Marine Strategy Framework Directive (MSFD)

Common Implementation Strategy

Recommendations for the publication of datasets under MSFD Article 19(3)

MSFD GUIDANCE DOCUMENT 15

JUNE 2018

Further information and documentation about TG-DATA and the present document can be found in TG DATA meetings folder on CIRCABC

Disclaimer:

This document has been developed through a collaborative programme involving the European Commission, all EU Member States, the Accession Countries, and Norway, international organisations, including the Regional Sea Conventions and other stakeholders and Non-Governmental Organisations. The document should be regarded as presenting an informal consensus position on best practice agreed by all partners. However, the document does not necessarily represent the official, formal position of any of the partners. Hence, the views expressed in the document do not necessarily represent the views of the European Commission.

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List of acronyms

AM: Area Management/Restriction/Regulation Zones and Reporting Units

AU: Administrative Units

CDR: Central Data Repository (Reportnet)

CMEMS: Copernicus Marine Environment Monitoring Service

CRS: Coordinate Reference System

DG-ENV: Directorate-General for Environment (European Commission)

DOI: Digital Object Identifier

EC: European Commission

EEA: European Environment Agency

EIF : European Interoperability Framework

Eionet: European Environment Information and Observation Network

EMODnet: European Marine Observation and Data Network

ETC/ICM: European Topic Centre on Inland, Coastal and Marine waters

EU: European Union

GES: Good Environmental Status (of MSFD)

GFCM: General Fisheries Commission for the Mediterranean

GML: Geography Markup Language

HB: Habitats and Biotopes

HELCOM: Baltic Marine Environment Protection Commission (Helsinki Convention - Helsinki Commission)

ICES: International Council for the Exploration of the Sea

INSPIRE: Infrastructure for Spatial Information in Europe

IR: Implementing Rule(s) (of INSPIRE)

ISO: International Organization for Standardization

JRC: Joint Research Centre (European Commission)

MLW: Marine LitterWatch

MS: Member States

MSFD: Marine Strategy Framework Directive

MSP: Maritime Spatial Planning

NGOs: Non-governmental organisations

NIS: Non-indigenous species

OF: Oceanographic geographical features

OGC: Open Geospatial Consortium

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

QC: Quality Control

RSCs: Regional Sea Conventions

SD: Species Distribution

SDI: Spatial Data Infrastructure

SDS: Spatial Data Services

SOAP: Simple Object Access Protocol

SOER: State and Outlook of the Environment Report (of EEA)

SoES: State of Europe´s Seas (of EEA)

SOS: Sensor Observation Service

SR: Sea Regions

TG DATA: Technical Group on Marine Data (MSFD Common Implementation Strategy)

TG: Technical Guidelines

UML: Unified Modelling Language

URL: Uniform Resource Locator

WCS: Web Coverage Service

WFS: Web Feature Service

WG DIKE: Working Group on Data, Information and Knowledge Exchange (MSFD CIS)

WISE-Marine: Marine Information System for Europe

WMS: Web Map Service

WSDL: Web Services Description Language

XML: Extensible Markup Language

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Recommendations for the publication of datasets under MSFD Article 19(3)

Key messages and structure of these recommendations

This document provides a series of recommendations for the publication of datasets under the Marine Strategy Framework Directive (MSFD) Article 19(3), which relates to access by the European Commission (EC) and the European Environment Agency (EEA) to the data resulting from the monitoring programmes and environmental status assessments, and its compliance with the INSPIRE Directive (Infrastructure for Spatial Information in Europe). The recommendations have been developed in the context of the MSFD 2018 reporting exercise (update of Articles 8, 9 and 10), although they propose a timeline that goes beyond 2018. They have been developed mainly to provide guidance on the publication of spatial datasets following INSPIRE guidelines, although it is also acknowledged that there may be non-spatial datasets underlying some of the assessments.

In order to fulfill their obligations under Article 19(3) in relation to the MSFD 2018 reporting, it is **recommended** that Member States (MS) cover the following steps:

1. **Screen the national information** to be submitted under Article 8 reporting and decide which data from the updated assessments will be made publicly available. In principle, all processed datasets underlying the assessments should be published. A table of example datasets is provided in these guidelines following a proposal currently under discussion by WG DIKE (Section 3 of this document provides more details and examples).

2. **Liaise with the INSPIRE National Contact Point** to coordinate the preparation, possible transformation and publication of the MSFD datasets and related metadata. This will avoid duplication of work and will ensure compliance with the INSPIRE Directive and its corresponding Implementing Rules. Information about INSPIRE national nodes is provided in Section 4 of this document.

3. **Create metadata** of the corresponding MSFD datasets following ISO standards and relevant INSPIRE Technical Guidelines, making sure that the metadata are made available through a INSPIRE Discovery Service, and identify the metadata Uniform Resource Locators (URL) that are to be provided under the MSFD 2018 reporting exercise (schema 'Indicators', class 'Datasets'). More information about formats and tools can be found in Section 5.1 and Annex II of these Recommendations.

4. **Publish the datasets through INSPIRE download services,** that will ensure the access to those[1]. The URLs of the datasets made available through the download services should be reported under the 2018 MSFD reporting exercise (schema 'Indicators', class 'Datasets'). See Section 5.2 and Annex III for more details.

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[1] The creation of view services is also an obligation under INSPIRE, although the focus in this document is on the creation of download services, in order to ensure the direct access to the data to any type of user.

The INSPIRE Directive has objectives, technical requirements and implementation steps that go beyond the scope of the MSFD 2018 reporting and Article 19(3). This applies in particular to the obligation related to data interoperability for INSPIRE Annex III themes, whose deadline still lies ahead, in 2020. However, TG DATA proposes to start addressing these additional steps in the recommendations, in an attempt to align national strategies and work towards marine data harmonization. In this line, the following additional step is also **recommended**:

5. Assess the **INSPIRE data specifications** that could be used for modelling each dataset. The scope of most MSFD-related datasets fall under some of Annex III themes of the INSPIRE Directive, for which data harmonization is not legally required before 2020. This implies that MS can actually make available data as-is in 2018 (i.e. without following the INSPIRE Data Specifications). However, given the complexity of achieving full data interoperability across MS, a roadmap guiding this process until 2020 is proposed in Section 7. Especially for those MS that are already working on data harmonization, a first selection of the relevant INSPIRE data themes and the corresponding technical requirements are already included in Section 5.3 and in Annex IV. In any case, the INSPIRE data specifications to be used per dataset (criterion) should be agreed within TG-DATA.

Note that the publication of the datasets and their corresponding metadata could be delegated to third parties such as **international organisations**, although it is recommended to clearly document such an arrangement, as well as communicate it formally to the services of the European Commission. In any case, MS have to be aware that they remain responsible for the legality of the data and the implementation of the INSPIRE Directive. More guidance on what this means in practical terms for the international organisations is provided in Section 6.1.

The present guidelines are structured as follows. The background information about the policy context behind the Article 19(3) obligation and the role of TG DATA is provided in Section 1. Section 2 describes the intended use of the datasets to be made available, both by citizens and European and national institutions. The scope of the datasets to be published is addressed in Section 3, including a recommended list of datasets related to MSFD Article 8 assessments. Due to the relevance of the INSPIRE Directive in these recommendations, Section 4 gives an overview of this piece of legislation and its implementation (e.g. regulatory framework, INSPIRE themes, timeline). Section 5 provides details on the recommended steps that MS shall follow in order to publish metadata and datasets in accordance to INSPIRE, and Section 6 is focused on the role that international organizations may play as information nodes for marine data in relation to the fulfillment of the Article 19(3) obligation by MS. Finally, Section 7 proposes a roadmap to continue publishing and harmonizing marine datasets in the coming years.

These guidelines also propose some resources for implementers, examples and best practices. Section 4.3 provides some useful references of INSPIRE repositories, platforms and tools, and some INSPIRE best practices are listed in Annex I. Finally, three examples have been included in Annex V, in order to guide the exercise of preparing the datasets according to a set of INSPIRE data specifications.

1   Introduction

1.1   Marine Strategy Framework Directive reporting

A number of obligations are laid down in the Marine Strategy Framework Directive (MSFD) according to which Member States (MS) have to notify the European Commission (EC) on the implementation of strategies for protecting their marine waters. The content of such strategies is split across a number of articles, which are the basis for the reporting obligations, namely Article 8 (Assessment of the environmental status of MS marine waters), Article 9 (Determination of good environmental status), Article 10 (Establishment of environmental targets), Article 11 (Monitoring programmes) and Article 13 (Programmes of measures[2]). The calendar for the preparation of the Marine Strategies is set in Article 5, where Articles 8, 9 and 10 had to be completed by 15 July 2012, Article 11 by 15 July 2014 and Article 13 by December 2015. For each of these, MS have three months to notify the EC of their reports. On the other hand, Article 17 states that the updating of those articles has to be done every six years after their initial establishment.

Therefore, Articles 8, 9 and 10 have to be updated and reported to the EC by the 15 October 2018 at the latest. In that respect, the EC and the European Environment Agency (EEA) have prepared a Reporting Guidance for this obligation, discussed within the Working Group on Data, Information and Knowledge Exchange (WG DIKE)[3].

The MSFD 2018 reporting will consist of the filling and submission of XML documents according to five schemas. Among these, the schema 'Indicators' requests the URL of the underlying datasets[4] and corresponding metadata, thus making the link to the obligation laid down in Article 19(3)(see Section 1.2).

