



EMODnet Biology

Data discovery and access

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

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1. Background

This task identifies the species which are protected by EU Directives and international conventions, and also those to be used as indicators of relevant MSFD descriptors. The focus of the activity to date has been on the MSFD element of this work as it was quickly discovered that the Pan-European Species directories Infrastructure (PESI) project (<http://www.eunomen.eu/portal/search.php?search=adv>) already contains much of this information for older legislation, notably:

- CITES;
- Habitats Directive;
- Birds Directive;
- OSPAR; and
- IUCN.

However, identification of species that will comprise indicators or components of indicators for the MSFD is a large and complex task in itself. The MSFD has 11 descriptors, of which it was decided early on to focus on the biodiversity descriptors together with commercial fish and non-indigenous species. Thus the descriptors being addressed in this task are:

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

Of these the most emphasis initially was on descriptors 1, 4 and 6, but where information was available for descriptors 2 and 3 it was also included.

Work was focussed on gathering information at a Regional Seas scale i.e. identifying species that were linked to indicators that were agreed between member states through a regional process via the regional seas commissions.

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

North-east Atlantic

- Greater North Sea including the Kattegat, and the English Channel
- Celtic Seas
- Bay of Biscay and Iberian Coast
- Macaronesian biogeographic region (waters surrounding the Azores, Madeira and the Canary Islands)

Baltic Sea

Mediterranean Sea

- Western Mediterranean Sea
- Adriatic Sea
- Ionian Sea and the Central Mediterranean Sea
- Aegean-Levantine Sea

