P01::CPHLPM01</skos:notation>
        <owl:versionInfo>3</owl:versionInfo>
        <dc:date>2014-06-30 08:56:54.0</dc:date>
        <skos:note xml:lang="en">accepted</skos:note>
        <owl:deprecated>false</owl:deprecated>
        <owl:sameAs rdf:resource="http://vocab.nerc.ac.uk/collection/P09/current/FLU2/"/>
        <skos:broader
        rdf:resource="http://vocab.nerc.ac.uk/collection/P02/current/CPWC/"/>
        <skos:related
        rdf:resource="http://vocab.nerc.ac.uk/collection/P06/current/UMMC/"/>
        <skos:broader
        rdf:resource="http://vocab.nerc.ac.uk/collection/P35/current/EPC00105/"/>
        <void:inDataset rdf:resource="http://vocab.nerc.ac.uk/.well-known/void"/>
    </skos:Concept>
</rdf:RDF>
```


P02: CPWC = Chlorophyll pigment concentrations in the water column
P06: UMMC = Milligrams per cubic metre
P35: EPC00105 = Water body chlorophyll-a

3) The URL for the current version of the P35 term for "The amount of the pigment chlorophyll-a contained in the particlate material of a specified volume of any body of salt or fresh water" is:
http://vocab.nerc.ac.uk/collection/P35/current/EPC00105/
Similar to P02 this P35 URL resolves to an XML document with SKOS elements where all related(P06 unit), narrower(P01 parameters with full description) and broader(P36 chemical group) resources are specified

Comments on BODC and other parameter lists

An essential difference between the BODC and the ICES parameter vocabulary is that at ICES the methodologies (for analysis, pre-treatment and chemical extractions etc.) and the matrix (seawater, sediment with different grain size, biota liver or muscle etc.) are separated from the parameter terms. Thus the usage of the ICES vocabularies is more flexible.

The BODC P01 parameters include the methodologies and matrix, making it more elaborate in usage. However there is strong support from the BODC vocabulary team, with experts for various disciplines, and the vocabularies can be extended any time as required. The maintenance of the list is done by BODC and P01 is already in the INSPIRE code list registry (http://inspire.ec.europa.eu/codelist/BODC_P01ParameterUsageValue).

For the P35 list (EMODNET chemistry lot aggregated parameter names) governance is now established with experts from EMODNET partners. P35 could be a compromise between the P02 (too coarse) and P01 (too complex) terms for the INSPIRE chemical parameters.

Another advantage of the BODC vocabulary is the cross mapping of Climate and Forecast Standard names (P07) to P01 and P02, which could be useful for some users in mapping the parameters to their own local terms.