During the reporting, the validation of the XMLs will include that the URLs provided are syntactically valid and working. Therefore, the preparation and publication of the datasets needs to happen before the Member States carry out the reporting exercise.

All the reporting schemas, as well as the Reporting guidance and other documentation, are available in the MSFD reporting resources website[5].

1.2   Article 19(3) obligation and link to the INSPIRE Directive (2007/2/EC)

Article 19(3) of the MSFD states the following:

In accordance with Directive 2007/2/EC, Member States shall provide the Commission […] with access and use rights in respect of data and information resulting from the initial assessments made pursuant to Article 8 and from the monitoring programmes established pursuant to Article 11.

No later than six months after […] such information and data shall also be made available to the European Environment Agency, for the performance of its tasks.

Therefore, MS are expected to make available the datasets resulting from Article 8 assessments and from Article 11 monitoring programmes in accordance with the INSPIRE Directive.

What does it mean to make available the datasets in accordance with the INSPIRE Directive? Which datasets have to be published? And what needs to be provided through the URLs requested by the

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[2] Together with any Article 14 exceptions

[3] Reporting on the 2018 update of articles 8, 9 & 10 for the MSFD version 5.1 (document MSCG_22-2018-03)

[4] Digital Object Identifiers (DOI) are also allowed

[5] http://cdr.eionet.europa.eu/help/msfd

schema 'Indicators' within the 2018 reporting exercise? These are the main questions that the present document aims to answer.

1.3   Role of TG DATA

The Technical Group on Marine Data (TG DATA) was created in 2012 to examine the issues of access to and standards for data[6]. This group discussed already in 2013 a draft strategy for implementation of MSFD Article 19(3)[7].

New Terms of Reference for this group were approved in the MSFD Common Implementation Strategy work plan for 2016-2019[8], where it is stated that the work of TG DATA should lead, among other issues, to *recommendations on accessing data and information according to MSFD Article 19(3), in the context of WISE-Marine and associated to INSPIRE, EMODnet, and other relevant processes and projects*.

The present document responds to this mandate. In particular, Section 2.2.2 describes how the data made accessible according to Article 19(3) will be discoverable and displayed in WISE-Marine. Section 4 of these recommendations introduces the link to INSPIRE and its Implementing Rules, and Section 6 gives an overview of the organisations that are currently publishing datasets, where EMODnet is included, among others.

2   Expected use of the data

2.1   Citizens

When the metadata are shared through national INSPIRE discovery services, they also become available through the INSPIRE infrastructure (geoportal), therefore accessible to a high number of users. Moreover, when the data are shared through view and download services, they can be more easily reused in value-added applications that can be of benefit to citizens.

On the other hand, the datasets and corresponding metadata URLs submitted by the Member States under the MSFD 2018 reporting will also be accessible through WISE-Marine[9].

WISE-Marine is a web-based infrastructure for sharing information with the marine community on the marine environment at EU level. WISE-Marine is being developed in a partnership among the EC (DG-ENV, JRC and Eurostat) and EEA (and its ETC/ICM), the group also behind WISE. One of its main objectives is to disseminate the information provided by MS to the EC through the MSFD reporting obligations. Therefore, it will have search engines that will help the users explore and access the reporting information. Similarly, a spatial metadata catalogue will be implemented in 2019, so that users can explore and access the datasets made available by MS according to Article 19(3). The metadata that will be discoverable through the catalogue will be those which URLs are to be reported in 2018 (see Section 1.1).

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[6]https://circabc.europa.eu/sd/a/2b2de96c-c169-4b15-9cdb-24c2d26d5651/Terms%20of%20Reference%20for%20WG%20DIKE%20technical%20group.doc

[7]https://circabc.europa.eu/sd/a/30d99880-e89a-4b8d-8a22-e54e5b47e20a/DIKE%20TSG1-2013-02_Art%2019_3strategy.docx

[8]https://circabc.europa.eu/sd/a/71bc6405-68c1-4b7a-809f-cebc2aa1a69b/CIS%20WP%252c%20amended%20and%20adopted%20in%20MSCG%20on%2028%20April%202017%20%20.docx

[9]http://water.europa.eu/marine

2.2 European institutions

2.2.1 European Commission

The Commission is required to monitor the implementation of the MSFD by MS and provide reports on progress with implementation. Through its Article 12 assessments, the EC assesses whether the elements reported constitute an appropriate framework to meet the requirements of the Directive, and provide guidance to MS on any modifications considered necessary. Because of the direct links between Article 19(3) and Articles 8 and 11, the implementation of Article 19(3) could be considered under these assessments. A first review of the implementation of Article 19(3) was made after the 2012 reporting (DIKE-8_2013_08rev1).

Also, the EC shall publish a first implementation report of the MSFD by 2019 at the latest. Among other aspects, the report needs to cover:

- A review of progress in the MSFD implementation. One of the implementation steps is to provide the URLs of the datasets and associated metadata underlying the criteria elements under the 2018 reporting. Therefore, the EC could assess the accomplishment of Article 19(3) by checking that the URLs provided point to existing datasets, and that those are downloadable. An analysis of the void reasons reported by the countries can also be performed in the cases where URLs have not been submitted.
- A review of the status of the marine environment. Among other sources of information, the datasets made available by MS may be used for the assessment of the status of the marine environment, in the cases where a European picture can be drawn based on them.

Other Commission services different that DG ENV, such as DG MARE, may benefit as well of the publication of the datasets used in MSFD assessments.

2.2.2 European Environment Agency

EEA's mandate is to provide timely, targeted, relevant and reliable information to policymakers and the public, in order to achieve significant and measurable improvement in Europe's environment.

The marine assessments aim to inform a diverse range of marine-related policy processes such as the MSFD, the Biodiversity Strategy and the State of the Environment Report (SOER).

A State of Europe´s Seas (SoES) Report[10] was published in 2015, being the first integrated assessment of the marine environment produced by the EEA. This was based on the data reported by MS under the MSFD 2012 reporting, as well as other sources.

EEA is planning to publish a second State of Europe´s Seas in 2022, which will review the state and trends of the marine environment, based on the following information:

- MSFD: 2018 reporting and datasets made available according to Article 19(3)
- Habitats and Birds Directives: reporting due in 2019
- Regional Sea Convention assessments: OSPAR Intermediate Assessment 2017, HELCOM State of the Baltic Sea 2018 (Second Holistic Assessment), UNEP/MAP Mediterranean Quality Status Report 2017, and Black Sea Report 2018
- SOER conclusions: to be published in 2020
- MSP Directive: plans to be published in 2021

The datasets published by MS according to Article 19(3) will be used by EEA for the development of European datasets whenever a theme is significantly well covered at the European level and the different layers are comparable and can be harmonised. These will be registered in the EEA's Spatial Data Infrastructure (SDI) (EEA spatial metadata catalogue)[11], used to create web map services that

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[10]https://www.eea.europa.eu/publications/state-of-europes-seas

[11]http://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search;jsessionid=891D045947CDF0E29F6F9F3321004FBF#/home

will be available in Discomap[12] (EEA's web map services server) and included in the WISE-Marine map viewers or in the data download section.

2.3 Member State Authorities

Member States may also benefit of the exercise related to MSFD Article 19(3) implementation, regarding the implementation at the national level of other European regulations such as the INSPIRE Directive, the Maritime Spatial Planning Directive[13], and the Nature Directives (Habitats Directive and Birds Directive[14]). Besides, it may be useful as well to facilitate other national processes related to the management and protection of the marine environment and to marine spatial planning on the national level.

3 Scope - which datasets have to be published?

The present section elaborates on the first step recommended to Member States in order to comply with Article 19(3), which consists on screening and identifying the datasets that shall be published and consequently reported under MSFD 2018 reporting exercise.

All datasets used in the assessments (processed data), as well as resulting from the monitoring programmes (detailed data) shall be made available. The detailed data are considered those datasets coming from the monitoring programmes after passing the corresponding quality check processes (QC), while the processed data are those datasets underlying the indicators assessments that are generated using one or more detailed datasets. Given the variety of parameters and datasets potentially used by each Member State under each criterion, it is out of the scope of this document to list or classify all datasets to be published. Table 1 provides some examples for guidance.

DG ENV has developed a proposal to address possible ways to use the 2018 reporting to deliver enough information to gain an overview of the pressures, impacts and state of the marine environment per region or sub-region focusing on specified outputs. This proposal is being discussed within WG DIKE, and is currently reflected in the document *Focused outputs from 2018 reporting* (DIKE_17-2018-06)[15]. This document can be used as an inspiration to select, as a priority, the criteria and underlying datasets that should be published according to Article 19(3). Nevertheless, the proposal has not yet been agreed and it may be updated, hence, it will run in parallel to these recommendations.

Table 1 has been prepared based on the above-mentioned document, including only the primary criteria that can be covered by one or more than one INSPIRE themes. A number of datasets are listed, together with their possible spatial representation type (i.e. point, polyline, polygon or grid), the elements to be covered by each type of dataset, the corresponding INSPIRE theme(s) and which organisations, other than MS, are currently publishing those.

Some of the datasets listed in Table 1 are expected to be derived from other datasets (e.g. pressures layers are often used to create layers on physical disturbance or physical loss of the seabed).