Black Sea

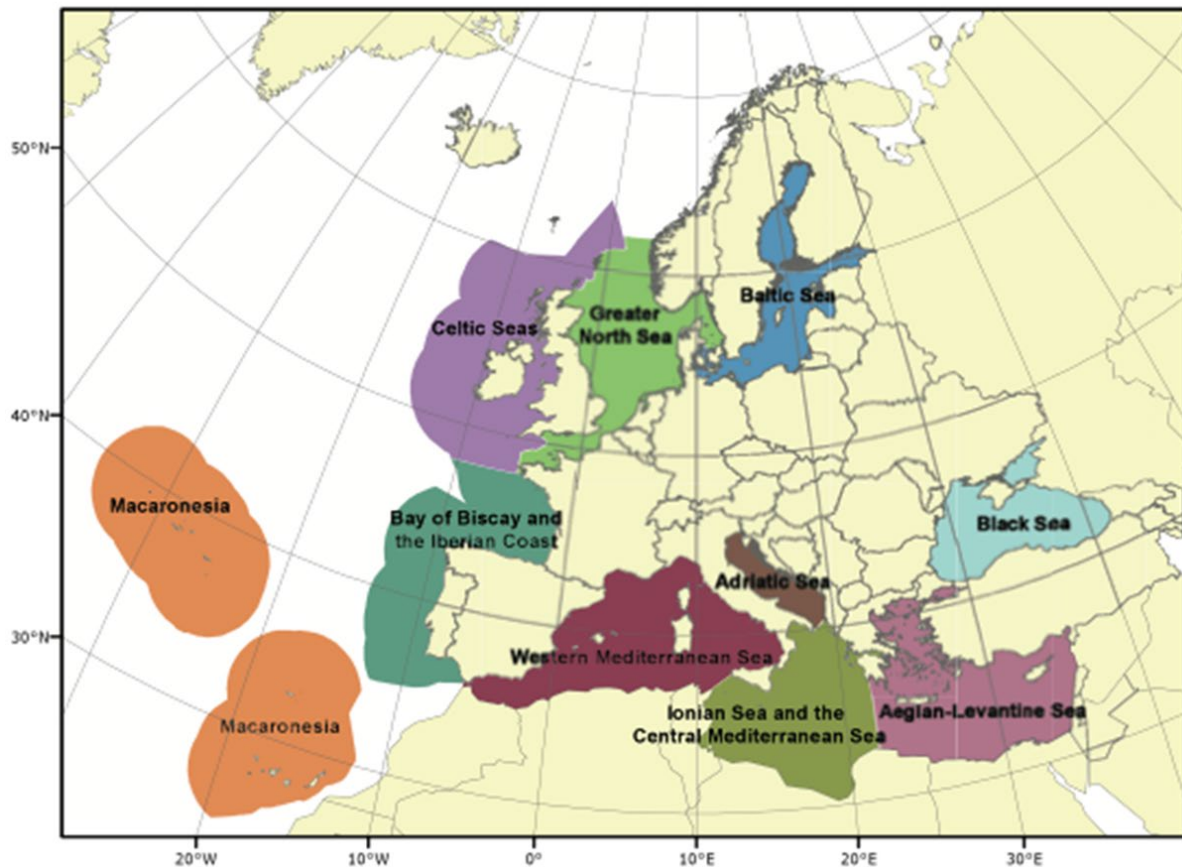


Figure 1 . Map of the regional seas and subregions defined within the MSFD.

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

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

It is important to also mention that each member state selected indicators and submitted these to the European Commission in July 2012. Many of these indicators have not been adopted at the

regional level but are may possibly be valid and potentially will be used by the member state to assess good environmental status within their EEZ.

2. North-east Atlantic

Within the OSPAR area, MSFD indicator development has been through ICG-COBAM. Of the indicators put forward by member states in 2013, a list of Common and Candidate Indicators has been defined (September 2013, updated April 2014). Common indicators are those adopted either 1) OSPAR wide (regions II, III and IV) or 2) adopted in one or more indicated OSPAR regions. Candidate indicators are still in development and amongst these there are priority indicators and those that are not priority.

Subregions and how they correspond with OSPAR regions:

- Greater North Sea – OSPAR region II
- Celtic Seas – OSPAR region III
- Bay of Biscay and Iberian Coast – OSPAR region IV
- Macaronesia – not included here as information not yet available

The OSPAR list of common and candidate indicators was used to devise a framework for collating information on the policy relevant species (ref spreadsheet). The main body of the work has been to resolve group indicators to species level. For example some indicators concern seabirds, and only after correspondence with the COBAM lead has information been gained on exactly which seabird species this concerns. Also as different indicators are at various stages in their development, it may be that the indicative lists collated here change slightly in the future, and the species lists targeted by indicators in development may become resolved (e.g. NIS)

Descriptor 1 – Biological diversity

D1 has been subdivided into species indicators and habitats indicators and then further categorised as below:

Species indicators

- Mammals (cetaceans & seals)
- Birds (seabirds, wading birds & waterfowl)
- Fish and cephalopods

Habitats indicators

- Benthic habitats (rocky and biogenic reef and sedimentary)
- Pelagic habitats

Each indicator group has several indicators that have been included in the list of common and candidate indicators – some of which are common indicators, some candidates and some priority indicators, showing the different stages of development of these indicators. Most of these groups have a lead scientist who is responsible for the development of the indicators for the group, but not all. Notably benthic habitats do not have a lead. Contact has been made with each of the group leads to determine for which indicators target species lists are available, or if these have not yet been agreed, indicative lists have been requested.

Table 1 Biodiversity indicators (Source: OSPAR Common and Candidate Indicators: updates reported to ICG MSFD April 2014)

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

D1 Birds 4	Non-native/invasive mammal presence on island seabird colonies	N					Not priority indicator
D1 Birds 5	Marine bird bycatch	N					Not priority indicator
D1 Birds 6	Distribution marine birds	N	II	M/N			May be demoted to candidate indicator due to lack of progress in development – will be decided 2015
D1 Fish Ceph 1	Abundance fish	Y	II, III	Y	Y		No information gathered on this indicator to date
D1 Fish Ceph 2	Proportion of large fish (large fish index)	Y	II, III	Y	Y	T	Also species list received for Bay of Biscay although not common there yet
D1 Fish Ceph 3	Mean maximum length of demersal fish and elasmobranchs	Y		Y	Y		No information to date although has been applied and tested in regions II, II & IV.
D1 Fish Ceph 4	Bycatch rates of Chondrichthyes	N					Not a priority indicator
D1 Fish Ceph 5	Conservation status of elasmobranch and demersal bony fish species (IUCN)						Not a priority indicator
D1 Fish Ceph 6	Proportion of mature fish						Not a priority indicator
D1 Fish Ceph 7	Distributional range of fish						Not a priority indicator
D1 Fish Ceph 8	Distributional pattern of fish						Not a priority indicator

