Development of a shared data and information system between the EU and the Regional Sea Conventions

Regional Sea Conventions data and information flows

Consortium leader: Deltares – The Netherlands
Lead partner for this task: HCMR – Greece

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Summary
EU DG-Environment has contracted a study for "Development of a shared data and information system between the EU and the Regional Sea Conventions". One component of this study is examining the data and information holdings within each of the four Regional Sea Conventions (RSCs) as well as the European Environment Agency (EEA), with the aim of characterizing the present data and information holdings and flow processes in place across Europe. This is specifically to evaluate how these data could be used to support the reporting objectives of the Marine Strategy Framework Directive and other related EU Directives.

This report presents an overview of data and information holdings of the RSCs, including an analysis of information flow processes and management systems in place at RSCs. Where appropriate, recommendations for further work to support harmonisation of data and information flows at regional and European level for mutual benefit are made. This is a joint deliverable for Tasks 1 and 2 of the project contract.

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List of abbreviations

AG LBS:	BSC Advisory Group on Control of Pollution from Land Based Sources
AG PMA:	BSC Advisory Group on Pollution Monitoring and Assessment
BAC:	Background Assessment Criteria
BSIMAP:	BSC Black Sea Integrated Monitoring and Assessment Programme
BSIS:	BSC Black Sea Information System
BSSAP:	BSC Strategic Action Plan for the Rehabilitation and Protection of the Black Sea
CAMP:	OSPAR Comprehensive Atmospheric Monitoring Programme
CBD AG:	BSC Advisory Group on Conservation of Biodiversity
CEMP:	OSPAR Co-ordinated Environmental Monitoring Programme
CHASE:	HELCOM Hazardous Substances Status Assessment Tool
COMBINE:	HELCOM Cooperative Monitoring in the Baltic Marine Environment
CP:	Contracting party
DPSIR:	Drivers, Pressures, State, Impact, Response
EEA:	European Environmental Agency
EIONET:	European environment information and observation network
EMEP:	European Monitoring and Evaluation Programme
EQS:	Environmental Quality Standards
ETC/ICM:	European Topic Centre on Inland, Coastal and Marine Waters
ETCs:	European Topic Centres
GES:	Good Environmental Status
HASEC:	OSPAR Hazardous Substances and Eutrophication Committee
HEAT:	HELCOM Eutrophication Assessment Tool
HELCOM MORS EG:	HELCOM Monitoring of Radioactive Substances Expert Group
HELCOM MUNI:	HELCOM ad-hoc Expert Group to update and review the existing information on dumped chemical munitions in the Baltic Sea
JAMP:	OSPAR Joint Assessment and Monitoring Programme
LBSA Protocol:	BSC Protocol on the Protection of the Marine Environment of the Black Sea from Land-Based Sources and Activities
UNEP-MAP:	UNEP Mediterranean Action Plan
MED POL:	UNEP-MAP Programme for the Assessment and Control of Marine Pollution in the Mediterranean Region
MONAS:	HELCOM Monitoring and assessment group
MS:	Member State
MSFD:	Marine Strategy Framework Directive
NFPs:	National Focal Points
NRCs:	National Reference Centres
PLC 5.5:	HELCOM Pollution Load Compilation 5.5
PLC 6:	HELCOM Pollution Load Compilation 6
REMPEC:	UNEP-MAP Regional Marine Pollution Emergency Centre
RID:	OSPAR Comprehensive Study of Riverine Inputs and Direct Discharges
RSCs:	Regional Sea Conventions
WFD:	Water Framework Directive
WG DIKE:	MSFD CIS Working Group on Data, Information, and Knowledge Exchange
WISE SoE TCM:	WISE State of Environment data on transitional, coastal and marine waters
SGBALANS:	ICES Study Group on data requirements and assessment needs for Baltic Sea trout (T)
WG BAST:	ICES Working Group for Baltic Sea Salmon and Sea Trout ()
BSPI:	HELCOM's Baltic Sea Pressure Index

HELCOM AIS EWG:	HELCOM Expert Working Group for Mutual Exchange and Deliveries of AIS data (Alien Invasive Species)
AIS:	Automatic Identification System (of ships)
HELCOM BSAP:	HELCOM Baltic Sea Action Plan
TG Litter:	Technical Group on Marine Litter
TG Noise:	Technical Group on Underwater noise and other forms of energy
GFCM:	General Fisheries Commission for the Mediterranean
MEDITS	International Bottom Trawl Survey in the Mediterranean
ICCAT	International Commission for the Conservation of Atlantic Tuna
DCF	Data Collection Framework (of Common Fisheries Policy)

1 Introduction

1.1 Background

The Marine Strategy Framework Directive (MSFD, 2008/56/EC) “establishes a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status in the marine environment by 2020 at the latest” [Art.1(1)]. For that purpose the Member States have to develop Marine Strategies which apply an ecosystem-based approach to the management of human activities. In addition, the MSFD is to “contribute to coherence between, and aim to ensure the integration of environmental concerns into, the different policies, agreements and legislative measures which have an impact on the marine environment” [Art.1(4)]. Such policies include Community legislation and International Conventions.

The MSFD places a range of requirements on Member States, through the preparation of marine strategies, to assess the state of the marine environment, its pressures, environmental impacts and uses, and to establish monitoring programmes, environmental targets and measures in order to achieve or maintain good environmental status (GES). The directive requires Member States to cooperate within and across Europe's regional seas, including via the Regional Sea Conventions (RSCs), in order to achieve the objectives of the directive in a consistent and coordinated manner.

The need to integrate information systems across policies in order to support policy implementation has been outlined at the 9th meeting of WG DIKE in the document “Integration and streamlining of marine reporting and data” (DIKE_9-2014-05). The document points out that in order to fully benefit from the reported information across all relevant policies and to ensure its preparation, reporting and access are as efficient as possible, it is necessary to more systematically review current reporting processes.

A review of the links between MSFD reporting requirements and reporting under other EU Directives and international agreements such as the Regional Sea Conventions has been undertaken by MRAG, UNEP-WCMC, URS (2013). This review focused on reporting requirements but whether or not Member States (MS) or Contracting Parties (CP) are fulfilling their obligations was not investigated. As regards RSCs, the review did not include some aspects relevant to the MSFD reporting framework, such as objectives, assessments and targets that are undertaken collectively by each Convention rather than by each MS (as Contracting Party) as a reporting requirement.

The Service Contract “Development of a shared data and information system between the EU and the Regional Sea Conventions” is examining the data and information holdings within each of the four Regional Sea Conventions as well as the EEA, with the aim of characterizing the present information holdings and flow processes in place across Europe, in the light of their ability to support the MSFD and other relevant EU policies. Hence the work includes information developed by each Convention and EEA, with a view to identifying those data and information streams of most relevance to both regional and MSFD needs (e.g. contributing to common indicator assessments).

The four Regional Sea Conventions which cover EU marine regions or sub-regions are:

- The Convention for the Protection of the Marine Environment in the North-East Atlantic of 1992 (further to earlier versions of 1972 and 1974) – the OSPAR Convention (OSPAR);
- The Convention on the Protection of the Marine Environment in the Baltic Sea Area of 1992 (further to the earlier version of 1974) – the Helsinki Convention (HELCOM);
- The Convention for the Protection of Marine Environment and the Coastal Region of the Mediterranean of 1995 (further to the earlier version of 1976) – the Barcelona Convention, implemented in the framework of UNEP/MAP;
- The Convention for the Protection of the Black Sea of 1992 – the Bucharest Convention, implemented by the Black Sea Commission (BSC).

Together with the Eionet, EEA manages and updates the WISE-SoE data flows and has developed several pan European indicators which are regularly updated.

1.2 Objectives

This report is part of Deliverable 2 'Review and analysis of RSC information systems' of the Service Contract 'Development of a shared data and information system between the EU and the Regional Sea Conventions'. The objectives mentioned in the Service Request with respect to Deliverable 2 are:

1. Review the existing and anticipated data and information flows from MSs (as Contracting Parties) to RSCs (or developed directly by/within the RSCs) and assess their potential to contribute to MSFD implementation needs;

2. Review the processes and systems for acquiring, managing and making available these data and information and identify where these could be improved, including how these data and information flows could be streamlined and harmonised between the MSs, the RSCs and the EU/EEA in the context of MSFD and other relevant marine policies;

This report presents a review of the data and information holdings within each of the four RSCs, as well as the respective flow processes and management systems with the view to clarify to what extent RSC activities can support EU policies; in particular the MSFD and the WFD. The review addresses the following aspects:

1. Content including data, data products, status assessments etc. with focus on indicators.
2. Processes. Who provides the data and how is information flowing and managed.

1.3 Methods

Information was collected by direct communication to the RSC Secretariats and from the web sites of the RSCs. Meetings with the RSCs were held: Deltares and AZTI met with OSPAR on 5-6 February 2014; SYKE and Deltares met with HELCOM on 4 March 2014; HCMR met with UNEP/MAP (28 January 2014 and 12 May 2014) and held short meetings with BSC (28 January 2014 and 30 May 2014), followed by email communications.

The collected information was reviewed and compiled to provide:

1. an inventory and analysis of RSCs data and information and its flows that are of MSFD relevance.

2. an overview of the indicators established or proposed by each RSC, what they are used for and on which methodologies and data they are based.
3. an overview of assessments that are of MSFD relevance.

The following MSFD-relevant topics are addressed in this report

- Human activities and associated pressures
- Biodiversity (relating the MSFD descriptors D1, D2, D4 and D6)
- Commercial fish and shellfish (relating the MSFD descriptor D3)
- Eutrophication (relating the MSFD descriptor D5)
- Hazardous substances (relating the MSFD descriptors D8 and D9)
- Hydrographical changes (relating the MSFD descriptor D7)
- Marine Litter (relating the MSFD descriptor D10)
- Underwater noise (relating the MSFD descriptor D11)

The inventory of RSC data and information flows was conducted with respect to MSFD descriptors or group of descriptors and related indicators, and includes information on activities and pressures. The main focus of the inventory was to identify the current and anticipated data flows that can be used for assessments against GES and MSFD reporting.

For the topics biodiversity, commercial fish and shellfish, hydrographical changes, marine litter and underwater noise both existing and anticipated data and information flows for the existing and developing indicators of the RSCs were considered.

For the topics eutrophication and hazardous substances existing RSC data flows were assessed using data reported by the Contracting Parties to the RSCs in 2012 as a snapshot of the actual current reporting. Data overviews were provided by ICES (HELCOM, OSPAR), the MED POL database (UNEP/MAP) and IRIS SES Project (BSC).

1.4 Outline

The outline of the report is as follows:

Chapter 2 addresses information and data flows on human activities and pressures.

Chapters 3-9 address the topics relevant to MSFD descriptors as described above (for each descriptor or group of descriptors). The outline of each chapter is as follows:

1. Introduction
2. Identification of data
3. Analysis of data and information flows
4. Indicators and assessments for P/S/I
5. Information flow processes and management systems
6. Conclusions

Chapter 10: Synthesis and recommendations

The compilation of information in this report is going to be used as input in the Marine Information Schema (IMS) that is in development under Task 3 of the project, as well as in Task 4 for the feasibility study on the establishment of a shared information system.

2 RSC and EEA data and information holdings and data flows related to activities and pressures

2.1 Introduction

MSFD requires reporting of human activities, pressures and impacts under article 8. An indicative list of activities and pressures is included in Annex 4 of the Commission Staff Working Paper (SEC, 2011).

This chapter presents a review and analysis of the RSCs and EEA data streams and assessments of pressures and human activities in relation to the MSFD requirements.

2.2 Identification of data

2.2.1 HELCOM

There is no coordinated database on the anthropogenic pressures in the Baltic Sea but there are databases holding data for single pressures. Information on HELCOM data streams on human activities and pressures can be found below

- Shipping traffic database (data since 1985) administered by the HELCOM AIS Expert Working Group containing raw data on parameters such as ship location and routes and aggregated data products on shipping traffic e.g. Baltic wide HELCOM AIS average shipping density raster map.
- HELCOM Shipping accidents database containing data on shipping accidents reported by HELCOM contracting parties since 2000.
- HELCOM illegal oil discharges database containing information on oil and other harmful substance spills observed by HELCOM CPs in national and joint co-ordinated aerial surveillance activities.
- HELCOM Monitoring of Radioactive Substances Expert Group (HELCOM MORS EG) reporting to HELCOM MORS discharge database that holds data on discharges of radionuclides to the Baltic Sea
- Information on dumped chemical munitions in the Baltic Sea is available in the latest report prepared by the *ad hoc* Expert Group to Update and Review the Existing Information on Dumped Chemical Munitions in the Baltic Sea (HELCOM MUNI) (HELCOM, 2013a).
- Information on HELCOM activities and parameters used for the quantification of anthropogenic pressures in the Baltic Sea estimated in the Baltic Sea Pressure Index (BSPI) available in the background report to the methodology and data of the Baltic Sea Pressure Index (BSPI) and the Baltic Sea Impact Index (BSII) (HELCOM, 2010a).

2.2.2 OSPAR

Information on OSPAR data streams on human activities and pressures can be found below: http://www.ospar.org/content/content.asp?menu=01511400000000_000000_000000

- Discharges of Radionuclides from the non-nuclear sectors includes data reported by CPs on estimated discharges from the offshore oil and gas industry, and other sectors. The most recent year reported is 2011.The radionuclides reported from the offshore oil and gas industry are: Ra-226, Ra-228, Pb-210, discharged via produced

water. The data are converted into total alpha and total beta (excluding tritium) activity. Data are available at: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Non_nuclear_discharges-2011.zip

- Discharges, Spills and Emissions From Offshore Oil and Gas Installations includes data as most recent year, data of 2012 on: Number of installations with emissions and discharges covered by OSPAR measures, Produced and displacement water, installations exceeding the 30 mg/l performance standard for dispersed oil, Use and Discharges of Oil Based drilling Fluids (OBF) and cuttings, Use and Discharges of other Organic Phase drilling Fluids (Other OPF), Accidental spillages, Emissions to air, Use and discharge of offshore chemicals.
- Dumping of Wastes or Other Matter at Sea includes as most recent year, 2012 data on the overviews of permits issued, tonnes licensed and tonnes dumped, dumping operations of dredged material exceeding national action levels for sea disposal, Dredging operation, deposit sites and dumping amounts, Total loads.
- Encounters with Dumped Chemical and Conventional Munitions: are shapefiles outlining locations of encounters with munitions.
- Environmental Monitoring of Radioactive Substances.
- OSPAR Database on Offshore Wind-farms, 2013 shapefiles including details of wind-farms in the OSPAR area such as name, location, distance from the coast, number of wind turbines, current status, capacity in MW, foundations type, water depth, height, environmental impact information and other additional remarks.
- Liquid Discharges from Nuclear Installations: includes data on discharges of radioactive substances measured as total alpha and total beta activity and excluding tritium from nuclear installations with the most recent year 2011.
- Mercury Losses from the Chlor-alkali Industry includes data on Chlorine Production, Mercury Losses, Mercury Losses through Product, Atmospheric Emissions of Mercury, and Mercury in Safely Deposited Wastes with the most recent year 2011.