In the case of publication of datasets in a gridded format, the use of EEA reference grids[16] or any other compatible grid are preferred. Grids may be represented as vectors (polygons) or

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[12] http://discomap.eea.europa.eu/index.aspx

[13] Directive 2014/89/EU

[14] Directive 92/43/EEC and Directive 2009/147/EC

[15] https://circabc.europa.eu/sd/a/917316af-b766-425a-ad04-fda4e9b781d3/DIKE_17-2018-07_MSFD2018Reporting_outputs_v2.doc

[16] https://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2

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raster/coverage. EEA grids are regular vector grids (available as *shapefiles* of 1, 10 and 100 km resolution), compliant with INSPIRE as they use the CRS ETRS89 (see Annex VI). However, most marine data are collected using CRS WGS84 and, although transformation is possible, it can introduce errors[17].

On the other hand, there are datasets underlying some of the criteria that cannot be defined at the spatial level, and therefore have not been included in Table 1. This is the case of criterion D2C1, criteria under D3, criterion D9C1 or criteria under D1 (except D1C4). Furthermore, some of the datasets listed in Table 1 are unlikely to be represented at the spatial level (see footnote in table). In those cases, the URLs or DOIs to be provided should direct to the datasets, expected in non-spatial formats (that could vary from different data services to FTP[18] solutions). It is to be mentioned that the present recommendations do not include any particular data modelling for non-spatial datasets.

When the datasets used within the assessments come from sources different to the institutions in charge of performing the assessments (e.g. satellite imagery), the publication of the datasets should depend on the applicable data policies from the original institutions. However, this is expected mainly for raw data, while most of the processed data underlying Article 8 assessments (both GES and ESA) would be expected to be published by the MS.

3.1 Future work: the selection of INSPIRE themes

The choice of the INSPIRE theme to be used in each case should take into consideration things such as i) the value for the data providers, ii) the possibility to simultaneously meet more than one obligation (e.g. national and European), or iii) the preference of users as regards the representation type. In any case, the choice of theme should lead to the best representation of the phenomenon for the intended use, while ensuring data interoperability across countries. A first proposal of INSPIRE theme allocation is provided in Table 1, that needs to be further developed and agreed upon in order to ensure a common approach across countries.

The INSPIRE themes that are covered by these datasets are the following: Sea Regions (SR), Oceanographical geographical Features (OF), Species Distribution (SD) and Habitats and Biotopes (HB). In some cases the Environmental Facilities (EF) theme has been included for datasets where the description of the monitoring network is relevant (e.g. monitoring programmes with a stable set of monitoring stations).

The SR theme includes areas of the sea primarily defined by their physical and chemical characteristics (meaning geometries defined by common physical or chemical characteristics, which can be common levels of parameters such as salinity or temperature, but it may also be, for example, seabed loss). In contrast, the OF theme generally specifies observations of oceanographic phenomena (e.g. point locations, aggregated in grids, along trajectories, etc.). Therefore, both themes have been included for some of the datasets.

In any case, the decision of which INSPIRE theme to use shall be taken considering how the data will be used and the spatial object types that have to be represented. Nevertheless, as described in Section 5.3, the harmonisation exercise is due by 2020 for the MSFD-related datasets[19] according to the INSPIRE calendar, reason why a roadmap to discuss, agree and implement the INSPIRE themes is provided in Section 7.

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[17] https://themes.jrc.ec.europa.eu/discussion/view/159833/using-eea-reporting-grids

[18] File Transfer Protocol

[19] As they typically fall under themes belonging to the Annex III of INSPIRE Directive

Table 1 Examples of datasets to be published in relation to Art.8 assessments and reporting.

Criterion	Datasets underlying the indicator assessments	Criteria elements	Possible spatial representation type (EEA recommended)	INSPIRE theme**	Publication by other organisations***
D5C1*	Nutrients concentrations in water *1..4 nutrients::type* *1..1 concentration::real* A range of nutrients with a single value of concentration.	DIN, TN, DIP, TP	Point OR Grid	OF or EF	RSCs - ICES / EEA / EMODnet / CMEMS
D5C2*	Chlorophyll a concentration *1..1 concentration::real* A single value of concentration.	Chlorophyll a	Point OR Grid	OF or EF	RSCs - ICES / EEA / EMODnet / CMEMS
D5C5*	Concentration of dissolved oxygen *1..1 concentration::real* A single value of concentration.	Dissolved oxygen	Point OR Grid	OF or EF	RSCs - ICES / EEA / EMODnet / CMEMS
D6C1^	Spatial extent of loss of seabed *1..1 habitatLoss::real* A single value of habitat loss.		Grid or Polygon	SR or OF	
D6C2^	Spatial extent of physical disturbances to seabed *1..1 PhysicalDistrurbance::Boolean* A yes/no of the existence of physical disturbance.		Grid or Polygon	SR or OF	OSPAR, HELCOM[+], EU
D6C3^	Distribution of habitat adversely altered by physical disturbance *1..1 value::Boolean* A yes/no of the existence of adversely altered habitat.	Habitats assessed	Grid or Polygon	HB	OSPAR, HELCOM[+], EU
D8C1*	Contaminants concentrations in water, sediment or biota *1..n contaminants::type* *1..3 medium::type [water, sediment, biota]* *1..1 concentration::real* A single value, typified by both contaminant and matrix.	Contaminants assessed	Point OR Grid	OF or EF	RSCs - ICES / EEA / EMODnet / CMEMS
D8C3	Spatial extent of pollution events *1..n PollutionEvent::type* *1..1 EventOccurance::Integer* The maximum spatial extent of a pollution event, typified by type of pollution.		Polygon OR Grid	SR or OF	RSCs[++] / EMODnet
D10C1[!]	Macro-litter in coastline, water column and seabed *1..n litter::type*	Litter categories (as listed in COM	Point OR Polyline	SR or OF	RSCs[+++] / EMODnet / ICES / CMEMS

Criterion	Datasets underlying the indicator assessments	Criteria elements	Possible spatial representation type (**EEA recommended**)	INSPIRE theme**	Publication by other organisations***
	1..3 medium::type [coastline, waterColumn and seabed] *1..1 litterAmount::real* Macro-litter by number of items, typified by matrix and type.	Decision (EU) 2017/848)			
D10C2[!^^]	Micro-litter in coastline, water column and seabed *1..n litter::type* *1..3 medium::type [coastline, waterColumn and seabed]* *1..1 litterAmount::real* Micro-litter by number of items, typified by matrix and type.	Litter categories (as listed in COM Decision (EU) 2017/848)	Point OR Grid	OF or EF	RSCs[+++] / EMODnet/ ICES / CMEMS
D11C1	Distribution of impulsive noise events per year *1..1 noiseEvent::Integer [noise event to be defined]* Number of events occurring.		Grid or Polygon	SR or OF	RSCs[+++] - ICES
D11C2	Distribution of continuous low-frequency sound level *1..1 ContinuousNoise::boolean* Presence or absence of continuous LFSL.		Grid or Polygon	SR or OF	RSCs[+++] / CMEMS
D1C1[!]	By-catch distribution *1..n species::type* *1..1 by-catch::distribution* For each grid cell or polygon there's a by-catch distribution associated to a species distribution.	Species assessed	Grid or Polygon	SD	RSCs (HELCOM) [+++] / CMEMS
D1C4	Species distribution *1..n species::type* *1..1 SpeciesNumber::real* Each grid cell contains the number of individuals of a particular species.	Species assessed	Grid or Polygon	SD	RSCs[++++] / EMODnet / CMEMS
D1C6	Habitat distribution *1..n habitat::type* *1..1 habitatCoverage::real* Each grid cell or polygon contains the habitat coverage (km2), typified by habitat type.	Habitats assessed	Grid or Polygon	HB	RSCs[+++] / EMODnet / CMEMS
D6C4^	Distribution of habitat loss *1..n habitat::type* *1..1 habitatLoss::real [reference to habitat baseline]* Each grid cell or polygon contains the habitat loss (km2), typified	Habitats assessed	Grid or Polygon	HB	

Criterion	Datasets underlying the indicator assessments	Criteria elements	Possible spatial representation type (EEA recommended)	INSPIRE theme**	Publication by other organisations***
	by habitat type.				
D6C5^	Distribution of habitat adversely altered *1..n habitat::type* *1..1 habitatAltered::real [reference to habitat baseline]* Each grid cell or polygon contains the habitat altered (km2), typified by habitat type.	Habitats assessed	Grid or Polygon	HB	
D3C1-C2-C3[!]	Population distribution of commercially-exploited fish and shellfish *1..n population::type* *1..1 population::distribution* A population distribution for a given fish species.	Stocks assessed	Grid	SD	Fisheries organisations (ICES, GFCM…)

*No need of publishing datasets of coastal/territorial waters if MS use WFD reporting assessments

**Agreement on the theme to be used would be needed in order to have coherent approaches across the EU

*** RSCs refers mainly to OSPAR and HELCOM at present, but other RSCs, notably the Barcelona Convention and the Bucharest Convention, may contribute now or in the future

[!] The spatial definition of the data may be difficult; therefore, non-spatial data would be expected. It could be e.g. table of species and number of individuals unintentionally captured (e.g. per fishing event, per area) in the case of D1C1

[+] Pressure layer produced in HELCOM State of the Baltic Sea report (HOLAS2). Spatial representation type: Raster grid (1x1 km). The dataset is not related to a core indicator with thresholds.