D1 Bent Hab 1	Typical species composition	Y		M	Y		No species lists available reflecting development status of indicator
D1 Bent Hab 2	Multi-metric indices	Y	II, III & IV	Y	N		Not possible to resolve to target species
D1 Bent Hab 3	Physical damage of predominant and special habitats	Y		Y	Y		In development – testing will be complete by end 2014.
D1 Bent Hab 4	Area of habitat loss	Y		N			Delayed development, may not be possible to resolve to species.
D1 Bent Hab 5	Size frequency distribution of bivalve or other sensitive/indicator species	N					Not priority indicator
D1 Pel Hab 1	Changes of plankton functional types (life form) index ratio	Y	III & IV	Y	Y		Indicative lists may be available for some components
D1 Pel Hab 2	Plankton biomass and/or abundance	N	II	Y	N		Not possible to resolve to species level
D1 Pel Hab 3	Changes in biodiversity index(s)	N	IV	Y	N		Not possible to resolve to species level

*this indicates the level of development needed – Y = yes, M = maybe, N = no.

Mammals currently has six indicators, of which four are priority indicators and common in at least one subregion. One indicator has candidate status and is not a priority (D1 Mammals 1 – Distribution of seals). D1 Mammals 2 – Distribution of cetaceans has been combined with D1 Mammals 4 – Abundance of cetaceans. Details of indicative target species lists have been obtained for the four priority indicators: D1 Mammals 3 – Abundance of seals; D1 Mammals 4 – Abundance of cetaceans; D1 Mammals 5 – Seal pup production; and D1 Mammals 6 – Mammals bycatch. However the latter indicator is unlikely to deliver to the 2017 assessment. This is because an identical process of indicator development is being undertaken within the EU Common Fisheries Policy, which is outside the influence of OSPAR. Technical specifications between the MSFD indicator and the CFP indicator for mammals bycatch may differ and this requires resolution before this indicator can be progressed.

Birds also currently has six indicators, but of these only two of these are common indicators in at least one OSPAR subregion. These are D1 Birds 1 – Abundance of marine birds and D1 Birds 6 – Distribution of marine birds. However the latter indicator is not a priority and as such may not be included in 2017 assessments. There is a further priority indicator: D1 Birds 3 Breeding status of marine birds which is proposed as common to OSPAR region II Greater North Sea and region III Celtic Seas, and is likely deliver to the 2017 assessment. Indicative target species lists have been received for D1 Birds 1, and D1 Birds 3 (OSPAR 2014 (1) and (2)), since the other developing indicator have not yet been resolved to identify target species at the current time. A further indicator D1 Birds 2 – Breeding success of kittiwake is not a priority indicator (and is included within D1 Birds 3).

Fish and cephalopods currently comprises seven indicators, of which two are common indicators in both the Celtic Seas and Greater North Sea: D1 Fish Ceph 1 – Abundance of fish and D1 Fish Ceph 2 – Proportion of large fish (large fish index (LFI)). In addition a further candidate indicator has priority status: D1 Fish Ceph 3 – Mean maximum length of demersal fish and elasmobranchs. To date information on the fish species targeted by these indicators has only been received for D1 Fish Ceph 2 – LFI, but this has been obtained for the Greater North Sea, Celtic Seas and Bay of Biscay (the latter is not a common subregion yet). In addition this indicator overlaps with D4 Foodweb 3.

Benthic habitats currently has one common indicator (common to all OSPAR areas): D1 Bent Hab 2 – Multi-metric indices. This is a very difficult indicator to resolve to species level as this comprises biotic indices such as the AMBI index which can be applied to any biological community and categories species assemblages into functional groups. As such it does not specifically target any species, rather all species present. This work is still under development as part of the French project “Benthoval”. In addition two further candidate indicators are considered priority: D1 Bent Hab 1 – Typical species composition and D1 Bent Hab 3 – Physical damage of predominant and special habitats. Both are currently in development and are likely to deliver to the 2017 assessment. It is clear though that it would be possible to resolve these to species level, once the indicators have been developed and tested. A further indicator D1 Bent Hab 4 – Area of habitat loss, although it is a priority indicator, is will expected to not delivery to the 2017 assessment. Thus to date no species targeted by benthic habitats have been included in the spreadsheet.