2.2.3 UNEP/MAP

Information on UNEP/MAP data streams on human activities and pressures can be found below:

- Releases, emissions and sources of pollutants in the Mediterranean region reported by the CPs and assessed in the National Baseline Budget (NBB) (UNEP/MAP, 2012a). Data include nutrients and hazardous substances released by different industrial sectors. One record in the database includes an emission value which aggregates all industrial releases for each pollutant from a given industrial subsector in an administrative region at national level (in total 103 pollutants reported).
- The Regional Marine Pollution Emergency Response Centre (REMPEC) database contains data on alerts and accidents in the Mediterranean Sea holding data on oil-related accidents reported since 1977 and other hazardous and noxious substances (HNS) related accidents reported since 1988.

2.2.4 BSC

Information on BSC data streams on human activities and pressures can be found below:

- Reporting of Land Based Sources of Pollution Advisory Group (LBS AG) including riverine, industrial loads and municipal loads of nutrients and hazardous substances, green-house gases, accidental pollution and waste waters.
- Reporting of Fishery and other Marine Living Resources Management Advisory Group (FOMLR AG) including aqua and mariculture activities, fishing fleet, fishing gears, fish processing, fishing areas and seasons, by-catch and discard, landings and stocks.
- Reporting of Integrated Coastal Zone Management Advisory Group (ICZM AG) including Population and Geography, Energy, Water and Wastewater, Coastal erosion, Tourism, Solid Waste Management, Agriculture, Industry, Transport, Climate.
- Reporting of the Environmental Safety Aspects of Shipping Advisory Group (ESAS AG) including ballast waters, oil spills, offshore installations, dumping and dredging, ports and port reception facilities, ships (tankers and cargo) calling at Black Sea ports and passing the Bosporus, cargo turnover, passengers.

The data are reported in specified templates (Excel Format) and stored in the Black Sea Information System (BSIS).

2.2.5 EEA

EEA has indicators on aquaculture production CSI33 and fishing fleet capacity CSI34.
CSI33 quantifies the development of European aquaculture production by major sea area and country as well as the contribution of aquaculture discharges of nutrients relative to the total discharges of nutrients into coastal zones. Data sources are FAO, Eurostat - Statistical Office of the European Union (ESTAT), and World Resources Institute http://www.eea.europa.eu/data-and-maps/indicators/aquaculture-production-1/#toc-4
CSI34 is a measure of the size and capacity of the fishing fleet, including the average size of vessels, which in turn are assumed to approximate to the pressure on marine fish resources and the environment. Data sets are from EUROSTAT. http://www.eea.europa.eu/data-and-maps/indicators/fishing-fleet-capacity/

2.3 Analysis of data and information flows

The analysis of data flows was focused on the parameters that are used by the RSCs in their assessments of human activities and pressures. HELCOM and UNEP/MAP assessments include data on activities and relevant parameters that are not reported under the current data streams described in 2.2, but were obtained from other sources, i.e. as done by the EEA for some of its indicators. The inventory of data flows can be found in Annex 1.

HELCOM activities and parameters listed in the inventory were those used for the quantification of anthropogenic pressures in the Baltic Sea estimated in the Baltic Sea Pressure Index (BSPI) (HELCOM, 2010a). For this quantification, HELCOM compiled data on 52 anthropogenic pressures. Data were requested from Contracting Parties or obtained from other available data sources (e.g., EU, EEA, EMEP, private companies). Further details on the data sources can be found in Annex 1. The data were compiled by the HELCOM HOLAS project and were further improved by the HELCOM BSPI workshop (11 February 2010, Stockholm). The BSPI tool was used in the HELCOM Initial Holistic Assessment (HELCOM, 2010b).

OSPAR activities and parameters listed in the inventory were compiled from the data streams presented in section 2.2 and relevant reports in the OSPAR area. Details on the data sources can be found in Annex 1.

UNEP/MAP activities and parameters listed in the inventory are from the State of the Mediterranean Environment report produced in the process of implementation of the ECAP approach (UNEP/MAP, 2012b). In the above report, data on human activities were collected from various sources (e.g. Plan Bleu, REMPEC, National Baseline Budget of pollution emissions and releases, FAO-GFCM, national sources). Further details on the data sources can be found in Annex 1.

BSC activities and parameters listed in the inventory are from the report on the Implementation of the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (2002-2007) (Annex IV Nationally reported data) (BSC, 2009a).

An overview of activities used by the RSCs in their assessments is shown in Table 2.1. The activities were categorized using a common typology developed for the MSFD assessments (provided by David Connor, DG Environment, 1406 MSFD assessment framework) in order to assess their relevance with MSFD requirements.

The activity themes addressed by all RSCs are Man-made structures (incl. construction phase) and Uses of environment and infrastructure.

As regards sub-activities, industry discharges and waste disposal, and land-based structures are used by all RSCs in their assessments.

Three of the RSCs use dredging (for navigation purposes), offshore marine infrastructure (including associated with mineral and energy extraction), cables and pipelines, extraction of oil and gas, wind energy production, transport – shipping in their assessments.

A number of sub-activities are not used by any of the RSCs (22 sub-activities).

The parameters used by the RSCs for the assessment of human activities are shown in detail in Table 2.2. Overall, a wide range of parameters are used for the quantification of these activities.

The common activities addressed by all RSCs are assessed using different parameters:

- Industrial discharges and waste disposal are assessed using parameters such as average outflow of discharge water, no of plants, emissions and production capacity from the Chlor-alkali industry, industrial hazardous waste production, total amount of waste waters etc.
- Tourism/leisure infrastructure is assessed using parameters such as number of bathing sites, % of coastline with artificial structures, number of tourists per kilometre of coastline during peak season, touristic accommodation capacities (places/year), etc.

Input loads of nutrients and hazardous substances that are assessed by all RSCs are addressed in Chapters 5 on eutrophication and Chapter 7 on hazardous substances respectively as input levels of pressures.

A good example of activities assessment in line with MSFD is the HELCOM application of the Baltic Sea Pressure Index (BSPI) where 52 anthropogenic pressures, classified according to the list of 18 pressures in Annex III, of the MSFD were used (HELCOM, 2010a).

Table 2.1.Human activities used by the RSCs in their assessments.

Theme*	Activity*	Sub-activity*	Baltic	NE Atlantic	Mediterranean	Black Sea
			HELCOM	OSPAR	UNEP/ MAP	BSC
Landscape restructuring						
	Land claim (permanent changes)			X		
	Canalisation and other watercourse	Canalisation				
	Coastal defence and flood protection	Sea walls	X	X		
		Flood protection	X			
	Landscaping (semi-permanent	Dredging (for navigation purposes)	X	X		X
		Beach replenishment/ nourishment		X		
Man-made structures (incl. construction	Urban developments					
		Urban discharges and waste disposal	X	X	X	X
	Industrial developments					X
		Industry discharges & waste disposal	X	X	X	X
	Transport infrastructure			X		
	Tourism/leisure infrastructure	Land-based structures	X	X	X	X
		Sea-based structures (piers, harbours,	X			
	Ports and other coastal constructions	Ports	X			X
	Offshore marine infrastructure		X	X		X
	Cables & pipelines		X	X		X
Extraction of non-living resources						
	Extraction of oil and gas		X	X		X
	Extraction of sand and gravel					
	Extraction of rock & minerals		X			
	Extraction of salt					
	Extraction of water					
Extraction of energy	Renewable energy generation (wind, wave & tidal power)					
		Wind energy production	X	X		X
		Tidal energy production				
		Wave energy production				
	Non-renewable energy generation	Fossil fuel energy production				
		Nuclear energy production	X			
Extraction of living resources	Fish & shellfish harvesting (professional, recreational)				X	X
		Potting/ creeling	X			
		Netting	X			
		Demersal long lining				
		Pelagic long lining	X			
		Benthic trawling	X			
		Pelagic trawling	X			
		Demersal seining				
		Purse seining				
		Benthic dredging				
		Suction/ hydraulic dredging				
		Leisure fishing				
		Hand collecting (shellfish)				

* Common typology of activities provided by David Connor, DG Environment.

Theme*	Activity*	Sub-activity*	Baltic HELCOM	NE OSPAR	Meditte UNEP/ MAP	Black Sea BSC
	Marine plant harvesting					
		Machine collection (fucoids, kelp)				
		Dredging (maerl)	X			
		Hand collecting (seaweed)				
	Hunting and collecting for non-food					
		Hunting	X			
		Harvesting/ collecting eggs				
		Collecting (curios)				
		Bait digging				
Cultivation of living resources						
	Aquaculture	Fin-fish mariculture	X	X		X
		Seaweed culture				
		Shellfish mariculture		X		X
	Agriculture				X	X
	Forestry					
Uses of environment and infrastucture	Transport - shipping		X		X	X
infrastucture	Transport - air					X
	Tourism and recreation				X	X
		Boating, yachting	X			
		Beach use	X			X
		Water sports (surface)				
		Scuba diving				
		Wildlife watching				
	Research and survey					
	Military use					
		Military - waste disposal (munitions)	X	**		
	Waste disposal					
		Solid waste disposal, incl. dredge	X	X		X
		Carbon sequestation				

* Common typology of activities provided by David Connor, DG Environment.

** data on dumped chemical munitions in the Baltic Sea is available but this parameter was not used in the latest HELCOM assessment of pressures (HELCOM, 2010a).

Table 2.2 Parameters used by the RSCs for the assessment of human activities.

Activity*	**Sub-activity***	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
Land claim (permanent changes)			Surface area		
Canalisation and other watercourse modifications	Canalisation Culverting Causeways				
Coastal defence and flood protection	Sea walls Breakwaters Groynes	Presence/absence of bridges and coastal dams	% of coastline with coastal protection measures		
	Flood protection	Total length of the defence structures			
Landscaping (semi-permanent changes)	Dredging (for navigation purposes)	Amount of dredged material (in tonnes)	Amount of material dredged (in tonnes)		Volume of dumped dredged spoils (m^3)
	Beach replenishment/ nourishment		Volume of sand extracted (m^3)		
Urban developments					
	Urban discharges and waste disposal	Average outflow of treated waste water			Total amount of waste waters discharged into the Black Sea
				BOD-5 released	Ammonia, Anionic active surfactants, BOD-5, COD-Mn, TOX, AOX, TSS loads and flow
					Amount of insufficiently treated water
					Amount of untreated waters

Activity*	**Sub-activity***	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
					Public sewage network system (No of localities)
					Drinking water supply network (No of localities)
					Volume of drinking water supplied to consumers (m^3)
					Population with access to clean drinking water (N^o)
					Length of drinking water supply network (km)
					Population connected to WWTP (total rural+urban)
Industrial developments					
	Industry discharges & waste disposal	Average outflow of discharge water		Industrial hazardous waste production (Tonnes per million Euros of industrial GDP)	Total amount of waste waters discharged into the Black Sea
			No of plants, emissions, production capacity from the Chlor-alkali Industry		
					Amount of insufficiently treated water
					Amount of untreated waters
				BOD-5 released by different industrial sectors(including WWTPS)	Ammonia, Anionic active surfactants, BOD-5, COD-Mn, TOX, AOX, and TSS loads and flow
		Average discharges of radioactive substances (caesium-137, strontium-90, and cobalt-60) (in Bq) over five	Discharges of radioactive substances in Bq		

Activity*	Sub-activity*	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
		years			
Transport infrastructure					
Tourism/leisure infrastructure	Land-based structures	Number of bathing sites per cell	% of coastline with artificial structures	Thousand tourists per kilometre of coast during peak season	Touristic accommodation capacities (places/year)
				International tourism receipts	Touristic accommodation units in coastal zone (n°/year)
					Number of tourist arrivals (national, from abroad, n°/year)
					Number of tourist facilities conducting ecological audit (n°)
					Number of Tourist Companies Promoting Green Tourism
					Number of "Blue Flag" beaches
					Carrying capacity of beaches (sqm per person)
					Number of tourist staying overnight (n°/year)
	Sea-based structures (piers, harbours, marinas, slipways)	Summed number of marinas (estimate based on population density)			
Ports and other coastal constructions	Ports	Total annual cargo volume (in tonnes)			Ports and port reception facilities
					Number of harbours

Activity*	**Sub-activity***	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
Offshore marine infrastructure (including associated with mineral and energy extraction)		Offshore wind farms: number of wind turbines per cell	No of installations and location		Offshore installations
Cables & pipelines		Submarine cables: presence or absence of cables under construction	Catalogue (not comprehensive)		Lengths of oil pipelines (km)
					Capacity of oil pipelines (tonnes per year)
					Length of gas pipelines (km)
					Capacity of gas pipelines (min tonnes/year)
Extraction of oil and gas		Operational oil platforms: presence/absence	No of installations, quantity and quality of discharges		Offshore installations
			Loads per year		
			No and location of installations		
Extraction of sand and gravel		Amount of dredged material (in tonnes)	Volume extracted		
Extraction of rock & minerals		Amount of dredged material (in tonnes)			
Extraction of salt					
Extraction of water					
Renewable energy generation (wind, wave & tidal power)					
	Wind energy production	Offshore wind farms: number of wind turbines per cell	Offshore wind farms: location, number of		No of wind farms

Activity*	Sub-activity*	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
			installations		
		Operational wind farms: number of turbines			
		Wind farms under construction: number of turbines under construction			
	Tidal energy production				
	Wave energy production				
Non-renewable energy generation	Fossil fuel energy production				
	Nuclear energy production	number of active reactors			
Fish & shellfish harvesting (professional, recreational)				Fish catches (tonnes)	Landings
					Fishing fleet
					Fishing gears
					Fish processing
					Fishing areas and seasons
					By-catch and discard
					Stocks
	Potting/ creeling	Commercial coastal and stationary fishery: Total amount of the landings or catches in tonnes			

Activity*	**Sub-activity***	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
	Netting	Commercial gillnet fishery: Total amount of the landings or catches in tonnes			
	Demersal long lining				
	Pelagic long lining	Commercial surface and mid-water fishery: Total amount of the landings or catches in tonnes			
	Benthic trawling	Commercial bottom-trawling fishery: Total amount of the landings or catches in tonnes			
	Pelagic trawling	Commercial surface and mid-water fishery: Total amount of the landings or catches in tonnes			
	Demersal seining				
	Purse seining				
	Benthic dredging				
	Suction/ hydraulic dredging				
	Leisure fishing				
	Hand collecting (shellfish)				
Marine plant harvesting					
	Machine collection (fucoids, kelp)				
	Dredging (maerl)	Amount of dredged material (in tonnes)			

Activity*	Sub-activity*	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
	Hand collecting (seaweed)				
Hunting and collecting for non-food purposes					
	Hunting	Average number of birds shot over five years (data per country)			
		Average number of seals shot over five years (data per country)			
	Harvesting/ collecting eggs				
	Collecting (curios)				
	Bait digging				
Aquaculture	Fin-fish mariculture	Total phosphorus load (P_TOT) per site	Finfish production (tonnes)		Fish restocking farms and species cultivated
					Mussel and fish rearing
					Norms and impacts
	Seaweed culture				
	Shellfish mariculture		Shellfish production (tonnes)		Mussel and fish rearing
Agriculture				People employed in agriculture	Total area of agricultural lands
				Agricultural land	Arable lands treated with mineral fertilizers (thousand ha)