[++] In HELCOM the aerial surveillance data is reported as points. Extent is not defined by a polygon. Volume is estimated. Core indicator with thresholds exists.

[+++] In HELCOM, data exists but there is no core indicator with thresholds.

[++++] In HELCOM, species distribution indicators exist, based on pointwise/aggregated data and assessed on assessment unit level.

^Assessment under development in many countries, therefore there may not be publishable datasets ready by the reporting date.

^^In most countries, there are not many data collections yet.

4   INSPIRE Directive implementation and calendar

As indicated at the beginning of these guidelines, this document provides a series of recommendations for the publication of datasets under MSFD Article 19(3), which specifically refers to the obligation for the MS to provide these datasets in accordance with the INSPIRE Directive. In this section, some basic definitions related to this Directive and its corresponding obligations are provided, in order to create a basic understanding on what MS are recommended to do in order to comply with Article 19(3).

INSPIRE is the acronym of the European Directive 2007/2/EC establishing an Infrastructure for Spatial Information in the European Union. This infrastructure is intended for the purposes of EU environmental policies and policies or activities that may have an impact on the environment, and it will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.

INSPIRE should be based on the spatial data infrastructures (SDIs) established and operated by the Member States of the European Union. It addresses 34 spatial data themes needed for environmental applications.

INSPIRE is based on a number of common principles:

- Data should be collected **only once** and kept where it can be maintained **most effectively.**
- It should be possible to seamlessly **combine** spatial information from different sources across Europe and **share** it with many users and applications.
- It should be possible for information collected at one level/scale to be **shared with all levels/scales**; detailed for thorough investigations, general for strategic purposes.
- Geographic information needed for good governance at all levels should be r**eadily and transparently** available.
- **Easy to find** what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.

4.1   Quick overview of the INSPIRE policy context

The core of INSPIRE is the obligation for public authorities to share with other public administrations the spatial data related to environmental policies, or policies or activities that have an impact on the environment. INSPIRE facilitates data sharing by removing barriers to interoperability in the domain of environmental geospatial information.

The topic of interoperability is increasing in importance - and not only for geospatial information. For years, the EC has been working on the European Interoperability Strategy (EIS) and the European Interoperability Framework (EIF). The Commission Communication with reference COM (2015) 192 and entitled "A Digital Single Market (DSM) Strategy for Europe" and the related DSM roadmap suggest that the EIF is to increase in importance, and the EC is expected to put forward a proposal to make the EIF mandatory. Furthermore, the Government Action Plan[20] specifically mentions INSPIRE as a way to facilitate digital interaction between administrations and citizen/business for high quality public services.

The EIF defines interoperability in the context of European public service delivery as "the ability of disparate and diverse organisations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organisations, through the

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[20] COM(2016) 179

business processes they support, by means of the exchange of data between their respective ICT systems."[21]

The four levels of interoperability defined in the EIF are used to help understanding how existing ICT systems used by public organisations to manage spatial data can be aligned with INSPIRE: the legal, organisational, semantic and technical levels.

The information needed to support the complex EU environmental legislation landscape is very diverse, cutting across policy domains, economic sectors and environmental media and themes. INSPIRE plays an important role in the environmental policy cycle, facilitating the access and use of the various spatial data sources relevant for integrated policy decision making at all levels of government, while supporting the flow of information between different public administration levels.

The INSPIRE data scope, covering 34 spatial data themes as described in the Annexes I, II and III of the Directive, is therefore cross-cutting the information and data requirements of the EU environmental *acquis*. The data themes typically cover datasets relevant to many environmental policy areas while, on the other hand, one thematic policy may be served by several INSPIRE data themes. Hence, the identification of which spatial data are necessary for "which measure" is a crucial step when linking INSPIRE to environmental policies, such as in the case of the MSFD.

Following the evaluation of this Directive carried out under the Regulatory Fitness and Performance Programme (REFIT)[22], the use of INSPIRE for environmental monitoring and reporting has been selected as a priority use case. The potential of INSPIRE to enhance and streamline the reporting processes and improve efficiency has also been reflected in the Fitness Check on Environmental Monitoring and Reporting[23] carried out in 2016. The Action Plan[24] resulting from this exercise, published in June 2017, includes a specific action where INSPIRE is on focus. This action, aligned accordingly with the INSPIRE Maintenance and Implementation Work Programme (MIWP), aims at promoting full implementation of the Directive giving priority to datasets most relevant for the implementation and reporting of EU environmental legislation. A rolling list of priority datasets[25] for reporting has already been published, where Marine Reporting Units (marine regions and sub-regions including assessments units) are included.

4.2   What do we have to do to implement INSPIRE?

To ensure that the SDIs of the MS are compatible and usable in a Community and transboundary context, the INSPIRE Directive required that common Implementing Rules (IR) were adopted and implemented in the areas listed in Table 2. These IR were adopted as Commission Decisions or Regulations and are binding in their entirety. The IR are complemented with Technical Guidelines (TG), which contain detailed instructions and recommendations for implementers[26].

The IR specify what needs to be implemented at an abstract level (although including as well detail detailed technical requirements), while the non-binding TG specify how legal obligations could be implemented, making reference to existing standards such as those from ISO and OGC.

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[21] http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf

[22] See COM(2016)478 and SWD(2016)273

[23] See SWD(2016)188

[24] See SWD(2017) 230

[25] https://ies-svn.jrc.ec.europa.eu/projects/2016-5/wiki/PriorityList

[26] https://inspire.ec.europa.eu/inspire-implementing-rules/51763

Table 2 Areas covered by INSPIRE Implementing Rules

AREA	DESCRIPTION
Metadata[27]	Member States shall ensure that metadata are created for the spatial data sets and services, and that those metadata are kept up to date
Data and Services Interoperability[28]	The INSPIRE Implementing Rules on interoperability of spatial data sets and services (IRs) and Technical Guidelines (Data Specifications) specify common data models, code lists, map layers and additional metadata on the interoperability to be used when exchanging spatial datasets.
Network Services[29]	INSPIRE Network Services specify common interfaces for web services (discovery services, view services, download services, transformation services, services allowing spatial data services to be invoked).
Data and Service Sharing[30]	Access to spatial data and services constitutes an important basis for environmental policies for all public authorities and is therefore a central aspect of the Infrastructure for spatial information in the European Community.
Spatial Data Services[31]	This Regulation sets out the requirements for technical arrangements for the interoperability and, where practicable, harmonisation of spatial data sets and spatial data services corresponding to the INSPIRE Directive themes listed in Annexes I, II and III. Interoperability of spatial data services is characterised by the capability to communicate, execute or transfer data among them.
Monitoring and Reporting[32]	EU Member States have to report annually a number of indicators for monitoring the implementation and use of their infrastructures for spatial information.

These guidelines will focus on provide recommendations on how to publish datasets and their corresponding metadata through standard web services, hence the more relevant IR and associated TG are those related to **metadata**, **network services** and **data and services interoperability.** More details on how to address them in the context of MSFD Article 19(3) are provided in Section 5 and Annexes II, III and IV of these guidelines.

4.2.1   Which data have to follow INSPIRE specifications?

One of the major goals of INSPIRE is to create harmonised spatial data sets that can be used seamlessly in cross-border applications. In order to reach the goal it is necessary to agree on common definitions for the 34 spatial data themes[33] covered by INSPIRE needed for environmental

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[27] See Metadata IR and TG on https://inspire.ec.europa.eu/metadata/6541

[28] See IR and Data Specifications on https://inspire.ec.europa.eu/data-specifications/2892

[29] See Network Services IR and TG on https://inspire.ec.europa.eu/network-services/41

[30] See guidelines and best practices on https://inspire.ec.europa.eu/data-and-service-sharing/62

[31] See IR and TG on https://inspire.ec.europa.eu/spatial-data-services/580

[32] See Decision, templates and guidelines on https://inspire.ec.europa.eu/monitoring-and-reporting/69

[33] http://inspire.ec.europa.eu/data-specifications/2892

applications. These 34 spatial data themes are classified and defined in the Annexes I, II and III of the Directive.

A list of INSPIRE data themes that are considered to be most relevant for the marine environment is provided below. The ones shown in bold are those referred to in Table 1. It is to be noted that the data themes are not developed in isolation, i.e. there is an association between themes. For example, an Administrative Unit (AU) may define the spatial scope for a species distribution (SD) dataset:

- a. Annex I:
  1. Geographical grid systems
  2. Administrative units
  3. Hydrography
  4. Protected sites
  5. Transport networks
- b. Annex II:
  1. Elevation (Bathymetry)
  2. Geology (includes seabed sediments and coastal geomorphology)
- c. Annex III:
  1. Environmental monitoring facilities
  2. Aquaculture facilities
  3. Area management /restriction /regulation zones (includes CZM)
  4. Natural risk zones
  5. **Oceanographic geographical features**
  6. **Sea regions**
  7. **Habitats and biotopes**
  8. **Species distribution**
  9. Energy resources
  10. Mineral resources

In accordance with what is provided for in the INSPIRE Directive, the IR on interoperability of spatial data sets and services and the corresponding Data Specifications for each of the 34 themes specify the common data models, code lists, map layers, additional metadata on the interoperability, as well as the association between the different themes.

4.2.2 Which are the deadlines?
The INSPIRE roadmap[34] sets out the deadlines for INSPIRE implementation. Figure 1 gives an overview of the roadmap to achieve full interoperability by 2021.