Pelagic habitats currently has three indicators, all of which are common in at least one subregion: D1 Pel Hab 1 – changes of plankton functional types (lifeform) index ratio; D1 Pel Hab 2 – Plankton biomass and/or abundance; and Pel Hab 3- Changes in biodiversity indices. Of these, only one is

suitable for inclusion since it is possible to resolve to species level and this is the first of these indicators. However, this work has not yet been completed but will be included here when available (McQuatters-Gollop ICG-COBAM pelagic habitats lead, pers. comm. July 2014).

Descriptor 2 – Non-indigenous species

Development of the D2 indicators is some way behind the biodiversity indicators. The original two D2 indicators (D2 NIS 1 - Pathways management measures and D2 NIS 2 - Rate of new introductions of NIS) have been combined into D2 NIS 3. Currently the target species lists have not been resolved but are likely to be by December 2014. The approaches for identifying target species have not been identified yet either, and may follow either 1) the GB Non-Native Species Secretariat (GB NNSS)¹ approach or 2) HELCOM/OSPAR ballast water approaches, or alternatively neither approach may be used and MSFD specific methods will be developed (Paul Stebbing, D2 COBAM lead, pers. comm. July 2012).

Descriptor 3 - Commercially exploited fish and shellfish

The assessment of the GES status for the Descriptor D3 is based on three criteria: (3.1) exploited sustainably consistent with high long-term yields, (3.2) have full reproductive capacity and (3.3) exhibit a population age and size distribution that is indicative of a healthy stock. D3 in the OSPAR area is heavily dependent on the Common Fisheries Policy (CFP) and its aim to 'restore and maintain populations of harvested species above levels which can produce maximum sustainable yield'.

ICES recognises six main categories of stocks taking into account biological information and data availability (WG GES 2013):

Category 1 – Stocks with quantitative assessments

This type of stock can be considered in two sub categories a) stocks with several year-classes contributing to the fishery that includes stocks with full analytical assessments and forecasts as well as stocks with quantitative assessments based on production models; and b) short-lived species stocks with quantitative assessments. These are the stocks that have short life cycles with catches dominated by single year-classes. They are not considered data-limited and this category includes stocks with full analytical assessments and forecasts as well as stocks with quantitative assessments based on production models.

Category 2 – stocks with analytical assessments and forecasts that are only treated qualitatively

This category includes stocks with quantitative assessments and forecasts which for a variety of reasons are considered indicative of trends in fishing mortality, recruitment, and biomass.

Category 3 – stocks for which survey-based assessments indicate trends

¹ <http://www.nonnativespecies.org/home/index.cfm>

This category includes stocks for which survey indices (or other indicators of stock size such as reliable fishery-dependant indices; e.g. LPUE, CPUE, and mean length in the catch) are available that provide reliable indications of trends in stock metrics such as total mortality, recruitment, and biomass.

Category 4 – stocks for which only reliable catch data are available

This category includes stocks for which a time-series of catch can be used to approximate MSY.

Category 5 – Landings only stocks

This category includes stocks for which only landings data are available.

Category 6 – negligible landings stocks and stocks caught in minor amounts as by-catch

This category includes stocks where landings are negligible in comparison to discards. It also includes stocks that are part of stock complexes and are primarily caught as by-catch species in other targeted fisheries. The development of indicators may be most appropriate for such stocks.

At the present time, a number of candidate stocks which have full assessments have been identified (ICES 2015) for the subregions of the North East Atlantic. It is likely that these stocks will contribute to the 2017 assessment. At the present time it is not clear how the data poorer stocks will be included in the assessment and which species will be targeted for inclusion.

Descriptor 4 - Foodwebs

There is considerable overlap between the biodiversity indicators and those proposed for foodwebs: in fact the two common indicators with priority status are both also D1 indicators. These are D4 Foodweb – Size composition in fish communities (LFI) which is the same as D1 Fish Ceph 2, and D4 Foodweb 5 – Change in plankton functional types which is the same as D1 Pel Hab 1. (although many of these overlap with D1 indicators). None of the other indicators proposed for foodwebs are likely to contribute to the 2017 assessment aside from D4 Foodweb 4 – Changes in average trophic level of marine predators (cf MTI).