Activity*	**Sub-activity***	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
					Fertilizers application rate (kg/ ha)
					Arable lands treated with pesticides (sqKm)
					Pesticides application rate (kg per ha)
					Area of irrigated lands (ha)
					Number of animal farms
					Number of cattle (thousand heads)
					Number of pigs (thousand heads)
					Number of sheep (thousand heads)
					Number of poultry (thousand heads)
Forestry					
Transport - shipping		Relative traffic intensity value (within 12 nautical miles from the coast)		Maritime accidents	
		Relative traffic intensity (outside 12 nautical miles from the coast)		Main shipping routes	Total harbour area (ha)
		Polluting ship accidents: amount of pollution (in m^3)		Container traffic	Harbour traffic capacity (min tonnes/year)
		Oil slicks and spills: amount of oil discharged classified according to three classes (1, 2 and 3)			Number of oil terminals
Transport - air					Capacity of oil terminals (kilotonnes per year)

Activity*	Sub-activity*	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
Tourism and recreation					
	Boating, yachting	Summed number of marinas (estimate based on population density)			
	Beach use	Number of bathing sites		Thousand tourists per kilometre of coast during peak season	Carrying capacity of beaches (sqm per person)
	Water sports (surface)				
	Scuba diving				
	Wildlife watching				
Research and survey					
Military use					
	Military - waste disposal (munitions)	**	Locations of dumped chemical munitions		
Waste disposal					
	Solid waste disposal, incl. dredge material	Quantity of disposed material (in tonnes)	Amount of material dredged (in tonnes)		Industrial wastes (tonnes/year)
					Hazardous industrial wastes(tonnes/year)
					Municipal wastes(tonnes)
					Number of landfills
					Total capacity of landfills
					Number of incineration plants (tonnes/year)

Activity*	**Sub-activity***	Baltic	NE Atlantic	Mediterranean	Black Sea
		HELCOM	OSPAR	UNEP/MAP	BSC
					Total capacity of incineration plants (tonnes/year)
	Carbon sequestration				

** Common typology of activities provided by David Connor., DG Environment*

*** Data on dumped chemical munitions in the Baltic Sea is available but this parameter was not used in the latest HELCOM assessment of pressures (HELCOM, 2010a).)*

2.4 Information flow processes and management systems

HELCOM

- Shipping traffic database: the database is hosted by the Danish Maritime Authority (DMA). Shipping traffic can be visualized and shapefiles are available in HELCOM map and data service at http://maps.helcom.fi/website/mapservice/index.html under “Maritime & Response-Maritime traffic statistics”.
- HELCOM Shipping accidents database: Shipping accidents can be visualized and shapefiles are available in HELCOM map and data service at http://maps.helcom.fi/website/mapservice/index.html under “Maritime & Response-Shipping accidents”.in addition, reports are available.
- HELCOM illegal oil discharges database: Illegal oil discharges can be visualized and shapefiles are available in HELCOM map and data service at http://maps.helcom.fi/website/mapservice/index.html under “Maritime & Response-Illegal oil disgharges”.in addition reports are available
- HELCOM Monitoring of Radioactive Substances Expert Group (HELCOM MORS EG) reports: CP submission to HELCOM data consultant (STUK, Finnish Radiation and Nuclear Safety Authority). Cs-137 concentrations in fish and water can be visualized and shapefiles are available in HELCOM map and data service at http://maps.helcom.fi/website/mapservice/index.html under “Sea environmental status-Hazardous substances-Radioactive Substances”.
- Dumped chemical munitions in the Baltic Sea: Multiple parameters related to dumped chemical munitions can be visualized and shapefiles are available in HELCOM map and data service at http://maps.helcom.fi/website/mapservice/index.html under “Maritime spatial planning-Defence and scientific research-Dumped chemical munitions”. In addition reports are available
- HELCOM Map and data service also contains visual information and available shapefiles for location of Oil platforms, Oil terminals, Nuclear facilities, Cables and pipelines, Offshore wind farms, dredging and dumping sites, bathing sites as well as commercial fisheries pressure.

OSPAR
Information on OSPAR data flow and management systems on human activities and pressures can be found below:
http://www.ospar.org/content/content.asp?menu=01511400000000_000000_000000

OSPAR is developing a system for management of in-house and incoming data and information, the OSPAR Data and Information Management System (ODIMS). The system should come in place during 2015.

- Discharges of Radionuclides from the non-nuclear sectors: Annual data collection by OSPAR on discharges from the non-nuclear sector has only been taking place from 2006-2011. Due to the incompleteness of datasets, no data have been published until 2009. Data are organized in a Microsoft Office Access Database that is available on-line at: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Non_nuclear_discharges-2011.zip. The latest report can be found at:

http://www.ospar.org/documents/dbase/publications/p00605/p00605_Discharges_from_the_non-nuclear_sectors_2011.pdf

- Discharges, Spills and Emissions From Offshore Oil and Gas Installations: Data are collected from 1984-2011. The latest data of 2011 are available in spreadsheet format at the following link: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Discharges_Spills_Emissions_2011.zip. The 2011 OSPAR report on discharges, spills and emissions from offshore oil and gas installations, is available at: http://www.ospar.org/documents/dbase/publications/p00603/p00603_offshore%20discharges_report%202011.pdf
- Dumping of Wastes or Other Matter at Sea from 1991-2011: the data are in the form of a Microsoft Office Access Database available at: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Dumping_of_Wastes-2011.zip. The latest annual 2011 OSPAR report on dumping of wastes or other matter at sea, is available at: http://www.ospar.org/documents/dbase/publications/p00607/p00607_dumping%20report_2011.pdf, and
- Encounters with Dumped Chemical and Conventional Munitions: Historic dumpsites and munition encounters data are available as shapefiles (GIS layers) at the following links: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Munitions_Dumpsites.zip , http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Munitions_Encounters-2011.zip. Their reports (od 2010 and 2011) are available at: http://www.ospar.org/documents/dbase/publications/p00519/p00519_2010%20revised%20dumping%20at%20sea%20of%20munitions%20and%20weapons.pdf , and http://www.ospar.org/html_documents/ospar/html/data/assessment_fact_sheets/ospar_assessment_sheet_munitions_2013.pdf
- Environmental Monitoring of Radioactive Substances: No on-line data access point or report was identified for these data, only contact email address.
- OSPAR Database on Offshore Wind-farms: OSPAR has produced the OSPAR Database on Offshore Wind-farms, which constitutes an inventory of all planned (under application), authorised, refused, operational, out of service and decommissioned wind-farms installations under the jurisdiction of the OSPAR Contracting Parties. The data are in the form shapefiles (GIS layers) and available at: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Windfarms_2013.zip . The latest report (updated on 2013) is available at: http://www.ospar.org/documents/dbase/publications/p00609/p00609_database_offshore%20wind-farms.pdf
- Liquid Discharges from Nuclear Installations: The data from 1995-2011 are in the form of spreadsheets and available at: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Nuclear_Liquid_Discharges-2011.zip. The latest 2011 annual report includes the data of 2011 on liquid radioactive discharges from nuclear installations and temporal trends for the period 1990 - 2011. An assessment has been made for the discharges from nuclear power stations, nuclear fuel reprocessing plants, nuclear fuel fabrication and enrichment plants, research and development facilities, and decommissioning and management of legacy radioactive wastes activities. Discharges are reported as total alpha, tritium and total beta activity (excluding tritium) in terabecquerel per year (TBq/y) for each type of nuclear installation.

- Mercury Losses from the Chlor-alkali Industry: The Chlor-alkali data from 1998-2011 are in the form of spreadsheets and available at: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Mercury_Losses_Chlor-Alkali-2011.zip. The 2011 report on Mercury losses from the Chlor-alkali industry can be found at: http://www.ospar.org/documents/dbase/publications/p00600/p00600_Mercury_losses_report_2011.pdf

UNEP/MAP
The UNEP/MAP information system is expected to be on line in December 2014. Releases, emissions and sources of pollutants in the Mediterranean region are reported by the CPs for the National Baseline Budget every five years.

BSC
The on-line Black Sea Information System (BSIS) was designed in the framework of the Black Sea Ecosystem Recovery Project (BSERP) for implementation of the Information Strategy of the Black Sea Commission. Nationally reported data of land based sources, conservation of biodiversity, fisheries and other marine living resources, environmental safety aspects of shipping, integrated coastal zone management and pollution monitoring and assessment started in 2001. Special reporting templates (Excel spreadsheet format) were developed. The database has been populated with data from 2001-2005. An important component of the BSIS system is the linking of spatial data available in GIS format (Black Sea GIS) with data from national reporting (monitoring, sensitivity zones, land based pollution sources, etc.). Additional data, such as designated protected areas, land use of the coastal zones are currently being digitised/reprocessed based on information presented by the countries. The on-line BSIS still requires improvement of functionality and refining.
Data flow within BSIS is organized in the following way:

- Black Sea coastal states annually deliver data on sources and inputs to the BSC– before 1st of August, for the previous year in the reporting formats
- Advisory Groups Focal Points in Black Sea countries enter data in standardised format and send it to the Secretariat or upload it using on-line importing routines.
- Secretariat staff checks and imports received data to central database using on-line importing routines.
- Data are not accessible on-line, only registered users can access the central BSIS and only data reported to EEA.

Additional data on Human Activities which were presented in the previous section were available in reports and not included in the above databases.

EEA
The latest version on aquaculture production (CSI33) indicator and assessment is published on September 2011 at: http://www.eea.europa.eu/data-and-maps/indicators/aquaculture-production-1/aquaculture-production-assessment-published-feb .
Updates were scheduled every 1 year in July-September.
The above address includes links for data discovery, direct data access from the sources, as well as data and products (maps) visualization services.

2.5 Conclusions

There are RSC data and information streams on human activities and several provide data on a regular basis. However not all sub-activities required by MSFD are reported. There are differences across RSCs with respect to the type of activities /sub activities they address.

There are several regional templates (mainly in excel format) and reporting mechanisms across the RSCs (simple email exchange or on-line submission tools). The data and their information (metadata) are organized in different ways: in files (e.g. in excel files), in relational data bases (e.g. SQL), or in on-line catalogues which however do not use common standards such as interoperable metadata formats and vocabularies to allow easy searching, retrieval and usage. Information on the quality control checks and validation procedures is not always visible and clearly reported. Not all the data types are accessible on-line, nor are all the databases developed available on-line. Even if the data can be identified and accessed, they do not always have the same units, naming and codes, thus their compilation in unique data sets is not always trivial.

In general, the homogenization and standardization of the regional distributed data and metadata systems requires more efforts as the data cannot be easily shared among the different systems.

Similar challenges are being managed in other currently on-going projects such as EMODnet Human Activities which provides data products and services from a wide range of human activities useful for different Descriptors, coming from public and private sources all across Europe, including RSCs. Data are harmonised into interoperable formats that include agreed standards, common baselines or reference conditions, assessments of their accuracy and precision.

3 RSC and EEA data and information holdings and data flows related to biodiversity

3.1 Introduction

MSFD sets out three biodiversity related Descriptors D1 – Biological Diversity, D4 – Food-webs and D6 – Sea-floor Integrity. MSFD Descriptor D2 – Non-indigenous Species is also included in this chapter since RSCs (HELCOM, OSPAR and BSC) address non indigenous species under the biodiversity theme.

D1 is assessed at different levels of biological organization i.e. species, groups of species, habitat and ecosystem level. Commission Decision 2010/477/EU sets out 7 criteria for D1 covering assessments at the species/species group level (1.1, 1.2, and 1.3), habitat level (1.4, 1.5, and 1.6) and ecosystem level (1.7) and 14 indicators to describe these criteria (Table 3.1). D1 focuses on groups of highly mobile marine species (birds, mammals, reptiles, fish and cephalopods), on predominant habitat types of the water column and seabed and their associated biological communities and also addresses specific species and habitat types which are listed for protection under the Birds and Habitats Directives and under international agreements.

D4 assessment has close links to the assessment at ecosystem level of D1 as it addresses functional aspects of marine ecosystems. Commission Decision 2010/477/EU sets out 3 criteria for D4 and 3 indicators to describe them (Table 3.1).

D6 assessment has strong links to D1 on seabed habitats. Commission Decision 2010/477/EU sets 2 criteria and 6 indicators for D6 (Table 3.1) that address the quality of seabed habitats which to some extent are linked to indicators under D1.

D2 addresses the introduction of non-indigenous species that is expected to have an effect on the state of all relevant biodiversity components (i.e. at the level of species, habitats and ecosystems). Commission Decision 2010/477/EU sets out 2 criteria for D2 and 3 indicators to describe them (Table 3.1).

RSCs (HELCOM, OSPAR, UNEP/MAP, BSC) have adopted key indicators for biodiversity covering objectives set by their strategies. The degree of indicator development varies among biodiversity indicators within RSCs and across RSCs and is presented in Chapter 3.4.

HELCOM core indicators were proposed and developed by the CORESET project (2010-2013). They were selected based on a set of predefined principles that included their capability for assessments under the HELCOM BSAP and the MSFD (HELCOM, 2013b). The HELCOM biodiversity core indicators cover the three HELCOM ecological objectives of the BSAP (Tables 3.1-3.4) and potentially cover MSFD Descriptors D1, D2, D4 and D6 although with gaps at the criterion/indicator level.

OSPAR has adopted a first set of common indicators based on a set of criteria including applicability across the OSPAR region and response to MSFD requirements (OSPAR, 2013a,b). The OSPAR biodiversity common indicators are grouped into species/species groups (Mammals, Birds, Fish-Cephalopods), habitat types (Pelagic, Benthic habitat), food

webs and non-indigenous species and are under development by the relevant expert groups under ICG-COBAM. The OSPAR biodiversity common indicators address MSFD Descriptors D1, D2, D4 and D6.

UNEP/MAP is in the process of implementing the Ecosystem Approach and has set Ecological Objectives (EOs) (Tables 3.1-3.4), operational objectives and indicators that are in line with the MSFD descriptors and criteria (UNEP/MAP, 2012c). Subsequently, a set of common indicators were proposed taking into account practices of other RSCs, experience gained by the CPs through their regular MED POL monitoring activities as well as the experience gained by EU MS through their implementation of EU Directives such as the Marine Strategy Framework Directive, the Water Framework Directive and the Habitats and Birds Directives. In the Integrated Correspondence Groups of GES and Targets meeting held in February 2013, 5 Common Indicators were agreed for EO1 on biodiversity and 1 Common Indicator on EO2 on non-indigenous species addressing MSFD Descriptors D1, D2 and D6 (UNEP/MAP, 2014a,b,c).