By the time of releasing these guidelines (April 2018), and for all themes covered by Annex I, II and III, MS are expected to have already made available metadata for spatial datasets and services. Spatial datasets covered by the three annexes should also be available for discovery, view, download and transformation from the INSPIRE geoportal, which implies that the corresponding network services should be already in place. Regardless the theme they fall under, all newly collected and extensively restructured spatial datasets, as well as existing datasets from Annex I themes, should already be conformant to the IR on Spatial Data and Services Interoperability, while those existing datasets covered by Annex II and III (the latter being the case for most of the marine datasets) may just be made available "as is". By November 2017, however, *all* datasets from Annex I themes should have been made conformant to the IR on Spatial Data and Services Interoperability, being October 2020 the deadline for those existing datasets falling under the scope of Annex II and III.

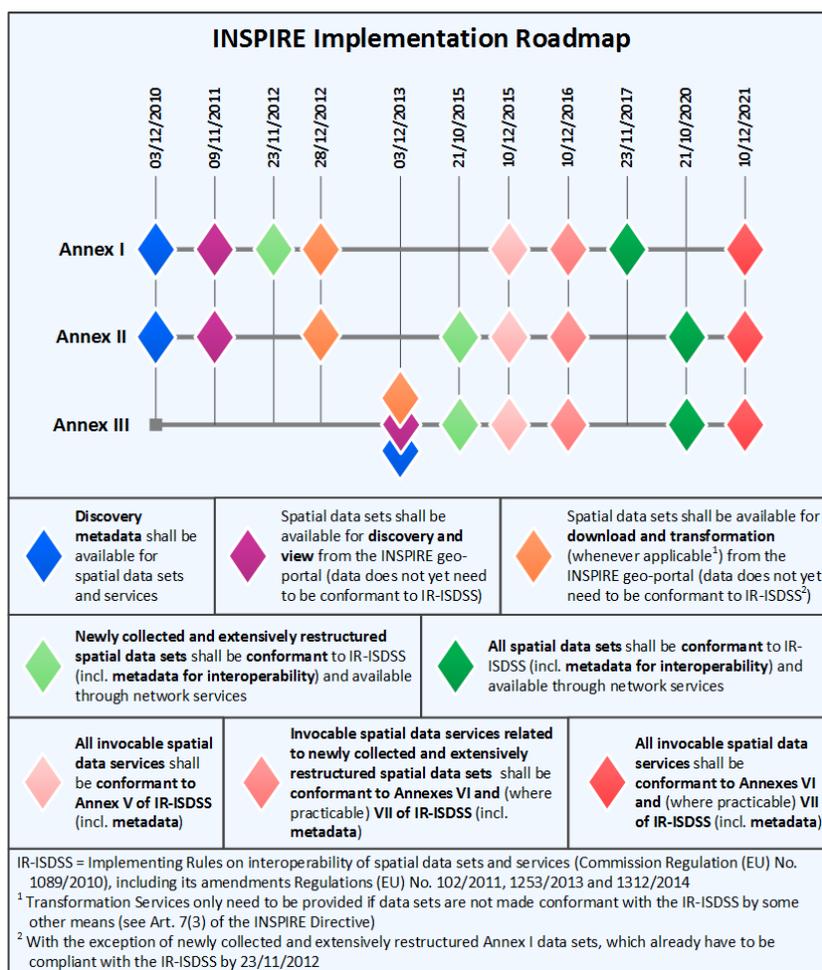[34] https://inspire.ec.europa.eu/timeline

Figure 1 INSPIRE Implementation Roadmap

Table 3 shows the requirements needed to be accomplished per year. Detailed information on the roadmap (articles and links) can be found in the INSPIRE Roadmap section[35].

Table 3 INSPIRE requirements per year

YEAR	REQUIREMENT
2010	Implementation of provisions for Monitoring and Reporting.
	Metadata available for spatial data sets and services corresponding to Annex I and II.
2011	The EC establishes and runs a geo-portal at Community level.
	Implementation of Regulation as regards the access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions for new arrangements.
	Discovery and view services operational.
2012	Implementation of Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services for Newly collected and extensively restructured Annex I spatial data sets.
	Download services operational.

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[35] https://inspire.ec.europa.eu/inspire-roadmap/61

YEAR	REQUIREMENT
	Spatial data sets shall be available for download and transformation (whenever applicable) from the INSPIE Geo-portal (data does not yet need to be conformant with the COMMISSION REGULATION (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services).
2013	Implementation of Commission Regulation (EU) No 102/2011 of 4 February 2011 amending Regulation (EU) No 1089/2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services for newly collected and extensively restructured Annex I spatial data sets.
	Implementation of Regulation as regards the access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions for existing arrangements.
	Metadata available for spatial data sets and services corresponding to Annex III.
2015	Newly collected and extensively restructured Annex II and III spatial data sets available.
	All invocable spatial data services shall be conformant to Annex V of Commission Regulation (EU) No 1089/2010 as amended by Regulation (EU) No 1312/2014 of 10 December 2014 (...) as regards interoperability of spatial data services.
2016	Invocable spatial data services related to newly collected and extensively restructured spatial data sets shall be conformant with Annex VI and, where practicable, Annex VII of Commission Regulation (EU) No 1089/2010 as amended by Regulation (EU) No 1312/2014 of 10 December 2014 as regards interoperability of spatial data services.
2017	Implementation of Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services for other Annex I spatial data sets still in use at the date of adoption.
2018	Implementation of Commission Regulation (EU) No 102/2011 of 4 February 2011 amending Regulation (EU) No 1089/2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services for other Annex I spatial data sets still in use at the date of adoption.
2020	Other Annex II and III spatial data sets available in accordance with IRs for Annex II and III.
2021	All invocable spatial data services shall be conformant with Annexes VI and (where practicable) VII of Commission Regulation (EU) No 1089/2010 as amended by Regulation (EU) No 1312/2014 of 10 December 2014 (...) as regards interoperability of spatial data services.

4.3 Resources for INSPIRE implementers

The European Commission's INSPIRE website[36] is the official knowledge base and should be seen as the starting point for any information on the implementation and use of INSPIRE.

Details of the Directive and the policy background leading to its adoption can be found in the background section[37]. There are also links to the Implementing Rules (IR) and Technical Guidelines (TG), as well as to other relevant documents.

The INSPIRE toolkit[38] section provides a repository of tools and resources developed by the INSPIRE team in order to facilitate the actual implementation by the MS. Among these tools, "Find your

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[36] http://inspire.ec.europa.eu

[37] http://inspire.ec.europa.eu/about-inspire/563

[38] http://inspire.ec.europa.eu/inspire-tools

scope" is especially useful as it supports data providers with the identification of INSPIRE spatial data themes and object types that are relevant to the datasets they manage, as well as facilitates the identification of missing information required by INSPIRE and potential extensions to cover the full dataset scope.

INSPIRE in Practice[39] is a collaborative platform that brings together different players involved in INSPIRE in a single place, facilitating the exchange of geospatial know-how and expertise that they have accumulated over time while dealing with INSPIRE and the various solutions that can be used in practice. This platform collects implementation examples which can be either full or partial descriptions of implementations that illustrate a step-by-step procedure to follow in order to generate INSPIRE resources.

The INSPIRE in your country section[40] provides information for the individual countries. More specifically, each country section provides contact information for experts and policy, status of implementation (of INSPIRE) and country fiches, which summarize the national progress and next steps in their implementation. This area is particularly useful to the marine/MSFD contacts who are not directly in the daily business of INSPIRE national implementation, but need to ensure they are familiar with the specifics of their implementation and its relation to the marine datasets.

5 Publication of datasets and metadata

This section elaborates on the actual recommendations on the publication of datasets and metadata in accordance to the obligations laid down by INSPIRE and in the context of the MSFD Article 19(3). This section does not intend to be a comprehensive technical guidance on how to set up INSPIRE services or transform datasets, but to provide general guidance on the main steps that Member States need to follow to comply with Article 19(3). For further details on the technical aspects of the process, see the Annexes document and the INSPIRE reference material as indicated under Section 4.3.

5.1 Metadata

In order to fulfil Article 19(3), and once Member States have identified those datasets to be made available (following the recommendations laid down in Section 3), Member States need to create INSPIRE compliant metadata and publish them through an INSPIRE compliant discovery service, ideally the national discovery service. This is further detailed in this section.

5.1.1 Generation of metadata

All datasets and data services need to be accompanied by a metadata file describing their basic characteristics such as the title, their unique identifier, their content, their quality, their lineage, their use constraints and data policy as well as the point of contact for the resource, among other information.

In order to create this metadata file, Member States need to follow the requirements as specified in the following regulation and technical documentation:

- Commission Regulation (EC) No 1205/2008 of 3 December 2008 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata and subsequent amendments[41].
- Technical Guidance for the implementation of INSPIRE dataset and service metadata based on ISO/TS 19139:2007 (version 2.0.1)[42].

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[39] https://inspire-reference.jrc.ec.europa.eu/

[40] http://inspire.ec.europa.eu/portfolio/inspire-your-country

[41] https://inspire.ec.europa.eu/Legislation/Metadata/6541

It is to be noted that not all necessary metadata elements are defined in these documents. Some elements defined as "metadata required for interoperability" which are actually defined in Article 13 of the Implementing Rules on the Interoperability of Spatial Datasets and Services[43] and further specified, together with recommended theme-specific metadata elements, in each of the corresponding Data Specifications.