Table 2. Food web indicators (Source: OSPAR Common and Candidate Indicators: updates reported to ICG MSFD April 2014)

Indicator name	Indicator title	Priority indicator	Common indicator (subregions)	Likely to deliver to 2017*	Possible to resolve to target species?	Target species (T) or indicative (I) obtained	comments
D4 Foodweb 1	Reproductive success of marine birds in relation to food availability	N					Not priority indicator
D4 Foodweb 2	Production of phytoplankton	N					Not priority indicator
D4 Foodweb 3	Size composition in fish communities	Y	III	Y	Y	I	Same as D1 Fish Ceph 2 (uncertain why subregions are different though)
D4 Foodweb 4	Changes in average trophic level of marine predators (cf MTI)	N	Proposed to promote to common in region IV	Y	Y		Indicator in development, no target species lists available
D4 Foodweb 5	Change in functional plankton types	Y		M	Y		Same as D1 Pel Hab 1 – see previous table
D4 Foodweb 6	Biomass, species composition and spatial distribution of zooplankton	N					Not priority indicator
D4 Foodweb 7	Fish biomass and abundance of dietary functional groups	N					Not priority indicator
D4 Foodweb 8	Biomass trophic spectrum	N					Not priority indicator
D4 Foodweb 9	Ecological Network Analysis (diversity)						Not priority indicator

Descriptor 6 – Seafloor integrity

Indicators are not required for seafloor integrity since this information is captured within the suite of indicators proposed for benthic habitats within Descriptor 1.

3. Baltic Sea

HELCOM have proposed the HELCOM core indicators to form the critical set of indicators that are needed to regularly assess the status of the Baltic Sea marine environment against targets that reflect good environmental status. These were designed with consideration of both the ecological objectives of the HELCOM Baltic Sea Action Plan and the qualitative descriptors and associated criteria of the MSFD. The indicators cover the Baltic Sea marine ecosystem, the main contaminants in it and address all the HELCOM ecological objectives and the MSFD qualitative descriptors for biodiversity, non-indigenous species, food web, sea-floor integrity and contaminants in the environment and seafood. HELCOM core indicators for descriptor 5 (Eutrophication) and Descriptor 3 (Commercially exploited stocks of fish and shellfish) were developed with eutrophication experts under HELCOM MONAS and ICES respectively.

The work in the CORESET project was divided into two expert groups: biodiversity and hazardous substances. Biodiversity was also subdivided into six teams who focussed on:

- Mammals
- Birds
- Fish
- Pelagic habitats (including associated communities)
- Seabed habitats (including associated communities)
- Non-indigenous species

The HELCOM core indicators do not exactly map onto the MSFD descriptors, criteria and indicators; many of the HELCOM core indicators cover multiple aspects e.g. Population growth rate, abundance and distribution of marine mammals clearly informs on all three species level criteria (1.1 Species distribution, 1.2 Population size and 1.3 Population condition). The current set of core indicators has been further developed during the CORESET II project and will be reviewed and a process of adoption of the work done so far will commence (April 2015). By mid-2015 it will become clear which indicators will be taken forward (Lena Avellan, pers. comm. March 2015).

Descriptor 1 – Biodiversity

The HELCOM core indicators that inform on the MSFD Descriptor 1 Biodiversity are shown in the table below. All of the species level indicators have been resolved to species by the HELCOM expert groups, though in one case it is likely that the list of species will increase with further development of the indicator (Abundance of waterbirds in the breeding season). The HELCOM core indicator *Extent, distribution and condition of benthic biotopes* was not possible to readily resolve to species level and is not included in the spreadsheet. Also there are no species associated with the HELCOM

core indicator *Lower depth distribution limit of macrophyte species* because detail on the indicator was not available.