BSC addresses the biodiversity theme under Ecosystem Quality Objective (EcoQO) 2 of the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (BSSAP) and the Landscape Conservation Protocol 2002 (Tables 3.1-3.4). BSC in the implementation of BSIMAP (Black Sea Integrated Monitoring and Assessment Program) used indicators for biodiversity (BSC, 2010a and personal communication with BSC Secretariat) addressing MSFD Descriptors D1, D2 and D6.

The objectives and indicators of the four RSCs in parallel to the corresponding criteria and indicators of MSFD for GES descriptors D1, D2, D4 and D6 can be found in Annex 2. Tables 3.1-3.4 present an overview of links between RSC objectives-indicators and MSFD criteria-indicators for D1, D2, D4 and D6. The colour coding in Tables 3.1-3.4 is as follows

- blue: existing relevant objective or common/core indicator
- light blue: existing candidate/pre-core indicator
- red: no relevant objective or common/candidate/core/pre-core indicator.

EEA has two indicators relevant to D2:
MAR002-Trends in introduction of non-indigenous species (NIS) per decade: rate of introduction of NIS per year, at Pan-European level, and sub-regional level.
MAR003-Trends in NIS pathways per decade: percentage of pathways per regional sea from 1950 to 2014.

Table 3.1 Linkages of the RSCs objectives and indicators to MSFD criteria and indicators for the GES Descriptor D1. Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator.

MSFD			**HELCOM**		**OSPAR**		**UNEP/MAP**		**BSC**	
D1: Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.			**Strategic goal**: Favourable conservation status of Baltic Sea biodiversity		**Strategic objective:** To halt and prevent by 2020 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems, and to restore, where practicable, marine areas which have been adversely affected		**Ecological Objective (EO) 1:** Biological diversity is maintained or enhanced		**Ecosystem Quality Objective (EcoQO) 2:** Conservation of Black Sea Biodiversity and Habitats Biodiversity and Landscape Conservation Protocol 2002 (BSBLCP) – art.1, 4	
Criteria	**Indicator**	**Type**	**Ecological objectives**	**Core/pre-core Indicators**	**Ecological Quality Objectives**	**Common/ candidate Indicators**	**Operational objectives**	**Common Indicators**	**Sub EcoQOs**	**Indicators**
1.1 Species Distribution	1.1.1. Distributional range	S								
	1.1.2 Distributional pattern within the latter, where appropriate	S								
	1.1.3 Area covered by the species (for sessile/benthic species)	S								
1.2 Population Size	1.2.1 Population abundance and/or biomass, as appropriate	S								
1.3 Population Condition	1.3.1 Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates)	S								
	1.3.2 Population genetic structure, where appropriate	S								
1.4 Habitat Distribution	1.4.1 Distributional range	S								

MSFD			HELCOM		OSPAR		UNEP/MAP		BSC	
	1.4.2 Distributional pattern	S								
Criteria	**Indicator**		**Ecological objectives**	**Core/pre-core Indicators**	**Ecological Quality Objectives**	**Common/ candidate Indicators**	**Operational objectives**	**Common Indicators**	**Sub EcoQOs**	**Indicators**
1.5 Habitat Extent	1.5.1 Habitat area	S								
	1.5.2 Habitat volume, where relevant	S								
1.6 Habitat Condition	1.6.1 Condition of the typical species and communities	S								
	1.6.2 Relative abundance and/or biomass, as appropriate	S								
	1.6.3 Physical, hydrological and chemical conditions	S								
1.7 Ecosystem Structure	1.7.1 Composition and relative proportions of ecosystem components (habitats and species)	S								

Table 3.2 Linkages of the RSC objectives and indicators to MSFD criteria and indicators for the GES Descriptor D2. Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator.

MSFD			**HELCOM**		**OSPAR**		**UNEP/MAP**		**BSC**	
D2: Non indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.			**Strategic goal**: Favourable conservation status of Baltic Sea biodiversity		**Strategic objective:** To halt and prevent by 2020 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems, and to restore, where practicable, marine areas which have been adversely affected		**Ecological objective (EO) 2:** Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem		**Ecosystem Quality Objective (EcoQO) 2c:** Reduce and manage human mediated species introductions	
Criteria	**Indicators**	**Type**	**Ecological objectives**	**Core/ pre-core Indicators**	**Ecological Quality Objectives**	**Common/ Candidate Indicators**	**Operational objectives**	**Common Indicators**	**Sub EcoQOs**	**Indicators**
2.1 Abundance and state characterisation of non-indigenous species, in particular invasive species	2.1.1 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 of such species.	P								
2.2 Environmental impact of invasive non-indigenous species	2.2.1 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)	I								
	2.2.2 Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible	I								

Table 3.3 Linkages of the RSC objectives and indicators to MSFD criteria and indicators for the GES Descriptor D4. Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator

MSFD			**HELCOM**		**OSPAR**		**UNEP/MAP**		**BSC**	
D4: All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.			**Strategic goal**: Favourable conservation status of biodiversity		**Strategic objective:** To halt and prevent by 2020 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems, and to restore, where practicable, marine areas which have been adversely affected		**Ecological objective EO4:** Alterations to components of marine food webs caused by resource extraction or human-induced environmental changes do not have long-term adverse effects on food web dynamics and related viability		Biodiversity and Landscape Conservation Protocol 2002 (BSBLCP)-art.1, 4 BSSAP 2009 **Ecosystem Quality Objective (EcoQO) 2**:Conservation of Black Sea Biodiversity and Habitats	
Criteria	**Indicators**	**Type**	**Ecological objectives**	**Core/ pre-core Indicators**	**Ecological Quality Objectives**	**Common/ Candidate Indicators**	**Operational objectives**	**Common Indicators**	**Sub EcoQOs**	**Indicators**
4.1 Productivity (production per unit biomass) of key species or trophic groups	4.1.1 Performance of key predator species using their production per unit biomass (productivity)	S								
4.2 Proportion of selected species at the top of food webs	4.2.1 Large fish (by weight)	S								
4.3 Abundance/distribution of key trophic groups/species	4.3.1 Abundance trends of functionally important selected groups/species	S								

Table 3.4 Linkages of the RSC objectives and indicators to MSFD criteria and indicators for the GES Descriptor D6. Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator.

MSFD			**HELCOM**		**OSPAR**		**UNEP/MAP**		**BSC**	
D6: Sea floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.			**Strategic goal**: Favourable conservation status of biodiversity		**Strategic objective:** To halt and prevent by 2020 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems, and to restore, where practicable, marine areas which have been adversely affected		**Ecological objective (EO) 6:** Sea-floor integrity is maintained, especially in priority benthic habitats.		Biodiversity and Landscape Conservation Protocol EcoQO 1b- Restore/rehabilitate stocks of commercial marine living resources	
Criteria	**Indicators**	**Type**	**Ecological objectives**	**Core/ pre-core Indicators**	**Ecological Quality Objectives**	**Common/ Candidate Indicators**	**Operational objectives**	**Common Indicators**	**Sub EcoQOs**	**Indicators**
6.1 Physical damage, having regard to substrate characteristics	6.1.1 Type, abundance, biomass and areal extent of relevant biogenic substrate	S/I								
	6.1.2 Extent of the seabed significantly affected by human activities for the different substrate types	I								
6.2 Condition of benthic community	6.2.1 Presence of particularly sensitive and/or tolerant species	S/I								
	6.2.2 Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species	S/I								
	6.2.3 Proportion of biomass or number of individuals in the macrobenthos above some specified length/size	S/I								
	6.2.4 Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community	S/I								

3.2 Identification of data

This chapter describes the current RSC data streams providing biodiversity data and the relevant databases.

3.2.1 ICES

ICES is the responsible data centre for part of the marine environmental monitoring data of HELCOM and OSPAR. Contracting Parties are obliged to report COMBINE (HELCOM Cooperative Monitoring in the Baltic Marine Environment) and CEMP (Comprehensive Environmental Monitoring Programme) monitoring data to ICES on an annual basis by 15 September every year using the agreed reporting formats. The submission is done by email.
The following data collections are held by ICES (based on the 2013 ICES dataset overview):

- Fish Trawl Survey (DATRAS). The database products are used by the ICES community (i.e. expert groups, scientists) and public users for fish stock assessments and marine biology studies
- Fish predation: Fish stomach content dataset from the Northeast Atlantic stomach contents for the study of predator/prey relationships and ecosystem food chains
- Biological community data (Phytoplankton, Zooplankton, Phytobenthos, Zoobenthos) for the estimation of the environmental and ecological status of the sea
- ICES Eggs and Larvae-Ichthyoplankton surveys with different target species, spatial and temporal coverage for biological and stock assessment studies
- ICES Historical Plankton digitized data from 1901 to 1912

3.2.2 HELCOM

Information on the parameters relevant to biodiversity that the HELCOM data and information streams include can be found below:

- HELCOM REDLIST datasets contain information about:
  - Red list of Baltic Sea species (http://helcom.fi/baltic-sea-trends/biodiversity/red-list-of-species) is the first threat assessment for Baltic Sea species and covers all marine mammals, fish, birds, macrophytes (aquatic plants), and benthic invertebrates, and follows the Red List criteria of the International Union for Conservation of Nature (IUCN).
  - Red List of Baltic Sea underwater biotopes, habitats and biotope complexes (http://helcom.fi/baltic-sea-trends/biodiversity/red-list-of-biotopes-habitats-and-biotope-complexes). The Red List assessment identifies biotopes, habitats and biotope complexes that are under threat of collapse.
- HELCOM MPA- The HELCOM Marine Protected Areas data base (former Baltic Sea Protected Areas (BSPA) database) is designed to centralise relevant information on the Baltic Sea Protected Areas. The database includes general information on the sites and their management plans, as well as lists of species, habitats, biotopes and biotope complexes.. Lists are based on EC Birds and Habitats Directives (Annex I and II); HELCOM Red List of Marine and Coastal Biotopes and Biotope Complexes of the Baltic Sea, Belt Sea and Kattegat (HELCOM 1998); and HELCOM list of threatened and/or declining species and habitats/biotopes of the Baltic Sea Area (HELCOM 2006). The Baltic Sea Protected Areas database is accessible from BSPA portal (http://bspa.helcom.fi/). From the portal it is possible to search and query

information about all protected areas. (http://bspa.helcom.fi/flow/bspaindex.index). The BSPA data sets can be visualized and accessed from the Baltic Sea Data and Map Service (see paragraph 3.5.2)
- HELCOM/ASCOBANS harbour porpoise database contains information about observations of harbour porpoises in the Baltic Sea (http://helcom.fi/baltic-sea-trends/data-maps/habitat/harbour-porpoise/).
- BALANCE project data. BALANCE - INTERREG III B project started in July 2005 and ended in December 2007- aimed towards development of informed marine management tools for the Baltic Sea based on spatial planning and cross-sectoral and transnational co-operation. BALANCE project produced large amount of spatial datasets of Baltic underwater habitats (http://helcom.fi/baltic-sea-trends/data-maps/habitat//balance).
- HELCOM COMBINE database holding CP biological community data on phytoplankton, zoobenthos, phytobenthos and zoobenthos held at and available through ICES.
- HELCOM SEAL expert group holds data on harbour porpoise, grey seal, ringed seal and harbour seal annual censuses (coordinated database).
- Joint OSPAR and HELCOM online ballast water management tool (see OSPAR below).
- Overall HELCOM biodiversity status based on assessment results, information on coastal fish, important bird areas, salmon rivers, spawning and nursery areas of cod, Zostera meadows and seabird wintering.

It must be noted that in addition to biodiversity data held by HELCOM, data held by other organisations were used in HELCOM biodiversity assessments and the development of indicators. For example, in the application of the indicator-based approach using BEAT (the HELCOM Biodiversity Assessment Tool) to assess the overall status of biodiversity at 22 national case studies, data on many of the parameters originated from EU WFD-related research (HELCOM, 2009a). A summary of data sources used for calculation of indicators in the HELCOM Core indicator reports (HELCOM, 2013b) can be found in Table 3.10. (Section 3.4.1). These include ICES datasets no reported through HELCOM (e.g. DATRAS), described in the previous paragraph.

3.2.3 OSPAR

Information on the parameters relevant to biodiversity indicators that the OSPAR data and information streams include, can be found below:

- OSPAR MPA network database outlines protected marine areas, containing data submissions up to 31 December 2012. The database comprises a total of 333 MPAs which cover ca. 700,600 km² or 5.17% of the OSPAR maritime area in the North-East Atlantic.
- OSPAR Habitats in the North-East Atlantic Ocean. These data include distribution and extent of threatened and/or declining habitats in the OSPAR area from 1847-2013. Dataset last updated February 2014.
- Joint OSPAR and HELCOM online ballast water management tool which includes a database with observations of alien species and physical features in ports, a list of target alien species, a list of all marine and alien species observed in port surveys in the region and an agreed risk assessment model.
- OSPAR EcoQO on seabird population trends. National data on seabird breeding population trends for the period 1986-2012 delivered to OSPAR and supplied to ICES

Working Group on Seabird Ecology (WGSE) (ICES, 2011). Future centralized collation and analysis of seabird data needed to enable the future operation of the EcoQO and the Marine Strategy Framework Directive (MSFD) common indicator for GES.

- Seal EcoQO: Seal Population Trends in the North Sea.
- Increase Proportion of Large Fish EcoQO.

3.2.4 UNEP/MAP

The Regional Activity Centre for Specially Protected Areas (RAC/SPA) (http://rac-spa.org/) is responsible for assessing the situation of natural heritage and assisting CPs in implementing the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean. Although there are no current data flows from UNEP/MAP CPs on biodiversity, RAC/SPA has been compiling data and publishing reports on biodiversity in the Mediterranean (e.g. UNEP-MAP RAC/SPA 2010a,b,c) and has developed a Mediterranean Geographical Information System (MEDGIS) on biological diversity (UNEP-MAP RAC/SPA 2010d) available at: http://medgis.rac-spa.org/. MedGIS is a pilot project within the framework of the UNEP-Mediterranean Action Plan. MedGIS includes data on the presence, abundance and composition of coastal and marine flora and fauna, habitats, related human factors, as well as the impacts and risks sensitive areas are exposed to. The MAPAMED is a common database on Marine Protected Areas in the Mediterranean that is operated jointly by MedPAN organisation and RAC/SPA available at http://www.mapamed.org/. RAC/SPA has also developed MAMIAS, a Marine Mediterranean Invasive Alien Species database available at http://mamias.org/.

Currently there is no regular data flow from UNEP/MAP CPs on biodiversity. The future Integrated Monitoring and Assessment Programme for the implementation of the Ecosystem Approach will be based on the UNEP/MAP common indicators and will include relevant biodiversity parameters.