The detailed metadata specifications required by INSPIRE for datasets and data services are provided in Annex II of the present Recommendations.

When following the abovementioned technical specifications, it is recommended to pay special attention to certain metadata elements in order to create high quality descriptions that will facilitate the discovery of the datasets:

- **Abstract**: it shall provide a clear and concise statement that enables the reader to understand the content of the data, containing information about the spatial coverage, main attributes, data sources, legal references (i.e. MSFD) and importance of the work. In particular, information related to the related MSFD criterion and criteria elements should be included in this text.
- **Lineage**: All relevant steps taken in order to create the datasets shall be described in this element (i.e. process history) as well as a statement on the overall quality of the dataset. Source datasets should also be referenced (including the UUID[44] of the corresponding metadata if available in the discovery service).
- **Keywords**: the use of descriptive keywords in the metadata is encouraged in order to allow for structured search following agreed concepts. Recommended thesauri (i.e. controlled vocabularies) which could be used as reference for these keywords are provided under section 5.3.2.

  It is highly recommended that the metadata of all datasets to be made available in the context of the Article 19(3) obligation includes at least a keyword from the metadata code list of priority datasets[45], in particular the keyword referring to the legal obligation behind the publication, in this case the MSFD[46]. This code list may include in the future more specific entries, e.g. related to Article 19(3) or individual descriptors or criteria.

  The GEMET includes as well a term referred to the Directive that can be used for tagging[47].

  It is also suggested that some keywords are added referring to the intended spatial coverage of the dataset (e.g. from the marine regions and subregions vocabulary[48]). Finally, and in order to be conformant with the INSPIRE Metadata Regulation, it is obligatory to include a keyword related to the relevant INSPIRE theme.

- **Resource locator:** this element should point out to the location (URL) where the data can be downloaded (download service) and displayed (view service). This is very important in order to ensure the connection between the dataset and the services providing access to them.

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[42] https://inspire.ec.europa.eu/id/document/tg/metadata-iso19139. This replaces the previous version (1.3) of the INSPIRE Metadata Technical Guidelines based on EN ISO 19115 and EN ISO 19119 (https://inspire.ec.europa.eu/documents/inspire-metadata-implementing-rules-technical-guidelines-based-en-iso-19115-and-en-iso-1), which may also still be used until the end of 2019.

[43] https://inspire.ec.europa.eu/Legislation/Data-Specifications/2892

[44] Universal Unique Identifier

[45] http://inspire.ec.europa.eu/metadata-codelist/PriorityDataset

[46] http://inspire.ec.europa.eu/metadata-codelist/PriorityDataset/dir-2008-56

[47] https://www.eionet.europa.eu/gemet/en/concept/15228

[48] http://dd.eionet.europa.eu/vocabulary/msfd/regions/view

Alternatively, an online resource providing additional information about the described data set should be given.

- **Conformity:** Metadata for an INSPIRE dataset or dataset series shall include at least the statement on the degree of conformity with the INSPIRE Implementing Rules for interoperability of spatial datasets and services[49].

A metadata editor tool is available in the INSPIRE geoportal[50] to generate XML metadata files for spatial data sets, data series and network services. In addition, a validator is also available that allows the validation of the metadata records against the INSPIRE metadata standards[51].

5.1.2 Publication of metadata

Once created, the metadata files describing datasets and associated web services shall be made available to facilitate finding and accessing these datasets and services. In the context of INSPIRE, this means that the metadata generated shall be discovered online through the use of a type of network (web) services known as discovery services, which will allow query the provided metadata content. More information on discovery services is provided in Section 5.2.1.

5.1.3 2018 MSFD reporting requirement to provide access to metadata

In order to fulfill MSFD 2018 reporting requirement related to the element "MD_URL" of the schema "Indicators", MS shall provide the URL facilitating direct access to the particular metadata record through the INSPIRE discovery service (be it the INSPIRE national node or any other discovery service).

5.2 Network services

The spatial datasets need to be made available online through web services, or as they are referred to in INSPIRE, network services[52]. This is required by Article 11(1) of INSPIRE Directive, which defines several types of network services.

Network services are required to be accessible through national SDIs. They should therefore enable the discovery and delivery of spatial data, via metadata catalogues and spatial data services, among other components.

In the context of the implementation of MSFD Article 19(3), the focus is on ensuring that the metadata are discoverable through discovery services, and in particular through the Member State's INSPIRE national node, as well as to implement download services for the datasets to be made available (in any case, the data should also be available through view services).

5.2.1 Discovery services

Discovery services allow users and computer programs to search for spatial datasets and services based on their metadata records. The INSPIRE discovery services are implemented in a consistent and compatible way across Europe and are based on European and international standards and current practices. For detailed information on the technical aspects of the discovery services, see the document "Technical Guidance for the implementation of INSPIRE Discovery Services"[53].

Regarding the obligation related to the fulfillment of MSFD Article 19(3), national organizations responsible to publish the MSFD relevant datasets are not expected to create and manage their own

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[49] Regulation 1089/2010

[50] http://inspire-geoportal.ec.europa.eu/editor

[51] http://inspire-sandbox.jrc.ec.europa.eu/validator/

[52] https://inspire.ec.europa.eu/network-services/41

[53] https://inspire.ec.europa.eu/documents/technical-guidance-implementation-inspire-discovery-services-0

discovery services, but to ensure that the metadata are available through the national or other (e.g. the RSCs') discovery services, whose content is then made available through the European INSPIRE Geoportal[54]. In order to do so, TG DATA members are recommended to coordinate with their national contact point for INSPIRE to agree on the most efficient technical and governance arrangements to make the metadata available through INSPIRE discovery services and eventually through the national INSPIRE discovery service node. A similar coordination is needed in the case of metadata that are published by international organizations. More guidance on this is provided in Section 6.

5.2.2   Download services

As definition, download services enable copies of complete spatial datasets, or of parts of such sets, to be downloaded. In order to create INSPIRE download services facilitating access to MSFD datasets, MS need to first follow the requirements as specified in the following regulation and technical documentation:

- Commission Regulation (EU) No 1088/2010 of 23 November 2010 amending Regulation (EC) No 976/2009 as regards download services and transformation services[55].
- Technical Guidance for the implementation of INSPIRE Download Services Version 3.1[56]
- Technical Guidance for the implementation of INSPIRE Download Services using Web Coverage Services (WCS)[57].

The INSPIRE Network Services Regulation provides two different options for the delivery of download services:

1. **Implementation of pre-defined dataset download service(s):** A pre-defined dataset download service provides for the simple download of pre-defined datasets (or pre-defined parts of a dataset) with no ability to query datasets or select user-defined subsets of datasets. A pre-defined dataset or a pre-defined part of a dataset could be (for example) a file stored in a dataset repository, which can be downloaded as a complete entity with no possibility to change content, neither encoding, coordinate reference system, etc.
2. **Direct access download service(s):** A direct access download service extends the functionality of a pre-defined dataset download service to include the ability to query and download subsets of datasets. The direct access download service allows more control over the download than the simple download of a pre-defined dataset or pre-defined part of a dataset. It can therefore be considered to be more advanced than pre-defined dataset download. In this case, the spatial information is typically stored in a repository (e.g. a database) and only accessible through a middleware data management system (although the precise implementation may vary). The term 'direct access' is used to mean the capability of a client application or client service to interact directly with the contents of the repository, e.g. by retrieving parts of the repository based upon a query. The query can be based upon spatial or temporal criteria, or by specific properties of the instances of the spatial object types contained in the repository.

These implementations can take place through different types of services. The INSPIRE-compliant ones are described in Table 4.

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[54] http://inspire-geoportal.ec.europa.eu

[55] https://inspire.ec.europa.eu/documents/commission-regulation-amending-regulation-ec-no-9762009-regards-download-services-and

[56] https://inspire.ec.europa.eu/documents/technical-guidance-implementation-inspire-download-services

[57] https://inspire.ec.europa.eu/id/document/tg/download-wcs

Table 4 Characteristics of the INSPIRE-compliant download services types

Name	Service type	Type of data
ATOM Syndication Format[58]	Pre-defined	Whole datasets
WCS (Web Coverage Service)[59]	Pre-defined and direct access	Coverages (incl. multidimensional)
WFS (Web Feature Service)[60]	Pre-defined and direct access	Spatial features (vector)
SOS (Sensor Observation Service)[61]	Pre-defined and direct access	Spatio-temporal observations

Therefore, a decision on which type of download service needs to be setup shall be taken in advance to the implementation, which should be based on the type of data to be published and the type of clients that are going to consume those data. In order to guide this decision, Annex III provides examples on current services made available using the first three approaches in Table 4. TG DATA members are encouraged to share their implementation as they proceed in order to create a repository of good practices for guiding other members.

5.2.3   2018 MSFD reporting requirement to provide access to datasets

The 2018 MSFD reporting schema "Indicators" includes an element "URL" which shall be populated, in the case of spatial datasets, with the web link providing direct access to the dataset through the download service, whatever type or technical solution (Open Source or commercial) used for its implementation.

In the case of non-spatial data, DOIs shall be expected. DOIs' metadata shall point to URLs where the objects can be found.

5.3   Spatial datasets interoperability

Interoperability means the possibility for spatial data sets to be combined, and for services to interact, without repetitive manual intervention, in such a way that the result is coherent and the benefit of the data sets and services is enhanced.