Table 3 Comparison of the proposed HELCOM core indicators with the Descriptor 1 Biodiversity indicators of the EC Decision 477/2010/EC (Source: HELCOM 2013)

MSFD Criteria	Proposed MSFD Indicator	Proposed HELCOM core indicators
Species level		
1.1 Species distribution	Distributional range	Population growth rate, abundance and distribution of marine mammals
	Distributional pattern	
	Area covered by the species	
1.2 Population size	Abundance	Population growth rate, abundance and distribution of marine mammals Abundance of salmon spawners and smolt Abundance of sea trout spawners and parr Abundance of waterbirds in the wintering season Abundance of waterbirds in the breeding season
	Biomass	Abundance of key fish species Abundance of fish key functional groups
1.3 Population condition	Population demographic characteristics	Pregnancy rate of marine mammals Nutritional status of seals White-tailed eagle productivity
Habitat level (including associated communities)		
1.4 Habitat distribution	Distributional range	Extent, distribution and condition of benthic biotopes
	Distributional pattern	
1.5 Habitat extent	Habitat area	Extent, distribution and condition of benthic biotopes Lower depth distribution limit of macrophyte species
	Habitat volume	
1.6 Habitat condition	Condition of typical species and communities	Population structure of long-lived macrozoobenthic species Extent, distribution and condition of benthic biotopes
	Relative abundance and/or biomass	
	Physical, hydrological and chemical conditions	
Ecosystem level		
1.7 Ecosystem structure	Ecosystem structure: composition and relative proportions of ecosystem components	

Descriptor 2 – Non-indigenous species

The HELCOM core indicators include *Trends in arrival of new non-indigenous species*, which is not possible to resolve to species level at this time. In addition there are a number of Baltic Sea Environment Fact Sheets that contribute to this descriptor. Some of these are related to the abundance and distribution of particular species (Zebra mussel, Marenzelleria worms (3 congeneric species) and Round goby), while others do not define species (*Observed non-indigenous and cryptogenic species in the Baltic Sea*).

Table 4 Comparison of the proposed HELCOM core indicators with the Descriptor 2 Non-indigenous species indicators of the EC Decision 477/2010/EC (Source: HELCOM 2013)

MSFD Criteria	Proposed MSFD Indicator	Proposed HELCOM core indicators
2.1 Abundance and state characterisation of non-indigenous species, in particular invasive species	Trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading such species	Trends in arrival of new non-indigenous species Abundance and distribution of the Zebra mussel (<i>Dreissena polymorpha</i>) Abundance and distribution of <i>Marenzelleria</i> species in the Baltic Sea
2.2 Environmental impact of invasive non-indigenous species	Ratio between invasive non-indigenous species and native species in some well-studied taxonomic groups (e.g. fish, macroalgae, molluscs) that may provide a measure of change in species composition (e.g. further to the displacement of native species)	Observed non-indigenous and cryptogenic species in the Baltic Sea
	Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible	Biopollution level index

Descriptor 3 - Commercially exploited fish and shellfish

Three fish species (cod, herring and sprat) for which full assessments exist have been proposed as candidates for D3 ICES 2015. However there is ongoing work between HELCOM and ICES through the HOLAS II project which may identify further data poorer stocks for inclusion in D3 assessments. This project is likely to deliver towards the end of 2015. In addition there is work underway within CORESET II project which has further developed the CORESET indicators and additional D3 indicators may be proposed (Lena Avellan, HELCOM pers. comm. March 2015).

Descriptor 4 – Food webs

Of the HELCOM core indicators that can inform on Descriptor 4 – Foodwebs, many are also indicators of biodiversity (those informing on 4.1). In addition though there is an indicator on the *Proportion of large fish in the community* and *Abundance of fish key functional groups*. The indicator on *Zooplankton mean size and total abundance* could not be resolved to species level.