3.2.5 BSC

The Black Sea Integrated Monitoring and Assessment Programme (BSIMAP) provides common data/information reporting formats and the contracting parties have the obligation to report to the BSC on an annual basis using these agreed formats. The reported data are stored in the Black Sea Information System (BSIS). Data on biodiversity are reported to the BSC by the Advisory Group on Conservation of Biological Diversity (CDB AG).
The draft BSIMAP (now considered by the Advisory Groups, final version by October 2014 will be circulated to the Black Sea Commission for adoption at its 30th Regular Meeting) includes the following mandatory parameters for reporting under CDB:

- Chl a
- Phytoplankton
- Mesozooplankton
- Biomass of Noctiluca
- Macrophytobenthos
- Macrozoobenthos
- Marine Protected Areas
- Number and names of introduced non-indigenous species
- Number and names of newly-introduced threatened species

Monitoring of marine mammals is not an obligatory parameter in BSIMAP but relevant data are reported to the Advisory Group on Environmental Aspects of Management of Fisheries and Other Marine Living Resources (FOMLR AG) through voluntary contributions. In cooperation with ACCOBAMS there are plans to adopt an amended Conservation Plan for cetaceans that will include monitoring.

A basin-wide Black Sea database for the comb jelly *Mnemiopsis leidyi* was created within the framework of Black Sea SCENE project for the Black Sea region and is being supported by the BSC Secretariat.

3.2.6 EIONET

The WISE-WFD database contains data from River Basin Management Plans reported by EU Members States according to article 13 of the Water Framework Directive. In the marine environment, the WFD monitoring covers coastal waters and transitional waters at the water body scale. There are two kinds of files that are filled in WISE-eionet reporting MS Excel templates. The marine xlms files that contain physicochemical data and the Biology TC (Coastal and transitional water bodies) templates that contain biological data. Table 3.5 shows the parameters that are filled in the marine and biology TC files of the WISE reporting system produced under the WFD monitoring of MS for coastal & transitional waters.
Regarding hydromorphology the WISE reporting includes the characterization of each sample depth in relation to the position of the thermocline and halocline (below, above or inside).
The parameters demanded by the WFD are based on data of taxa and their abundance and/or biomass for phytoplankton, macrophytes (macroalgae and angiosperms) and benthic invertebrate fauna. The Eionet-WISE WFD reporting files include however for macroalgae, macrophytes and macro invertebrates the ultimate result of classification of these biological quality elements expressed as ecological quality ratios of the classification indices/metrics applied. The classification indices are based on data and parameters such as taxa and their abundance, species sensitivity percentages and ratios, diversity and species richness.

Table 3.5. WFD parameters reported in WISE-eionet for coastal and transitional waters

WFD indicative parameters			
Hydromorphological	General physicochemical	Biological	Chemical
Thermocline position	Oxygen, salinity, temperature, transparency	Phytoplankton biomass (chlorophyll-a)	Hazardous substances in water
Halocline position	Nutrients: nitrates, nitrates, ammonium, silicates, phosphates, total Nitrogen, total Phosphorus in water	Macroalgae Ecological quality ratio of classification indices/metric applied	Hazardous substances in sediments
Substrate category (hard or soft bottom)		Benthic macroinvertebrates Ecological quality ratio of classification indices/metric applied	Hazardous substances in biota
		Angiosperms Ecological quality ratio of classification indices/metric applied	

3.3 Analysis of data and information flows

Since there are rather limited existing data flows and assessments for biodiversity, the analysis was performed on both existing and anticipated data flows relevant to MSFD descriptors D1, D2, D4 and D6 and was based on the developing indicators of the RSCs.

The inventory of biodiversity relevant data flows can be found in Annex 3.
The inventory of data flows was structured with respect to MSFD indicators. The information was compiled from reports on the on-going work on common/core indicators by the RSCs such as Technical Specifications for OSPAR common and candidate biodiversity indicators, HELCOM Core Indicator reports, Baltic Sea environment fact sheets, final report of the HELCOM CORESET project (HELCOM, 2013b) and UNEP/MAP documents on the developing common indicators e.g. the Integrated Correspondence Groups of GES and Targets Meeting (Athens, 17-19 February 2014). Information for the Black Sea data flows was provided by the IRIS project and communication with BSC Secretariat. The DEVOtool (developed by the DEVOTES project) providing information on biodiversity indicators including required parameters, was applied in cases where information on parameters used for the developing indicators was not available elsewhere.

The status of the data flow was indicated as existing, proposed or no data flow. 'Existing data flows' indicate available data from Regional and National monitoring programmes, projects and other sources used by the RSCs for the development of their indicators. 'Proposed data flows' indicate parameters proposed by the RSCs to be used for the development of their indicators. 'No data flows' indicate that there are no current plans for data flows (e.g. no indicator proposed). .

Information on sampling frequencies, reporting programmes, duration of data flows, database name, database holder, etc. was included where available.
An overview of the parameters used or proposed by the RSCs for assessment of their biodiversity indicators in relation to the MSFD indicators for D1, D2, D4 and D6 is shown in Tables 3.6-3.9. A more detailed overview linking MSFD descriptors, criteria, indicators to RSC objectives, indicators and parameters can be found in Annex 2.

The most frequently used parameter across species and species groups (i.e. mammals, birds, fish, plankton, benthos) by all RSCs is abundance. Biomass is used or proposed for plankton and benthos (by all RSCs) and fish. Length/size is used for bird, fish, bivalves and zooplankton by HELCOM and OSPAR. Biotic indices and multimetric indices, including WFD methodologies, are used or proposed by all RSCs. HELCOM and OSPAR use methodologies combining data on human pressures and benthic habitats.

There are many gaps in MSFD indicator coverage (see next Chapter). Only for MSFD indicators 1.2.1, 1.4.1, 1.6.1, and 6.2.2, relevant parameters are used by all RSCs. As regards species groups, fish parameters are not used in BSC biodiversity indicators but in fishery indicators relevant to MSFD Descriptor D3 (see Chapter 4).

The parameters for which data are found in one common database are:

HELCOM

- Mammals: abundance, pregnancy in examined animals, blubber thickness (HELCOM/ASCOBANS harbour porpoise database and data held by HELCOM SEAL expert group)
- Fish: abundance (sea trout spawners and parr, salmon spawners and smolt), total biomass and the biomass of fish >30cm (ICES DATRAS)
- Threat assessment of benthic biotopes (HELCOM Red list datasets)
- Zooplankton species composition, abundance and biomass (ICES DOME)
- Phytoplankton species composition, abundance and biomass (ICES DOME)
- Soft-bottom macrofauna species composition, abundance and biomass (ICES DOME)
- Phytobenthos species composition and abundance (ICES DOME)
- National coastal benthic diversity indices relating to soft bottom macrofauna developed for EU WFD

OSPAR

- Fish: species biomass, high trophic level species biomass, proportion of large fish (>40 cm) of total (ICES DATRAS)
- Plankton: abundance, biomass (some data in ICES DOME)
- Surface area of damaged habitat (spatial data in OSPAR List of Threatened and/or Declining Species and Habitats)

UNEP/MAP

Currently there is no regular data flow from UNEP/MAP CPs on biodiversity. The MedGIS pilot project includes data on the presence, abundance and composition of coastal and marine flora and fauna and habitats.

BSC

All parameters presented in Tables 3.6-3.9 are stored in BSIS in excel format but are not accessible on-line.

Table 3.6 Parameters used or proposed by the RSCs for assessment of their biodiversity indicators in relation to the MSFD indicators for D1 on: a. Species, species groups; and b, Habitats, Ecosystems. Proposed parameters (RSC indicator at early development stage or data not available) are in italics.

a. Species and species groups

MSFD indicator	RSC parameters							
	HELCOM	parameter	OSPAR	parameter	UNEP/MAP	parameter	BSC	parameter
1.1.1 Distributional range	Mammals	Abundance	Mammals	Range of pupping (breeding) sites, range of moult (haul-out) sites	*Mammals Birds Reptiles,*	No info		
			Mammals	Strandings data, distribution, relative abundance and population trends				
1.1.2 Distributional pattern within the latter, where appropriate			Birds	No info				
			Fish Cephalopods	No info				
1.1.3 Area covered by the species (for sessile/benthic species)								
1.2.1 Population abundance and/or biomass, as appropriate	Mammals	Abundance	Mammals	Abundance (counts of pups at pupping (breeding) sites, harbour seals at moult (haul-out) sites)	*Mammals*	*Abundance*	Mammals	Abundance
			Mammals	Abundance	*Reptiles*	*Fecundity*		
	Birds	Abundance	Birds	Abundance	*Seabirds*	*Abundance*		
	Fish	Abundance	Fish Cephalopods	No info				

MSFD indicator	RSC parameters							
	HELCOM	**parameter**	**OSPAR**	**parameter**	**UNEP/MAP**	**parameter**	**BSC**	**parameter**
			Fish Cephalopods	No info				
	Fish	Biomass	Fish	Species biomass, stable isotopes or stomach content (to determine trophic status)	*Fish*	*Abundance*		
	Fish	Biomass						
1.3.1 Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates)	Mammals	Pregnancy in examined animals	Mammals	Pup counts	*Mammals, Birds Reptiles, Zoobenthos, Fish*	No info		
	Mammals	Blubber thickness	Mammals	Numbers of by-catch in fishing gear				
			Birds	Number of birds caught of each species accidentally caught by commercial fishing gear				
	Birds	Brood size in nest surveys	Fish Cephalopods	No info				
			Fish Cephalopods	No info				
			Birds	Annual breeding success: observations (no. chicks fledged per pair) and models				
			Birds	Annual failure rate				

MSFD indicator	RSC parameters							
	HELCOM	parameter	OSPAR	parameter	UNEP/MAP	parameter	BSC	parameter
			Birds	Observations of presence/absence of non-native or invasive mammal species				
			Fish	Proportion of large fish (>40 cm) of total				
			Fish	Mean maximum length of demersal fish and elasmobranchs				
			Fish	Species biomass, stable isotopes or stomach content (to determine trophic status)				
1.3.2 Population genetic structure, where appropriate								

b. Habitats and ecosystems

MSFD indicator	RSC parameters							
	HELCOM	**parameter**	**OSPAR**	**parameter**	**UNEP/MAP**	**parameter**	**BSC**	**parameter**
1.4.1 Distributional range	Seabed habitats	Threat assessment of benthic biotopes	Water column habitats-plankton	Abundance or biomass (per taxa)				
			Water column habitats-plankton	Biodiversity index				
1.4.2 Distributional pattern								
1.5.1 Habitat area	Seabed habitats	Threat assessment of benthic biotopes	Seabed habitats	Activity data sources such as EIAs				
	Seabed habitats-phytobenthos	Depth distribution limits of macrophyte species						
1.5.2 Habitat volume, where relevant								

MSFD indicator	RSC parameters							
	HELCOM	parameter	OSPAR	parameter	UNEP/MAP	parameter	BSC	parameter
1.6.1 Condition of the typical species and communities	*Seabed habitats-bivalves*	*Size-frequency distribution, density, lower depth limit of blue mussels, size-frequency distribution of soft bottom bivalves*	Water column habitats-plankton	Abundance or biomass (per taxa)	*Seabed habitats*	*Biomass and specific trophic level*	Water column habitats-phytoplankton	Species level taxonomy, relative abundance, relative biomass
1.6.1Condition of the typical species and communities	Seabed habitats	Threat assessment of benthic biotopes	Seabed habitats	Biological (species composition and relative abundances), environmental (substrate and water abiotic characteristics) and disturbance characteristics	*Seabed habitats*	*Biotic indices based on benthic macrofauna communities (WFD methodologies)*	Water column habitats-zooplankton	Species level taxonomy, relative abundance, relative biomass
			Water column habitats-Plankton	Biodiversity index	*Seabed habitats*	*Specific composition and specific abundance parameters for benthic habitats*	Water column habitats-mesozooplankton	Biomass
			Seabed habitats	Species lists and distribution	*Seabed habitats-phytobenthos*	*Structural descriptors of Posidonia oceanica meadows*	Water column habitats-plankton	Biomass

MSFD indicator	RSC parameters							
	HELCOM	**parameter**	**OSPAR**	**parameter**	**UNEP/MAP**	**parameter**	**BSC**	**parameter**
			Seabed habitats	Number of individuals per size class	*Seabed habitats-phytobenthos*	*Abundance of perennial seaweeds*	Water column habitats-plankton	Biomass
			Water column habitats-Fish	Mean maximum length		*Macroalgae abundance*	Water column habitats-plankton	Diversity index
			Water column habitats-Fish	no info		*Zoobenthos abundance*	Seabed habitats-phytobentos	Relative abundance and biomass
1.6.2 Relative abundance and/or biomass, as appropriate			Water column habitats-plankton	Biomass or abundance			Seabed habitats-zoobenthos	Relative abundance and biomass
			Seabed habitats-bivalves	Number of individuals per size class				
			Water column habitats-plankton	Abundance or biomass (per taxa)				
1.6.3 Physical, hydrological and chemical conditions			Seabed habitats	Surface area of damaged habitat (special and predominant): sampling and modelling				

Table 3.7 Parameters used or proposed by the RSCs for assessment of their biodiversity indicators in relation to the MSFD indicators for D2. Proposed parameters (data not available) are in italics.

MSFD indicator	RSC parameters			
	HELCOM	**OSPAR**	**UNEP/MAP**	**BSC**
2.1.1 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 of such species.	Number of NIS			*Mnemiopsis leidyi* biomass
2.2.1 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)				
2.2.2 Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible		*Identification of high risk areas, Presence/absence of key species*		

Table 3.8 Parameters used or proposed by the RSCs for assessment of their biodiversity indicators in relation to the MSFD indicators for D4.

MSFD indicator	RSC parameters					
	HELCOM	parameter	OSPAR	parameter	UNEP/MAP	BSC
4.1.1 Performance of key predator species using their production per unit biomass (productivity)	Mammals	Abundance	Birds	Breeding success (Number of chicks per pair) Abundance (colony size)		
	Birds	Frequency distribution of occupied eagle nests containing 0, 1, 2 or 3 nestlings (productivity, breeding success, nestling brood size) nutritional condition of nestlings	Phytoplankton	Production/biomass (functioning of the food web)		
	Fish	Parr density, number of sea trout spawners, number of sea trout rivers and streams, fishing catches of sea trout				
	Fish	Smolt production in rivers (modelled based on different methods), number of rivers with self-reproducing salmon populations, number of spawners in the rivers, smolt survival (relative rate)				
4.2.1 Large fish (by weight)	Fish	Total biomass and the biomass of fish >30cm	Fish	Proportion of large fish (>40 cm) of total		
4.3.1 Abundance trends of functionally important selected groups/species	Fish	Catch Per Unit Effort (CPUE) data	Fish	Species biomass, stable isotopes or stomach content (to determine trophic status)		
	Zoo plankton	Total abundance and biomass, mean size	Plankton	Plankton abundance or biomass (per taxa)		
			Zooplankton	Biomass, species composition or size structure		
			Fish, benthic species	Abundance and biomass		

Table 3.9 Parameters used or proposed by the RSCs for assessment of their biodiversity indicators in relation to the MSFD indicators for D6. Proposed parameters (RSC indicator at early development stage or data not available) are in italics.