The INSPIRE IR on interoperability of spatial data sets and services and Technical Guidelines (Data Specifications) specify common data models, code lists, map layers and additional metadata on the interoperability to be used when exchanging spatial datasets. INSPIRE data specification guidance documents are based on the UML data models and can be found at https://inspire.ec.europa.eu/Technical-Guidelines/Data-Specifications/2892.

The use of the INSPIRE data specifications in considered crucial to achieve interoperability across Europe, but it is worth mentioning that there is already a lot of work done by the community towards interoperability by e.g. the use of common vocabularies or the use of reference grids. All these aspects are briefly introduced in the present section.

5.3.1   INSPIRE Data Specifications

In this section, and based on the example of MSFD datasets listed in Table 1 (see Section 3), the data models for the themes of SD (Species Distribution), HB (Habitats and Biotopes), SR (Sea Regions) and

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[58] https://inspire.ec.europa.eu/documents/technical-guidance-implementation-inspire-download-services

[59] https://inspire.ec.europa.eu/id/document/tg/download-wcs

[60] https://inspire.ec.europa.eu/documents/technical-guidance-implementation-inspire-download-services

[61] https://inspire.ec.europa.eu/id/document/tg/download-sos

OF (Oceanographic geographical features) from INSPIRE Annex III are proposed for consideration. Annex IV of these Recommendations provides more details of the Data Specifications of the selected themes, and three examples have been included in Annex V to show proof of concept on how to use some of them.

An initial assessment of these datasets indicates that the four-abovementioned themes should be sufficient for accomplishing MSFD Article 19(3) obligation. Which exact theme will then be used for a particular dataset shall depend on choices regarding the desired outcome of the MSFD. There is still some discussion needed around this point. Key considerations for this discussion are as follows:

- SD and HB represent respectively species and habitats distribution, which in principle could be applied to any geometry. In practice, this means a polygon or a grid. This polygon may be defined in another INSPIRE theme, for example AU, AM or SR. An example of this would be values attributed to a MSFD Marine Reporting Unit. When using a grid, the use of EEA reference grids is recommended, grid resolutions depending on the topic (e.g. underwater noise versus seabed disturbance).
- OF can describe point observations, point time series observations, multi point observations, grid observations, grid series observations and point observation collections. This includes grids and points, so if the dataset comprises values associated to a point or grid, then OF should be used. A grid can contain many attributes, e.g. temperature, salinity, turbidity. When the observations are linked to a monitoring network, this should be described using the Environmental Monitoring Facilities data model (EF).
- SR can be used to describe an area of common characteristics (SeaArea) or to represent a phenomenon (MarineContour). Therefore, this includes polygons and polylines. SeaArea and Shore (and their sub-types) should be used to identify areas of sea, inter-tidal areas, etc. If other properties need to be attached to those (i.e. use them as "reporting units"), an extension of the schema would be needed to link to these objects. MarineContour's can be used to represent the value of some phenomenon at a particular time (similar to the observation types defined in the OF theme). SR allows the user to do the following:
    - Define a segmented shoreline at a given tidal state with different attributes for each segment (e.g. litter).
    - Define an inter-tidal area with attributes. This inter-tidal area could be used as a polygon for SD or HB.
    - The concept of a named sea, e.g. North Sea
    - Sea regions can be defined as 'sea surface' or 'sea bed' if required.

It is to be highlighted that, according to the INSPIRE implementation calendar, data falling under Annex III need to be interoperable (i.e. made available in accordance to the IR on Data and Service Interoperability and the corresponding data specifications) by 2020. This means that the datasets to be made available under MSFD Article 19(3) within the 2018 reporting exercise do not necessarily need to be transformed in accordance with the relevant INSPIRE Data Specifications.

An agreement on the actual data models to be used for MSFD datasets is needed in order to achieve interoperability across Europe, especially for those that can be modelled following more than one INSPIRE theme, as marked in Table 1. Not all MSFD datasets may have the same priority in order to achieve cross-country harmonization, and clear use cases to guide the modelling are necessary.

Given its complexity, and that the INSPIRE deadline ultimately still lies ahead, the achievement of this task goes clearly beyond the intended timeframe of the present Recommendations. A roadmap is therefore proposed in Section 7 that goes beyond the MSFD 2018 reporting deadline in order to coordinate MS efforts towards harmonization of MSFD related datasets.

5.3.2   Vocabularies/thesaurus used

Apart from the code lists defined in the INSPIRE Registry[62], that are to be used when ensuring the compliance with the INSPIRE legislation as recommended by these guidelines, there are a number of vocabularies and thesauri used by the community for the publication of marine data. This section includes a brief description of the most used vocabularies/thesaurus for the publication of marine data.

EMODnet/SeaDataNet proposes several levels of thesaurus to describe **parameters** (variable names). It is suggested to make use of:

- P02 thesaurus (Discovery description) within INSPIRE compliant metadata (following recommendations in section 5.1.1).
- P01 thesaurus (BODC Parameter Usage Vocabulary), which includes unit and method, for detailed parameters (e.g. for data observed by monitoring systems). It is referred in OF (http://vocab.nerc.ac.uk/collection/P01/current/).
- P035 (aggregated parameters) to describe a product derived from multiple data sources and origins.

The following tool may be used to search the most appropriate entry to describe the data:

http://seadatanet.maris2.nl/bandit/browse_step.php

If an appropriate parameter is not found in these thesauri, the creation of a new entry may be asked online at: https://www.bodc.ac.uk/resources/vocabularies/vocabulary_builder/

For **physical parameters**, EMODnet/SeaDataNet thesauri include mapping to/from other popular thesauri such as the Climate and Forecast Metadata Convention (often known as CF Convention), which is used by e.g. Copernicus Marine Services within its products distributed in NetCDF.

For **chemical parameters**, including contaminants, EMODnet/SeaDataNet works with ICES, OSPAR and HELCOM to establish the thesaurus. In addition, the thesaurus includes the reference to the CAS identifier of the observed chemical substance (Chemical Abstract Service and CAS Registry: http://support.cas.org/content/chemical-substances/faqs).

When the chemical substance is observed in biota, the support taxon is identified using the WoRMS Taxonomy[63].

Thanks to EMODnet Chemistry, most of the thesauri used by European Member States to describe their own marine chemical data are already mapped to EMODnet/SeaDataNet thesauri (e.g. Sandre[64] to EMODnet in France).

For **marine litter**, work is ongoing by the MSFD TG on Marine Litter to define an adapted thesaurus (TG Litter). This work is progressively incorporated in EMODnet/SeaDataNet thesauri.

Regarding **biology data**, the INSPIRE theme on Species Distribution only includes the use of EU-NOMEN, EUNIS and the Nature Directives codes. However, the World Register of Marine Species (WoRMS) is a vocabulary broadly used for marine species. It includes both scientific names and vernacular names (common usage names) and has links to the commercially exploited species coding (FAO ASFIS). EUNIS[65] is broadly used for marine habitats.

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[62] http://inspire.ec.europa.eu/registry

[63] http://www.marinespecies.org/

[64] http://www.sandre.eaufrance.fr/

[65] http://eunis.eea.europa.eu/

5.3.3 INSPIRE geographical grids

Some of the datasets listed in Table 1 can be represented in a gridded format. This section tries to capture the basic elements regarding the use of grids within INSPIRE and the requirements regarding interoperability.

Geographical grid systems are included in Annex I of the INSPIRE Directive, which means that they are considered as reference data, for example data that constitute the spatial frame for linking and/or pointing to other information that belong to specific thematic fields as defined in the INSPIRE Annexes II and III.

Unlike the other themes, the grids specification does not concern a downloadable or viewable thematic data set. Rather, it presents a basic functionality allowing the harmonised and interoperable geographic location of spatial objects defined by the other INSPIRE thematic data specifications.

A geographical grid system is a harmonised multi-resolution structure composed of cells, regular in shape or area. Cells are usually squares based on a given coordinate reference system but, in rare cases, they can be shaped differently, for example as hexagons, with a common point of origin and standardised location. They are used for indirect georeferencing of themes with typically coarse resolution and wide geographical extent.

There are many types of grids available for different purposes. Ideally, one grid that is useful for all purposes ought to be created but it is not possible for one grid to cover uniformly the whole of Europe.

Examples of cell sizes that could be used for marine datasets are 10x10, 25x25 or 100x100 km.

More information can be found at the Data specification document[66] for this INSPIRE theme.

5.3.3.1 Pan-European grids

Two Pan-European grids are to be used within continental Europe in the INSPIRE context:

- The Equal Area Grid
- The Zoned Geographic Grid

The Equal Area Grid is two-dimensional and is based on the ETRS89 Lambert Azimuthal Equal Area coordinate reference system. It is mainly intended for spatial analysis or reporting purposes (for example, statistical information), but not for communities where the grids have to be optimised for data exchange, supercomputer processing and high volume archiving of new data each day. The requirements and recommendations associated to this grid are based on the results from the "European Reference Grids" workshop[67].

This grid, designated as Grid_ETRS89-LAEA, is fully specified in section 5.2.1 from the Data specification document.