Table 5 Comparison of the proposed HELCOM core indicators with the Descriptor 4 Foodwebs indicators of the EC Decision 477/2010/EC (Source: HELCOM 2013)

MSFD Criteria	Proposed MSFD Indicator	Proposed HELCOM core indicators
4.1 Productivity of key species or trophic groups	Performance of key predator species (mammals, seabirds) using their production per unit biomass (productivity)	Population growth rate, abundance and distribution of marine mammals White-tailed eagle productivity Abundance of salmon spawners and smolt

		Abundance of sea trout spawners and parr
4.2 Proportion of selection species at the top of food webs	Large fish (by weight)	Proportion of large fish in the community (by length)
4.3 Abundance/distribution of key trophic groups and species	Abundance trends of functionally important selected key trophic groups/species	Abundance of fish key functional groups Zooplankon mean size and total abundance

Descriptor 6 – Seafloor integrity

There are six HELCOM core indicators proposed to inform on MSFD Descriptor 6 – Seafloor integrity. Out of these 6, only two can be resolved to species level since the others either concern habitats or are based on multi-metric indices. However the indicator *Population structure of long-lived macrobenthic species* can inform on both MSFD 6.2.3 and 6.2.4 (Proportion of biomass or number of individuals in macrobenthos above some specified length/size and Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community, respectively). Incidentally these are also able to inform on Descriptor 1 Biodiversity habitat level indicators as well.

Table 6 Comparison of the proposed HELCOM core indicators with the Descriptor 6 Seafloor integrity indicators of the EC Decision 477/2010/EC (Source: HELCOM 2013)

MSFD Criteria	Proposed MSFD Indicator	Proposed HELCOM core indicators
6.1 Physical damage, having regard to substrate characteristics	Type, biomass and areal extent of relevant biogenic substrate	Extent, distribution and condition of benthic biotopes
	Extent of the seabed significantly affected by human activities for the different substrate types	Cumulative impacts on benthic biotopes
6.2 Condition of the benthic community	Presence of particularly sensitivity and/or tolerant species	A parameter embedded in the indicator 'State of the soft-bottom macrofauna communities'
	Multi-metric indices assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species	State of the soft-bottom macrofauna communities
	Proportion of biomass or number of individuals in macrobenthos above some specified length/size	Population structure of long-lived macrobenthic species
	Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community	Population structure of long-lived macrobenthic species

4. Mediterranean Sea

Targets for achieving Good Environmental Status of the Mediterranean Sea and its coastal zone by 2020 were adopted at the 18th Meeting of the Contracting Parties to the Barcelona Convention (COP18) (UNEP 2013). The Contracting Parties also agreed to design an Integrated Monitoring and Assessment Programme by the next Meeting of the Contracting Parties (COP19), and mandated the Secretariat to carry out an assessment of the state of the Mediterranean environment in 2017.

A list of common indicators for the MSFD in the Mediterranean region, including biodiversity indicators, were agreed in February 2014. Details on the process and the list of indicators can be found in the Introduction of the attached Main Elements of the Integrated Monitoring and Assessment Programme (UNDP (1) 2015). This document will be further refined on the basis of recommendations from working groups and monitoring experts (due April 2015). The final adoption will likely come in February 2016 at the Conference of the parties. Until then, indicator species should be considered proposed rather than agreed.

The process in the Mediterranean region has focussed on ecological objectives that broadly align to MSFD Descriptors. These ecological objectives have common indicators. These have been defined as “an indicator that summarizes data into a simple, standardized and communicable figure and is ideally applicable in the whole Mediterranean basin, but at least on the level of sub-regions and is monitored by all Contracting Parties. A common indicator is able to give an indication of the degree of threat or change in the marine ecosystem and can deliver valuable information to decision makers.” (UNDP (1) 2015).

The Common indicators agreed, which are at the core of the Integrated Monitoring and Assessment Programme:

1. Habitat distributional range (EO1);
2. Condition of the habitat’s typical species and communities (EO1);
3. Species distributional range (EO1 related to marine mammals, seabirds, marine reptiles);
4. Population abundance of selected species (EO1, related to marine mammals, seabirds, marine reptiles);
5. Population demographic characteristics (EO1, e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles);
6. Trends in abundance, temporal occurrence and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (EO2, in relation to the main vectors and pathways of spreading of such species);
7. Concentration of key nutrients in water column (EO5);
8. Chlorophyll-a concentration in water column (EO5);
9. Location and extent of the habitats impacted directly by hydrographic alterations (EO7);
10. Length of coastline subject to physical disturbance due to the influence of man-made structures (EO8);
11. Concentration of key harmful contaminants measured in the relevant matrix (EO9, related to biota, sediment, seawater);

12. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9);
13. Occurrence, origin (where possible) extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution (EO9);
14. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9);
15. Percentage of intestinal enterococci concentration measurements within established standards (EO9);
16. Trends in the amount of litter washed ashore and/or deposited on coastlines (EO10);
17. Trends in the amount of litter in the water column including microplastics and on the seafloor (EO10);
18. Candidate Indicator: Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds and marine turtles (EO10);
19. Candidate Indicator: Coastal ecosystems and landscapes

In line with the recommendations of the Integrated EcAp Correspondence Group on Good Environmental Status (GES) and Targets Meeting (UNEP(DEPI)/MED WG.3940/4), in the context of the Barcelona Convention

The Common indicators that are of relevance to this work are 1-6, since they deal with biodiversity components. Annex I (Proposed habitats and species lists) from Recommendations of the Online Informal Working Groups (UNDP(2) 2015) was used to identify species proposed as targets for indicators for GES for the Mediterranean.

5. Black Sea

The development of indicators for the MSFD in the Black Sea region is closely connected with the wider programmes of the Black Sea Commission. This is because only two contracting parties of the Bucharest Convention are obliged to fulfil MSFD requirements out of the 6 bordering the Black Sea. For this reason it is likely that Black Sea Commission indicators (agreed in the Biodiversity Protocol of the Bucharest Convention that came into force in 2012) will form the basis of the MSFD biodiversity indicators (V. Todorova pers. comm.). Considerable work has been done to identify and improve existing monitoring efforts, identify gaps and harmonisation needs for the different contracting parties through a number of projects e.g. MSIS (Velikova et al. 2013), EMBLAS (EMBLAS 2013), and a project supporting joint implementation (ARCADIS 2015). What should become emergent from this work is the indicators that are currently being used and how they can be applied to the MSFD descriptors, and secondly the main gaps that will require new indicators and the establishment of new monitoring programmes.

Annex 2 of the Biodiversity Protocol is divided into several sections:

- Macroalgae
- Higher plants
- Polychaetes

- Crustacea
- Molluscs
- Echinoderms
- Fish
- Mammalia
- Birds

All taxa apart from polychaetes, crustacea, molluscs and echinoderms were included in the indicator database. The rationale for not including the invertebrates was that these are likely to be associated with habitats, and at the present time it is not clear what the priority habitats are and how these species are supported by them. It is expected that this work will be done as part of the indicator development programme. In addition, some of the bird species are not marine or coastal (e.g. *Asio flammeus*, Short-eared owl) and would not likely be targeted by Descriptor 1 indicators. Finally since the majority of these potential indicator species have not been fully aligned to the MSFD hierarchy, it is not known which criteria and indicator classes they will contribute to (e.g. *Puffinus puffinus* could be a target species for one or all of the following:

- 1.1.1 (Distributional range);
- 1.2.1 (Population abundance); and/or
- 1.3.1 (Population demographic characteristics).

The Black Sea Commission indicators also include Annex 4; List of species whose exploitation should be regulated by the Black Sea Biodiversity and Landscape Conservation Protocol. The species list comprises 28 fish species, 6 molluscs, 6 crustaceans and 3 bird species. It is possible that these species will become the target of Descriptor 3 indicators for commercially exploited fish and shellfish species.

The Black Sea Strategic Action Plan (2009) addresses the main areas of concern and their causes, through the aims of four Ecosystem Quality Objectives:

- EcoQO1: Preserve commercial marine living resources (this approximates MSFD Descriptor 3);
- EcoQO2: Conservation of Black Sea Biodiversity and Habitats (this aligns with MSFD Descriptors 1, 4 and 6);
- EcoQO3: Reduce eutrophication (this maps over MSFD Descriptor 5); and
- EcoQO4: Ensure Good Water Quality for Human Health, Recreational Use and Aquatic Biota (which concerns MSFD Descriptors 8 and 9).

A discussion document has recently been produced which begins to answer the above questions and identifies potential indicators for each indicator criteria and class, but this is not comprehensive across all the taxon groups (ARCADIS 2015). Where specific indicator species have been proposed, these have been included in the database, but this is likely to be built on in future work and as the other CPs move towards harmonized monitoring these indicators may change.

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