MSFD indicator	RSC parameters			
	HELCOM	**OSPAR**	**UNEP/MAP**	**BSC**
6.1.1 Type, abundance, biomass and areal extent of relevant biogenic substrate	Threat assessment of benthic biotopes	Surface area of damaged habitat (special and predominant): sampling and modelling		
6.1.2 Extent of the seabed significantly affected by human activities for the different substrate types	Integration of spatial data of human pressures and benthic habitats	Surface area of damaged habitat (special and predominant): sampling and modelling Activity data sources		
6.2.1 Presence of particularly sensitive and/or tolerant species			*Biotic indices based on benthic macrofauna communities (WFD methodologies)*	Shannon-Wiener community diversity index
6.2.2 Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species	National coastal indices developed for EU WFD, offshore index	Biological (species composition and relative abundances), environmental (substrate and water abiotic characteristics) and disturbance characteristics	*Biotic indices based on benthic macrofauna communities (WFD methodologies)*	Shannon-Wiener community diversity index
6.2.3 Proportion of biomass or number of individuals in the macrobenthos above some specified length/size	*Size-frequency distribution, density, lower depth limit of blue mussels Size-frequency distribution, of soft bottom bivalves*			
6.2.4 Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community	*Size-frequency distribution, density, lower depth limit of blue mussels Size-frequency distribution, of soft bottom bivalves*			

3.4 Indicators and assessments for P/S/I

3.4.1 HELCOM

A summary of HELCOM biodiversity core and pre core indicators (HELCOM, 2013b), their type (P/S/I), status (level of readiness), current monitoring by the Baltic Sea countries and data sources used for their development by the HELCOM CORESET project is shown in Table 3.10.

The core indicators that have been processed by expert groups over several years (e.g. ICES WG Baltic Salmon and Sea trout) are operational. The marine mammal (abundance) indicator (authored by HELCOM SEAL EG), the zooplankton indicator (authored by the HELCOM ZEN QAI) and the coastal fish indicators (authored by HELCOM FISHPRO) are close to being operational. The core indicators will be included as mandatory parameters to the coordinated monitoring programme and the monitoring manuals will be revised. Core indicator methodologies are available in the Core Indicator reports (see links in Table 3.10).

All HELCOM biodiversity indicators are state indicators apart from three -proportion of oiled birds, number of by-caught birds and mammals, and cumulative impacts on the seabed- that can be considered pressure indicators.

The links between HELCOM objectives/core indicators/parameters and MSFD criteria/indicators can be found in Annex 2. A summary of the links between HELCOM biodiversity indicators and MSFD indicators is shown in Tables 3.1, 3.2, 3.3 and 3.4.

HELCOM core and pre-core indicators cover:

- 6 of the 14 MSFD indicators and 6 of the 7 MSFD criteria for D1
- 1 of the 3 MSFD indicators and 1 of the 2 MSFD criteria for D2
- all of the MSFD indicators and criteria for D4
- all of the MSFD indicators and criteria for D6

HELCOM used for the latest Biodiversity assessment the integrated thematic assessment tool for Biodiversity BEAT (HELCOM, 2009a). A matrix tool termed BEAT (the HELCOM Biodiversity Assessment Tool) is used to assess the overall status of biodiversity divided into the three categories of ‘Landscapes’, ’Communities’, and ’Species’, according to the biodiversity segment of the HELCOM Baltic Sea Action Plan (BSAP). In order to create an overall assessment of the site, the reported indicators were regrouped in the following categories: Category I - Landscapes; Category II – Communities; and Category III – Species, following the structure agreed in the HELCOM BSAP. In addition to these three categories, an additional Category IV for supportive features was included to cover other parameters of interest (e.g., nutrient concentrations, physical variables). The integrated assessment of the health of the Baltic marine ecosystem is based on the interim assessment tool HOLAS, an abbreviation of ‘tool for the Holistic Assessment of Ecosystem Health status‘. The HOLAS tool employs three categories of indicators: (i) biological indicators; (ii) hazardous substances indicators; and (iii) supporting indicators and can be considered as an across-descriptors aggregation tool.

Under the HELCOM Red List project, HELCOM developed a Red List of Baltic Sea species in danger of becoming extinct that covers all marine mammals, fish, birds, macrophytes (aquatic plants) and benthic invertebrates (HELCOM, 2013c), and HELCOM Red List of Baltic Sea underwater biotopes, habitats and biotope complexes (HELCOM, 2013d) following the Red List criteria of the International Union for Conservation of Nature (IUCN).

Table 3.10. HELCOM core and pre-core biodiversity indicators description, type (P/S/I), development status, current monitoring by Baltic Sea countries and data sources used for their calculation in the HELCOM CORE indicator reports. Indicator type is according to HELCOM (2013b).

HELCOM Core indicators	Description	Type	Status	Monitoring	Data sources in HELCOM CORE indicator reports	Link
Population growth rates, abundance and distribution of marine mammals	Population growth rate, abundance and distribution of harbour porpoise, grey seal, ringed seal and harbour seal	S	Operational	Yes (adequate for grey seal, ringed seal and harbour seal)	Monitoring of grey seal abundance during the moulting period (DK, EE, FI, SE). Monitoring of harbour seal abundance during the moulting period (DK, SE). Monitoring of ringed seal abundance during the breeding period (EE, FI, SE). Harbour porpoise surveys (DE, DK, SE). Project data and scientific literature.	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Population_growth_rate_abundance_and_distribution_of_marine_mammals.pdf
Pregnancy rates of marine mammals	Considers fertility and is assessed by increasing pregnancy rate and supported by assessments of maturity of females and prevalence of uterine obstructions (harbour porpoise, grey seal, ringed seal and harbour seal)	S	Operational for grey seal	Yes (DE, FI, LT, SE)	The National Swedish Monitoring Program of Seas and Coastal areas, top predators, pathology in seals, Swedish EPA, Swedish Museum of Natural History 1977–2011. Baltic grey seal necropsy data of Finnish Game and Fisheries Research Institute and Finnish Food Safety Authority, 1977–2011. Baltic ringed seal necropsy data of Finnish Game and Fisheries Research Institute, years 2000–2011	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Pregnancy_rates_of_marine_mammals.pdf
Nutritional status of seals	Nutritional status assessed by the thickness of animals' energy reserve, the blubber	S	Operational for grey seal	Yes (FI, LT, SE)	The National Swedish Monitoring Program of Seas and Coastal areas, top predators, pathology in seals, Swedish EPA, Swedish Museum of Natural History 1977 – 2011. Baltic grey seal and ringed seal necropsy data of Finnish Game and Fisheries	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Nutritional_status_of_seals.pdf

HELCOM Core indicators	Description	Type	Status	Monitoring	Data sources in HELCOM CORE indicator reports	Link
					Research Institute and Finnish Food Safety Authority, years 1977–2008	
Number of drowned mammals and waterbirds in fishing gears	Number of drowned marine mammals (cetaceans and seals) and waterbirds in fishing gears.	P	Under development	No	Various studies and scientific literature.	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Number_of_drowned_mammals_and_waterbirds_in_fishing_gear.pdf
White-tailed eagle productivity	Combines the breeding success and brood size into a single indicator and assesses the reproductive output of the population	S	Under development	Yes (FI, SE, EE, LT, DE, PL, RU, DK)	The National Swedish Monitoring Programme of Seas and Coastal areas/ National Environment. Protection Agency; Swedish Museum of Natural History; Swedish Society for Nature Conservation (Project Sea Eagle). Agency for Environment, Nature Conservation, and Geology of Mecklenburg- Western Pomerania. WWF Finland, Project Sea Eagle; Finnish Museum of Natural History.	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-White-tail_eagle_productivity.pdf
Abundance of waterbirds in the wintering season	Follows temporal change in the abundance of key seabird species and the OSPAR EcoQO methodology for the status of seabirds in the North Sea	S	Under development	Yes (All HELCOM CPs)	National monitoring data from coastal mid-winter censuses from all the HELCOM Contracting Parties.	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator_Abundance_of_waterbirds_in_the_wintering_season.pdf

HELCOM Core indicators	Description	Type	Status	Monitoring	Data sources in HELCOM CORE indicator reports	Link
Abundance of waterbirds in the breeding season	Uses two parameters: abundance that follows the OSPAR EcoQO methodology and breeding success that will be developed separately for each bird species	S	Under development	Yes (DE, EE FI, LT, PO, RU, SE)	Various institutions, people and national monitoring data.	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Abundance_of_waterbirds_in_the_breeding_season.pdf
Number of waterbirds being oiled annually*		P	Under development	Limited		
Abundance of key functional fish groups	Abundance of key functional groups in coastal fish communities	S	Under development	Coastal fish monitoring annually coordinated within the HELCOM Fish PRO expert network.	Coastal fish monitoring programs in the Baltic Sea (HELCOM area)	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Abundance_of_fish_key_functional_groups.pdf
Abundance of key fish species	Abundance of perch and flounder	S	Under development	Coastal fish monitoring annually coordinated within the HELCOM Fish PRO expert network.	Coastal fish monitoring programs in the Baltic Sea (HELCOM area)	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Abundance_of_key_fish_species.pdf

HELCOM Core indicators	Description	Type	Status	Monitoring	Data sources in HELCOM CORE indicator reports	Link
Proportion of large fish in the community	Large fish indicator	S	Demersal fish: semi-ready, Pelagic fish: not ready	BITS, BIAS	Baltic International Trawl Survey (BITS), ICES DATRAS Baltic hydroacoustic survey (BIAS)	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Proportion_of_large_fish_in_the_community.pdf
Abundance of sea trout spawners and parr	Sea trout parr densities comparison with reference densities in good habitats of the spawning rivers.	S	Operational	Yes (all CPs)	Sea trout monitoring by all Baltic countries by electrofishing for parr in the natal streams Information of the sea trout spawning rivers from ICES WGBAST, ICES SGBALANST and the HELCOM project SALAR	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Abundance_of_sea_trout_spawners_and_parr.pdf
Abundance of salmon spawners and smolt	Number of smolts measured from the rivers reflecting the abundance of the adult spawners and success of recruitment. The indicator is based on the annual work of the ICES Working Group on Baltic Salmon and Sea Trout(WGBAST) and is supplemented by the results of the HELCOM SALAR project	S	Operational	Yes	Annual reports of ICES WG BAST HELCOM SALAR project	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Abuncance_of_salmon_spawners_and_smolt.pdf
Zooplankton mean size and total abundance	Mean zooplankton size presented as a ratio between the total zooplankton abundance) and total biomass. This metrics	S	Ready. lacking only a coordinated database	Yes (HELCOM COMBINE parameters and methods)	National monitoring programmes with HELCOM COMBINE parameters and methods	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Zooplankton_mean_size_

HELCOM Core indicators	Description	Type	Status	Monitoring	Data sources in HELCOM CORE indicator reports	Link
	is complemented with an absolute measure of total zooplankton stock, to provide a two dimensional index, MSTS (Mean Size and Total Stock).					and_total_abundance.pdf
State of the soft-bottom macrofauna communities	Indices developed to notice changes in abundance of sensitive species. The indices have been validated against various pressure gradients	S	Under development	YES (all countries)	• Offshore data on macrobenthic community composition obtained during monitoring cruises of the Finnish Institute of Marine Research since 1964 collected within the framework of the HELCOM COMBINE programme; data stored in the database of the Finnish Environment Institute. • Coastal data: ○ Sweden: www.viss.lst.se ○ Finland: www.ymparisto.fi/oiva ○ Estonia; Latvia; Denmark; Russia; Poland: Chief Inspectorate for Environmental Protection http://www.gios.gov.pl/artykuly/1046/Contact-us ○ Lithuania ○ Germany	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator_State_of_the_soft-bottom_macrofauna_communities.pdf
Lower depth distribution limit of macrophyte species*		S	Under development			

HELCOM Core indicators	Description	Type	Status	Monitoring	Data sources in HELCOM CORE indicator reports	Link
Population structure of long-lived macrozoobenthic species	Size frequency distribution of soft bottom bivalves Size-frequency distribution, density, lower depth limit of blue mussels	S	Under development	No	Scientific literature	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator_Population_structure_of_long-lived_macrozoobenthic_species.pdf
Cumulative impact on benthic habitats*		P	Under development			
Extent, distribution and condition of benthic biotopes*	The indicator shows the results of the HELCOM REDLIST threat assessment for all the biotopes at the EUNIS levels 5 or 6 in each Baltic Sea sub-basin. The results are also summarized at lower EUNIS levels in order to get a simpler overview of the state of benthic biotopes.	S	Under development	Will be updated every six years together with the threat assessment of biotopes and Species	HELCOM RED LIST project. The threat assessments by the RED LIST project used all kinds of monitoring and project data available from the region and expert judgment.	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Red-listed_benthic_biotopes.pdf
Trends in arrival of new non-indigenous species	Numbers of non-indigenous species found in Baltic Sea sub-basins within an assessment period of six years. The indicator is based on a baseline study, identifying the number of already arrived non indigenous species	P	Ready	Data is mainly compiled from scientific studies	BalticSea Alien Species database European DAISIE database NOBANIS database Scientific publications HELCOM list of non-indigenous species and national experts	http://helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Trends_in_arrival_of_new_non-indigenous_species.pdf

3.4.2 OSPAR

An objective under the OSPAR strategy for biodiversity and ecosystems is the identification of marine species, habitats or ecosystems that need to be protected, conserved or restored. OSPAR has developed a list of threatened and/or declining species and habitats, for which trends are established. This list contains invertebrates, birds, fish, reptiles, mammals and benthic habitats. Background documents for each species or habitat are based on a compilation of existing information from national monitoring programmes or other sources, and give an overview of available data and information and an assessment of the overall status. The background documents are published on the OSPAR website.

OSPAR recognized that there is a need for improved coordination of biological monitoring programmes (OSPAR 2010). For the monitoring and assessment of status at the ecosystem scale, OSPAR has developed an initial set of Ecological Quality Objectives (EcoQOs) for the North Sea (OSPAR, 2009a). The EcoQOs have been developed as tools for the assessment of ecosystem health, by setting objectives for specified indicators and measuring progress. Most EcoQOs link to specific human activities and pressures (shipping, litter, fishing, eutrophication, hazardous substances). The EcoQO on healthy seal populations indicates ecosystem health at a more general level.

In line with the MSFD, OSPAR has adopted a set of common and candidate indicators for biodiversity. The linkages between OSPAR EcoQOs, OSPAR common and candidate biodiversity indicators and relevant parameters, with MSFD criteria and indicators are shown in Annex 2. A summary of the links between OSPAR biodiversity indicators and MSFD indicators is shown in Tables 3.1, 3.2, 3.3 and 3.4.

OSPAR common and candidate indicators cover:
- 9 of the 14 MSFD indicators and 6 of the 7 MSFD criteria for D1,
- 1 of the 3 MSFD indicators and 1 of the 2 MSFD criteria for D2
- all of the MSFD indicators criteria for D4
- 4 of the 6 MSFD indicators and 2 of the 2 MSFD criteria for D6

The OSPAR common indicators are developed by several expert groups under ICG COBAM and technical specifications on most of the indicators have been prepared. The technical specifications include information on the state of methodological development and operationalization of the indicators. A summary of OSPAR biodiversity core and pre-core indicators, their type (P/S/I), status (level of readiness) and current monitoring by the NE Atlantic countries is shown in Table 3.11. Most of the indicators are state indicators, seven are pressure indicators and two are impact indicators.