The Zoned Geographic Grid is a two-dimensional multi-resolution geographic grid based on the ETRS89-GRS80 geodetic coordinate reference system. It follows a structure analogue to DTED (Digital Terrain Elevation Data), dividing the world into different zones in latitude, to mitigate the effect of convergence of meridians. The grid may be used as a geo-referencing framework when gridded data (raster data) is delivered using geodetic coordinates, mainly suited for reference data (such as elevation or orthoimagery), to achieve their interoperability for data provision and therefore serve cross border purposes at global level.

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[66] http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_GG_v3.1.pdf

[67] http://www.ec-gis.org/sdi/publist/pdfs/annoni-etal2003eur.pdf

This grid, designated as Grid_ETRS89-GRS80zn_res, is fully specified in section 5.2.2 from the Data specification document.

Both grids are multi-resolution grids, associated with predefined resolution levels, and provided with a designator and a coding system for identifying individual cells at all these levels.

Annex VI of the present Recommendations includes a description on how to make use of the EEA reference grids.

6 Role of international organisations and implications for the compliance with the INSPIRE Directive

The present section of the guidelines elaborates in the role that international organisations may have in regards to fulfilment of the obligation laid down by Article 19(3) of MSFD and with the INSPIRE Directive, and builds on a note by DG ENV clarifying this delegation (DATA_6-2018-03[68]). In terms of compliance with the different directives:

- **MSFD requires MSs to make their data and metadada available, and URLs provided through the Art.8 reporting exercise (schema 'Indicators', class 'Datasets');**
- **The INSPIRE Directive requires that the metadata are INSPIRE-compliant (following the standards and the Technical Guidelines, and using a INSPIRE Discovery Service) and that the data sets are available through INSPIRE download services.**

In the context of marine information, there is a long tradition of collaboration between MS and international organisations, such as Regional Sea Conventions (RSC). A number of official or voluntary arrangements exist through which MS submit a number of datasets to international organisations through official or voluntary flows. The arrangements change from organisation to organisation, but generally the datasets are produced at national level. The international organisations can then make use of them for assessments or development of data products, and at the same time making them available to the public through their websites. This is the case of RSCs, ICES, the EEA, EMODnet or CMEMS, as reflected in Table 1.

From a pragmatic point of view and given the role of regional cooperation structures to bring together Member States and neighbouring countries that share marine waters to co-ordinate cooperation, **these international structures could function practically as information nodes for marine data** and, thus, could be accepted in the INSPIRE infrastructure after the fulfilment of the INSPIRE procedures[69].

The INSPIRE Directive makes it clear that the delegation of (parts of) the implementation does not release the Member State from the obligation laid down in Article 15(2) to provide access to the services referred to in Article 11(1) of the Directive through the INSPIRE Geoportal. In particular, Article 26 sets the span of the Directive: "This Directive is addressed to the Member States".

It is clear that whatever practical arrangements are envisaged, the Member State obligation, liability and accountability for the implementation of the INSPIRE Directive vis-à-vis EU law cannot be delegated or transferred to a third party. In case of non-compliance, the Member State will be the sole interlocutor for the European Commission. In practice, this means for any breach of the

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[68] https://circabc.europa.eu/sd/a/64761ef5-7e34-417e-90da-71e00601fe29/DATA_6-2018-03_Note%20delegation%20to%20international%20organisations_v3.pdf

[69] The procedure for the MSs to connect new INSPIRE discovery services in the INSPIRE geoportal is in https://ies-svn.jrc.ec.europa.eu/projects/mig-inspire/wiki/DiscoveryServiceRegister. Specifically, to request the addition of discovery services (including from RSCs) to the INSPIRE geoportal, a request should be sent by the INSPIRE National INSPIRE Contact Point to the JRC geoportal team, including the discovery service to be added and a contact point (e-mail address and EU Login) for that service.

obligations under the EU acquis, Member States are the ones who will be held accountable by the European Commission based on the provisions of the Treaties.[70]

When delegating implementation to a third party, whether it is between local/regional/national/international levels of authority or other third party, it must be clear and documented (e.g. by Memorandum of Understanding, contract or other kind of documentation of legal arrangements) that the MS delegates specific implementation tasks to the third party but remains responsible for the legality of the data and the implementation of the INSPIRE Directive. As requested by Art. 21(2)(b) of the INSPIRE Directive, Member States will have to communicate this arrangement formally to the services of the European Commission.

In Annex VII a selection of datasets published by some international organisations is provided, together with a brief description of the standards that they are currently using. In many cases, different data types follow the same standards, but there are also many region- and data type-specific standards. An analysis of whether the metadata and web services used are INSPIRE compliant has been performed. In a nutshell, this analysis shows that:

a) At the metadata level for species, habitats, contaminants, and satellite observations at the European level through EMODnet, Copernicus or regional data portals (Biology, Chemistry and Chemistry) the metadata are described in ISO 19115[71] standard. The publication of the metadata via a web application can be quite varied, through a standard GeoNetwork catalogue (ICES, EMODnet Biology), the SeaDataNet Common Data Index system (EMODnet Chemistry) or another metadata viewer (CMEMS). However, because these systems follow the implementation of the same ISO standards, discovery services are available regardless of presentation application. It is therefore recommended that metadata are described using ISO 19115 and its 19139 implementing specification.
b) As regards the publication of the datasets, the solutions are very heterogeneous and can vary from zip files available in a FTP server to INSPIRE compliant view services (WMS). Datasets are not frequently published using INSPIRE compliant download services.
c) Regarding the data specifications used, they are also very diverse and presented in different encodings, the most used ones being Excel, CSV, ESRI shapefiles, NetCDF files and raster images, GML being rarely used.

6.1 Requirements for the international organisations that act as data providers on behalf of Member States

This section presents the requirements for international organisations in order to act on behalf of Member States in regards to MSFD Article 19(3) and INSPIRE Directive fulfilment.

Building on the steps laid down in the Key messages section for Member States at the beginning of the present guidance, it is recommended that international organisations cover the following steps:

1. Screen the regional indicators and underlying datasets that their EU Contracting Parties have used within their MSFD Article 8 assessments and will use in the reporting exercise.
2. If still not done, create the corresponding INSPIRE compliant metadata, following the recommendations laid down in Section 5.1.
3. Implement discovery and download services following the INSPIRE guidelines, as recommended in Section 5.2.
4. In collaboration with the JRC, and after the official request by MSs, connect their discovery service with the European INSPIRE geoportal, so that the MSFD datasets are discoverable at the European level.

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[70] See in particular under Article 258 (ex Article 226 TEC) of the Treaty on the Functioning of the European Union.

[71] https://www.iso.org/standard/26020.html

The last step is still to be discussed and tested by the INSPIRE community. Collaboration has already started between the JRC and some international organisations, which will set up the needs for Article 19(3) and INSPIRE fulfilment before the 2018 reporting exercise starts.

7   Conclusions and next steps

Within the MSFD 2018 reporting exercise, the EU Member States will notify the European Commission on the update of MSFD Articles 8, 9 and 10, as well as on Article 19(3) fulfilment, by providing the URLs of the datasets underlying the assessments carried out under Article 8.

For each indicator reported under the "Indicators" schema, at least two URLs have to be provided for the associated datasets:

-   Download service making the dataset available
-   Link to the metadata record of the dataset

Therefore, before starting the reporting exercise, Member States will have to prepare and publish all their datasets accordingly. In this regards, if some of their datasets have been collected and published by a international organisation (e.g. a Regional Sea Convention, EMODnet, ICES, CMEMS, etc), Member States will be able to provide the URLs where these organisations have made the data and metadata available. This means a partial delegation of Article 19(3) and the INSPIRE Directive fulfilment on these organisations. In this respect, it is recommended that such delegations are documented and notified to the European Commission.

Most of the datasets are expected to be spatially explicit datasets, therefore in those cases, both the metadata and the network services making the dataset and metadata available shall be implemented in accordance with INSPIRE legislation.

Regarding the harmonisation of the MSFD related datasets, the use of some of the INSPIRE themes is provided in the present document, although it is acknowledged that a lot of work still needs to be done. In addition, the INSPIRE themes to be used for each one of the MSFD criterion needs to be agreed at the MSFD Common Implementation Strategy level. For this, a roadmap for TG DATA work is provided in Table 5 in order to move towards such harmonisation. This will allow to have at least a set of agreed datasets harmonised by 2020 (INSPIRE deadline for harmonisation of Annex III themes), aiming to have a complete set of harmonised datasets by 2024 (due data of the second update of MSFD Articles 8, 9 and 10).

Table 5 Proposed roadmap for MSFD datasets harmonisation

Timeline	Step
Feb-Sep 2018	Examples provided in the present Recommendations (Annex VI) may be used by Member States to start the exercise on modelling following the INSPIRE data specifications.
Autumn 2018	Building on the lessons learned, new case studies will be proposed and approved in TG-DATA meeting. To be followed and implemented as use-cases by Member States until Spring 2019.
Spring 2019	Lessons learned and best practices to guide the proposal of additional cases to be approved in TG-DATA meeting. All the worked examples to be followed and implemented by all Member States until 2020 (and beyond).
2020	All datasets agreed and presented in TG DATA will be fully harmonized across Member States.

In order to cover the steps above, the use of the INSPIRE Marine and Atmosphere Cluster[72] is encouraged. This Cluster may act as a sharing and collaboration tool to follow the proposed roadmap, and may store the marine examples as living documents. Further steps will be taken in order to explore the use of the Cluster as a platform for TG DATA.

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[72] https://themes.jrc.ec.europa.eu/groups/profile/213/marine-and-atmosphere-cluster