Table 3.11. OSPAR core and candidate biodiversity indicators, type, development status and current monitoring in the OSPAR area. Type is according to SEC (2011) and OSPAR technical specification.

OSPAS common and candidate indicators	Type	Status	Monitoring	Technical specifications
Mammals-1: Distributional range and pattern of grey and harbour seal haul-outs and breeding colonies	S	Candidate	Yes	Available
Mammals-2: Distributional range and pattern of cetaceans species regularly present	S	Common incorporated in M4	Yes	Available
Mammals-3: Abundance of grey and harbour seal at haul-out sites & within breeding colonies	S	Common	Yes	Available
Mammals-4: Abundance at the relevant temporal scale of cetacean species regularly present	S	Common	Yes	Available
Mammals-5: Harbour seal and Grey seal pup production	S	Common	Yes	Available
Mammals-6: Numbers of individuals within species being by-caught in relation to population	P	Common		Available
Birds-1: Species-specific trends in relative abundance of non-breeding and breeding marine bird species Fish	S	Common	Yes	Available
Birds-2: Annual breeding success of kittiwake	S	Candidate	Limited	Available
Birds-3: Breeding success/failure of marine birds	S	Candidate prioritized, already developed but not operational	Yes	Available
Bids-4: Non-native/invasive mammal presence on island seabird colonies	P	Candidate		N/A
Birds-5: Mortality of marine birds from fishing (by catch) and aquaculture	P	Candidate		No info
Birds-6: Distributional pattern of breeding and non-breeding marine birds	S	Common		N/A
Fish Ceph-1: Population abundance/biomass of a suite of selected species	S	Common		No info
Fish Ceph-2: OSPAR EcoQO for proportion of large fish (LFI)	S	Common, operational		No info
Fish Ceph-3: Mean maximum length of demersal fish and elasmobranchs	S	Candidate		No info
Fish Ceph-4: By-catch rates of Chondrichthyes	P	Candidate		No info
Fish Ceph-5: Conservation status of elasmobranch and demersal bony-fish species (IUCN)	S	Candidate		No info

Fish Ceph-6: Proportion of mature fish in the populations of all species sampled adequately in international and national fish surveys	S	Candidate		No info
Fish Ceph-7: Distributional range of a suite of selected species	S	Candidate		No info
Fish Ceph-8: Distributional pattern within range of a suite of selected species	S	Candidate		No info
PelHab1: Changes of plankton functional types (life form) index Ratio	S	Common, developed but not operational yet	Yes including CPR	Available
PelHab-2: Plankton biomass and/or abundance	S	Common, operational for phytoplankton biomass, developed not operational yet for phytoplankton abundance	Yes including CPR	Available
PelHab3: Changes in biodiversity index (s)	S	Common, developed but not operational yet	Yes including CPR	Available
BentHab-1: Typical species composition	S	Candidate		N/A
BentHab-2: Multi-metric indices	S	Common	Yes	Available
BentHab-3: Physical damage of predominant and special habitats	P	Candidate		Available
BentHab-4: Area of habitat loss	I	Candidate		N/A
BentHab-5: Size-frequency distribution of bivalve or other sensitive/indicator species	S	Candidate		No info
NIS-1:Pathways management measures	P	Candidate		
NIS-2: Rate of new introductions of NIS (per defined period)	P	Candidate		
NIS-3: The rate at which non-indigenous species are introduced is reduced as a result of the management of high risk pathways and vectors	P	Common, under development (combination of NIS1 and NIS2, proposed as a replacement for both)	Limited	Available
Food web-1: Reproductive success of marine birds in relation to food availability	S	Candidate, under development	Yes	Available
Food web-2: Production of phytoplankton	S	Candidate, under development	Yes limited	Available

Food web-3: Size composition in fish communities (LFI)	S	Common, operational	Yes, IBTS	Available
Food web-4: Changes in average trophic level of marine predators (cf MTI)	S	Candidate, under development	Yes	Available
Food Web-5: Change of plankton functional types (life form) index Ratio between: Gelatinous zooplankton & Fish larvae, Copepods & Phytoplankton, Holoplankton & Meroplankton.	S	Candidate prioritized, already developed but not operational	Yes including CPR	Available
Food Web 6: Biomass, species composition and spatial distribution of zooplankton	S	Candidate, under development	Yes including European Ferry Box Network , CPR	Available
Food Web-7: Fish biomass and abundance of dietary functional groups	S	Candidate, under development	Yes , IBTS	Available
Food Web 8: Changes in average faunal biomass per trophic level (Biomass Trophic Spectrum)	S	Candidate, developed but not operational yet	Yes, covered under the DCF	Available
Food Web-9: Ecological Network analysis indicator (e.g. trophic efficiency, flow diversity)	S	Candidate	Yes	Available

3.4.3 UNEP/MAP

The CPs to the Barcelona Convention in the process of implementing the Ecosystem Approach have adopted Mediterranean Ecological Objectives (EOs) including EO1 Biodiversity, associated with Operational Objectives and Indicators (UNEP/MAP, 2012c). Subsequently a set of common indicators were proposed and adopted from these agreed indicators as the ones that are most mature based on data availability/existing monitoring practice and/or obligations. For EO1: Biological diversity is maintained or enhanced, and EO2: Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem, the following common indicators have been adopted (UNEP/MAP, 2014a, b, c).

EO1

- Habitat distributional range
- Condition of the habitat's typical species and communities
- Species distributional range
- Population abundance of selected species (related to marine mammals, seabirds, marine reptiles, marine macroalgae, zoobenthos, fish)
- Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates);

EO2

- Trends in abundance, temporal occurrence and spatial distribution of non-indigenous species, particularly invasive, non-indigenous species, notably in risk areas (in relation to the main vectors and pathways of spreading of such species)

All EO1 common indicators are state indicators; EO2 indicator is a pressure indicator[1].

The common indicators will be further specified (purpose of the indicator, parameters to be measured, including thresholds, baselines, scope and key elements to monitor) and an outline of specifications is planned to be discussed in the upcoming ECAP Coordination Group (September 2014). It is proposed to use Habitats Directive Guidelines and WFD methods included in the Commission Decision 2008/915/EC for guidance on methodologies. Monitoring guidance is also being prepared. GES description and Targets have been agreed (Decision IG.21/3) but will continue to be further improved, in line with scientific and policy developments.

The linkages between UNEP/MAP EOs, common biodiversity indicators and relevant parameters with MSFD criteria and indicators are shown in Annex 2. A summary of the links between UNEP/MAP biodiversity indicators and MSFD indicators is shown in Tables 3.1, 3.2, 3.3 and 3.4.

UNEP/MAP common indicators cover:

- 5 of the MSFD indicators and 5 of the 7 MSFD criteria for D1
- 1 of the 3 MSFD indicators and 1 of the 2 MSFD criteria for D2
- none of the MSFD indicators and criteria for D4
- 2 of the 6 MSFD indicators and 1 of the 2 MSFD criteria for D6

In the process of the implementation of the Ecosystems Approach UNEP/MAP prepared an Initial Integrated Assessment of the Mediterranean Sea (UNEP/MAP, 2012d). UNEP MAP assessment follows the ECAP approach focusing on various biodiversity elements The assessment is text based and uses several parameters such as: number of species, occurrence of conservation interest (SPA protocol) flagship species, habitat types and condition, number and distribution of Non Indigenous species (NIS) for zoobenthos; habitat types and condition, number of species and biomass, extend and distribution of meadows for macroalgae and/or angiosperms; chlorophyll-a biomass, diversity, cell abundance dominance of small sized species, phytoplankton blooms, occurrence of exotic (NIS) species for phytoplankton, number of species, abundance, concentration, biomass, occurrence of exotic (NIS) species for zooplankton; population of fisheries species and impact of fisheries for fish and occurrence of conservation interest (SPA protocol) and flagship species for mammals, reptiles and seabirds.

Lists of endangered or threatened species and species whose exploitation is regulated in the Mediterranean are included in Annex II and Annex III of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (http://195.97.36.231/dbases/webdocs/BCP/ProtocolSPA96annexesAmendmentsCoP16_Eng.pdf); however information on these species and their habitats is sometimes limited (UNEP/MAP 2012b). A list of Specially Protected Areas of Mediterranean Importance (SPAMI's List) has also been established under the above protocol.

[1] *The type of indicators (Pressure, State, Impact) are according to SEC (2011).*

3.4.4 BSC

BSIMAP (Black Sea Integrated Monitoring and Assessment Programme) is based on national monitoring programmes financed by the Black Sea countries. Each country decides which and how many stations will observe and which stations will be used for the reporting for the BSIMAP. BSIMAP regulates the frequency of sampling but the countries do not always observe it. BSIMAP provides recommendations on parameters, and methodologies to be used. Manuals on sampling and analysis have been developed for phytoplankton (Moncheva & Parr, 2005, Moncheva, 2010) and soft-bottom macrozoobenthos (Todorova and Konsulova 2005). Good drafts are available for zooplankton (micro-, meso-, macro-), macroalgae and zoobenthos (macro-hard bottom, meio-).

The BSIMAP follows the DPSIR (Drivers, Pressures, State, Impact, Response) model allowing detection of negative impacts as well as the effects of measures taken in a timely manner, thereby enabling the necessary corrective actions to be further taken. The choice of parameters to monitor is related to the main environmental problems recognized in the Black Sea region and re-evaluated every 5 years based on BSC reports: Black Sea Transboundary Diagnostic Analysis (BS TDA), State of the Environment of the Black Sea (SoE) (e.g. BSC SoE Report 2002 and 2008, www.blacksea-commission.org) and Report on the Implementation of the Strategic Action Plan for Environmental Protection and Rehabilitation of the Black Sea (BS SAP) initially adopted in 1996 and later amended in 2009. Deficiencies in the provisions for indicator-based reporting in line with the DPSIR model, hence, with the MSFD requirements, are presented in detail for Bulgaria, Romania and Turkey in the Diagnostic report II prepared in the framework of the MISIS project (Velikova et al, 2013). For Georgia, Russian Federation and Ukraine a same report was prepared under the EMBLAS Project of EC/UNDP (www.emblas.project.org).

BSIMAP parameters are optional or compulsory, depending on the priorities. BSIMAP does not contain specific methodologies on how to calculate indicators.

BSC biodiversity indicators used in the latest CDB AG reporting (personal communication to BSC Secretariat) are the following[2]:

- Phytoplankton taxonomic structure, phytoplankton abundance phytoplankton biomass and related metrics (State indicators)
- Zooplankton taxonomic structure, zooplankton abundance, zooplankton biomass (State indicators)
- Mesozooplankton biomass (State indicator)
- Biomass of *Noctiluca scintillans* (State indicators)
- *Mnemiopsis leidyi* biomass (Pressure indicator)
- Shannon-Wiener community diversity index (State indicator)

The BSC “Diagnostic report” (BSC, 2010a) includes Designated Protected Areas and threatened and protected species in the list of biodiversity indicators.

The linkages between BSC biodiversity indicators and relevant parameters with MSFD criteria and indicators are shown in Annex 2. A summary of the links between BSC biodiversity indicators and MSFD indicators is shown in Tables 3.1, 3.2, 3.3 and 3.4.

[2] *The type of indicators (Pressure, State, Impact) are according to SEC (2011).*

BSC indicators cover:

- 5 of the MSFD indicators and 4 of the 7 MSFD criteria for D1
- 1 of the 3 MSFD indicators and 1 of the 2 MSFD criteria for D2
- none of the MSFD indicators and criteria for D4
- 2 of the 6 MSFD indicators and 1 of the 2 MSFD criteria for D6

For the assessment of biodiversity in the latest State of the Environment of the Black Sea report (BSC, 2008), BSC used various biological quality elements and parameters/variables such as:

Meiobenthos density, abundance and biomass, macrobenthos groups composition, species number, diversity, biomass, quantity indicators of development of benthic biocoenoses, density index, long term trends, biotic index AMBI, for zoobenthos; percentage coverage, biomass, production, species number, taxonomic composition, diversity for phytobenthos; species composition, diversity, abundance, biomass, density and trends of algal groups for phytoplankton; biomass, abundance, dominant groups, trends, species composition for zooplankton; total capture production, length-weight and age characteristics, mean annual and unreported catches and total abundance of Russian sturgeon, catch, biomass variations of Pontic shad, recruitment, spawning stock, biomass, catch and fishing mortality of main pelagic fishes, the state of populations of key demersal fishes for fish and geographic range, abundance, habitat end ecology, life history parameters, threats and population trends for cetaceans.

The list of threatened species in the Black Sea is included in Annex 5 to the Black Sea Biodiversity Protocol) but it is not complete, it is a compilation of what has been evaluated until now in the surrounding countries (BSC, 2010b). For most taxonomic groups, except for birds and mammals, the list needs significant inputs.

3.4.5 Gaps in RSC indicator coverage of MSFD indicators

The following gaps are identified in RSC common/core indicator coverage of MSFD indicators (Tables 3.1, 3.2, 3.3 and 3.4).

D1 – Biological Diversity

MSFD indicators 1.1.3 *Area covered by the species (for sessile/benthic species), 1.3.2 Population genetic structure, where appropriate*, 1.4.2 *Distributional pattern, and 1.5.2 Habitat volume, where relevant,* 1.7.1 *Composition and relative proportions of ecosystem components (habitats and species)*.are not covered by the RSCs.

MSFD indicators 1.1.2 *Distributional pattern within the latter, where appropriate*, 1.1.3 *Area covered by the species (for sessile/benthic species)*, 1.6.3 *Physical, hydrological and chemical conditions* are not covered by HELCOM, UNEP/MAP and BSC.

D2 – Non-indigenous species

MSFD indicators 2.2.1 *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* and 2.2.2 *Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible* are not covered by the RSCs.

D4 – Food-webs
MSFD indicators 4.1.1 *Performance of key predator species using their production per unit biomass (productivity)*, 4.2.*1 Large fish (by weight)* and 4.3.1 *Abundance trends of functionally important selected groups/species*, are not covered by UNEP/MAP and BSC.

D6 – Sea-floor integrity
MSFD indicators 6.2.3 *Proportion of biomass or number of individuals in the macrobenthos above some specified length/size* and 6.2.4 Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community are not covered by OSPAR, UNEP/MAP and BSC. These parameters are lacking maybe because of the tedious analytical processes involved.
MSFD indicators 6.1.1 *Type, abundance, biomass and areal extent of relevant biogenic substrate* and 6.1.2 *Extent of the seabed significantly affected by human activities for the different substrate types, are not covered* by UNEP/MAP and BSC.

3.5 Information flow processes and management systems

3.5.1 ICES

ICES is the data centre of HELCOM COMPINE and OSPAR CEMP data but also holds data from national institutes that are part of the ICES network of member countries bordering the NE Atlantic and Baltic Seas. ICES data -beyond COMPINE and CEMP datasets, are also propose/used for the development and calculation of HELCOM and OSPAR core/common indicators.
Submissions of data may be made at any time: for OSPAR and HELCOM yearly assessments, data must be submitted by mid-September and data files are organised according to one data type per one monitoring year from one reporting laboratory. Data coming into the ICES system undergoes a number of automated checks including checks on format, required information, range checks, valid references, outliers and cross-references. In addition a number of visual checks are made by the data managers, before the data is released to the data portals. Because the data portals are specifically used for a number of regional assessments related to the Regional Sea Conventions and the CFP Data Collection Framework, a continuous check and feedback on data are made by these users. Data are organized in relational data bases and the metadata are ISO19115 compliant. Both data and their metadata are available on-line through Web Services. The main database technology is Microsoft SQL Server and main programming languages are Microsoft Visual C# .net and Microsoft Visual Basic .net, Java, Ajax, PostGreSQL, XML, JavaScript.

The following thematic data portals (which include the COMPINE and CEMP biological community data) provide on-line discovery, view, and download services compliant with the INSPIRE regulation:

- **biological community** data are made available through the web portal http://ices.dk/marine-data/data-portals/Pages/DOME.aspx (Database on Oceanography and Marine Ecosystems). This portal has a map visualisation function using the Google API, as well as the ability to download individual dataset files. The regional extractions for OSPAR are made from this database and in Autumn 2012 this functionality provided in the DOME portal directly.
- **Fish Trawl Survey** datasets collected in connection with the Data Collection Framework (EU-DCF) are managed under the http://datras.ices.dk portal. This portal has an upload and screening facility, as well as downloads of a number of fisheries

related data products. The Eggs and Larvae database http://ices.dk/marine-data/data-portals/Pages/Eggs-and-larvae.aspx aims to store, and make available, data collected by ichthyoplankton surveys for use by ICES and the wider marine community. It provides an overview of available fish egg and larvae survey data collected, and a unified portal for access to the ichthyoplankton survey data.

- **Fish predation** and **Historical plankton** are 'historical' dataset collections, where the dataset is considered complete and there are no immediate plans to update them. Each have a data portal http://ices.dk/marine-data/dataset-collections/Pages/Plankton.aspx and http://ices.dk/marine-data/data-portals/Pages/Fish-stomach.aspx built on the same framework with the same functionality as can be found on the ICES Data portal.

3.5.2 HELCOM

HELCOM hosts several databases and datasets related to the Baltic Sea. Information on the biodiversity related data can be found at the information page of the HELCOM Map and Data Service (http://helcom.fi/baltic-sea-trends/data-maps/helcom-map-and-data-service) which make environmental information accessible for interested users and the general public. The map and data service (http://maps.helcom.fi/website/mapservice/index.html) is based on ESRI's ArcGIS Server and Flex development platform. Through the HELCOM map and data service, users are able to:

- Visualize, analyse and search Baltic Sea environmental data
- View metadata of each map layer
- Draw and save or print your own maps
- Download ESRI shapefiles
- Access layers in OGC WMS standard protocol.

Biodiversity related data can be found grouped under the following HELCOM web links and databases:

- Both HELCOM REDLIST of species and biotopes, habitats and biotope complexes are available as information sheets (in pdf format) under the relevant biodiversity web links referred in the beginning of paragraph 3.2.2: http://helcom.fi/baltic-sea-trends/biodiversity/red-list-of-species/ and http://helcom.fi/baltic-sea-trends/biodiversity/red-list-of-biotopes-habitats-and-biotope-complexes/, respectively.
- The HELCOM BSPA data sets can be visualized and accessed in form of shapefiles from the Baltic Sea Data and Map Service under "Habitat>Protected areas" (http://maps.helcom.fi/website/mapservice/index.html). INSPIRE compliant metadata are also available together with the data layers.
- HELCOM/ASCOBANS harbour porpoise database is a Microsoft Office Access Database and can be downloaded from: http://helcom.fi/Documents/Baltic%20sea%20trends/Data%20and%20maps/Biodiversity/2013_HELCOM-ASCOBANS_balticseaporpoise.zip. The HELCOM Map and Data service displays Baltic Sea harbour porpoise opportunistic sightings, strandings and bycatches covering the HELCOM marine area. The data sets are accessible as shape files under "Habitat>Ecological features>Harbour porpoise"

(http://maps.helcom.fi/website/mapservice/index.html). INSPIRE compliant metadata are also available together with the data layers.

- BALANCE project data (2005-2007): Part of the BALANCE datasets can be visualized and downloaded in the HELCOM Map and Data Service, under "Habitat>Physical features" (http://maps.helcom.fi/website/mapservice/index.html) together with INSPIRE compliant metadata. Additional Baltic wide datasets, Archipelago sea area and Latvian coast GIS data produced by the BALANCE projects accompanied with their ISO metadata can be downloaded as zip files (rasters or shapefiles) from: http://helcom.fi/baltic-sea-trends/data-maps/habitat/balance/.
- HELCOM COMBINE database is hosted by ICES.
- HELCOM SEAL database: it is a cross-cutting activity (e.g. harbour porpoise database, BALSAM project, etc.). No separate on-line access portal was found only expert group reports.
- The Joint OSPAR and HELCOM online ballast water management tool (see OSPAR below).
- Overall HELCOM biodiversity status based on assessment results is visualized and shape files are available in HELCOM Map and Data Service (under “Habitat>Ecological features>Biodiversity status”) at: http://maps.helcom.fi/website/mapservice/index.html . Also, the information on coastal fish, important bird areas, salmon rivers, spawning and nursery areas of cod, Zostera meadows and seabird wintering grounds can be found under “Ecological features” at the same site.

3.5.3 OSPAR

Information on how to access the latest biodiversity data collected as part of the on-going monitoring work carried out in the OSPAR Maritime Area, subject to the OSPAR data policy, can be found under the following databases and documents:http://www.ospar.org/content/content.asp?menu=01511400000000_000000_000000

- MPA network database: The data and information have been provided by CPs in the process of nominating their MPAs to the OSPAR Commission and subsequently to the OSPAR database of Marine Protected Areas held at the German Federal Agency for Nature Conservation (BfN). Submissions to the limits of the continental shelf are not included. The MPA database in the form of an MS Access database can be downloaded from: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_MPA-DB_2013.zip. The shapefiles are available at: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_MPA-GIS_2013-shp.zip. The 2012 MPA Network status report is available at: http://www.ospar.org/documents/dbase/publications/p00618/p00618_2012_MPA_Status%20Report.pdf
- OSPAR Habitats in the North-East Atlantic. Points or Polygon data available for download either as an ESRI File Geodatabase or as ESRI Shapefiles through the EUSeaMap interactive map (webGIS) at: http://www.searchmesh.net/default.aspx?page=1974
- OSPAR List of Threatened and/or Declining Species and Habitats: the relevant information such as summaries of the coverage of data for the distribution of listed habitats within the OSPAR area or maps indicating the distribution and density of

habitat data supplied by CPs and other sources up to January 2006 can be found at: http://www.ospar.org/content/content.asp?menu=00180302000132_000000_000000

- The Joint OSPAR and HELCOM online ballast water management tool (http://jointbwmexemptions.org/ballast_water_RA), released on 10th July 2014. The application can be accessed using "bw_reader" as "user name" and "balwat" as "password". Data and information can be freely visualized, processed and downloaded.
- OSPAR EcoQo on seabird population trends: report in pdf format on the development of an ecological quality objective (EcoQO) on seabird population trends and available for download at: http://www.ospar.org/documents/dbase/publications/p00576/p00576_ecoqo%20seabird%20populations.pdf.
- Seal EcoQo: background document published on individual EcoQOs as part of the North Sea Pilot Project on the Ecological Quality Objective for Seal Population Trends in the North Sea, 5th North Sea Conference, OSPAR Commission, 2005. It is available in pdf format at:http://www.ospar.org/documents/DBASE/Publications/p00245/p00245_Background%20Document%20EcoQO%20-%20seals.pdf
- Large Fish EcoQo: OSPAR Background Document on the EcoQO on changes in the proportion of large fish and evaluation of the size-based indicators, OSPAR Commission, 2008. Available in pdf format at:http://www.ospar.org/documents/dbase/publications/p00356/p00356_bd%20ecoqo%20fish%20communities.pdf .

3.5.4 UNEP/MAP

RAC/SPA MedGIS is a pilot project within the framework of the UNEP-Mediterranean Action Plan. MedGIS includes data on the presence, abundance and composition of coastal and marine flora and fauna, habitats, related human factors, as well as the impacts and risks sensitive areas are exposed to (UNEP-MAP-RAC/SPA. 2010d).

The MAPAMED database was developed was developed in 2011-12 and is available on www.mapamed.org. It provides the following functionalities:

- Search and explore the database
- Visualize Mediterranean MPAs through the mapping interface
- View detailed information about an MPA
- Download MPA spatial data

The MAPAMED database contains:

- Spatial data: polygon(s) showing the outer limits of MPAs.
- Core attributes: MPA basic information on the core attributes defined by UNEP-WCMC in the data standards for the World Database on Protected Areas
- Specific attributes: with more detailed information on MPAs (governance, objectives, management plan, staff, equipment, budget, uses, pressures, regulations, habitats, species, etc.).

The next development steps include addition of more detailed information about MPAs, especially regarding their zoning, and establishment of a dataflow from the national level to the international one, taking into consideration already existing dataflow.

RAC/SPA MAMIAS database available at www.mamias.org, includes information on alien and invasive species in line with a feasibility study realised during the last biennium in order to identify the ways and means to put in the Mediterranean region such a system.

3.5.5 BSC

The BSC biodiversity data are stored in the Black Sea Information System (BSIS) that has been described in the previous chapter.
In addition, a basin-wide Black Sea *Mnemiopsis leidyi* database was created within the framework of Black Sea SCENE project for the Black Sea region and is being supported by the BSC Secretariat. The published database reference (http://bscps.ma.cx:88/MLDB/) does not work. The online database has primitive interface and very simple search and download open data features.

3.5.6 EEA

The European inventory of nationally designated areas holds information about protected areas and the national legislative instruments, which directly or indirectly create protected areas. The Common Database on Designated Areas (CDDA) is more commonly known as Nationally designated areas. The inventory began in 1995 under the CORINE programme of the European Commission. It is now one of the agreed Eionet priority data flows maintained by EEA with support from the European Topic Centre on Biological Diversity. It is a result of an annual data flow through Eionet countries. The EEA publishes the data set and makes it available to the World Database of Protected Areas (WDPA). The CDDA data can also be queried online in the European Nature Information System (EUNIS).
Data in the form of an a Microsoft Office Access Database and INSPIRE compliant metadata can be downloaded from: http://www.eea.europa.eu/data-and-maps/data/nationally-designated-areas-national-cdda-7.

3.6 Conclusions

There are current RSC data streams relevant to biodiversity but these are limited and RSCs use or plan to use data from additional sources such as ICES, WFD, national monitoring, etc. in the development of their indicators. Biodiversity-relevant data are currently reported by HELCOM, OSPAR and BSC data streams. UNEP/MAP plans to include biodiversity parameters in the Integrated Monitoring and Assessment Programme for the implementation of the Ecosystem Approach.
Currently, only data on few of the parameters planned/used by the RSCs for their indicators are stored in one common database. For most parameters, information on where is the data was not found.
Potentially, the data that are held in databases and are accessible through webGIS tools and services, can be combined and shared among the users and applications. However, further technical work is required on systems homogenization and interoperability.

However not all data related with biodiversity indicators are organized in a form (such a database or online system) that can be easily found, visualised and accessed (for example BSC data, part of data listed in Table 3.10).

Recent work by Levin et al. (2014) on biodiversity data requirements for systematic conservation planning specifically for the Mediterranean region, which could apply generally to European seas, highlights the necessary steps to be taken in order to fill up the gaps in data flow that apply especially for the Descriptors D6 and D1. These steps are summarized as: a) to provide access and availability to currently inaccessible datasets and databases on depth, habitats, and species distribution; b) to harmonize current approaches in marine mapping; c) to develop a framework applicable throughout the Mediterranean/EU region for habitat mapping and d) to undertake further extensive habitat mapping to fill up the gaps especially in the deep seas and special features like canyons and seamounts.

4 RSC and EEA data holdings and data flows related to commercial fish and shellfish

4.1 Introduction

MSFD addresses fisheries activities in GES Descriptor D3: *Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock*. This Descriptor is strongly linked to the Common Fisheries Policy. Commission Decision 2010/477/EU sets out three criteria for D3 addressing the level of pressure of the fishing activity (3.1), the reproductive capacity of the stock (3.2) and the population age and size distribution (3.2), and three indicators to describe these criteria (Table 4.1).

Among RSCs, BSC has indicators on the level of fishing pressure relating to D3 (Table 4.1).

OSPAR has two EcoQOs for the North Sea: The OSPAR EcoQO for commercial fish species aims to maintain safe levels of fish species by management of fisheries based on the precautionary principle. The EcoQO is based on evaluations of the status of commercial fish stocks prepared by ICES and used in fisheries management and combines spawning stock biomass and fishing mortality. The EcoQO for size composition of fish communities looks at the average length of fish in a community, which can be used to indicate the impact of fishing and is also used for D1/D4.

UNEP/MAP has an Ecological objective for commercial fish and shellfish, and has agreed on relevant Indicators (UNEP/MAP, 2012c) but currently these are not included in the set of UNEP/MAP common indicators (UNEP/MAP, 2014a).

The objectives and indicators of the RSCs in parallel to the corresponding criteria and indicators of MSFD for GES descriptor D3 can be found in Annex 2. Table 4.1 presents an overview of links between RSC objectives/indicators and MSFD criteria/indicators for D3. The colour coding in Tables 4.1 is as follows

- blue: existing relevant objective or indicator
- red: no relevant objective or common/candidate/core/pre-core indicator

EEA has an indicator on the status of commercial fish stocks CSI32. http://www.eea.europa.eu/data-and-maps/indicators/status-of-marine-fish-stocks/status-of-marine-fish-stocks-8.

4.2 Identification of data

HELCOM does not collect commercial fish data (only coastal fish data for the indicators abundance of key functional fish groups and abundance of key fish species described; see previous Chapter). Commercial fish data are reported directly to ICES by Baltic Sea countries and are not part of HELCOM work.

OSPAR does not collect commercial fish data, but uses data reported to ICES.

UNEP/MAP does not collect commercial fish data. Commercial fish data in the Mediterranean are collected within the General Fisheries Council for the Mediterranean (GFCM) mandate; the Data Collection Framework of the CFP (e.g. MEDITS) and the International Commission for the Conservation of Atlantic Tuna (ICCAT).

BSC collects data on fisheries from the CPs. Data are reported to BSC by the FOMLR AG (Fishery and other Marine Living Resources Management Advisory Group) under the BSMAP. They are stored in the BSIS. Reporting templates are in MS Excel format.

EEA
CSI32 assess the status of fish stocks using the ratio of the number of over-fished stocks to the total number of commercial stocks per fishing area in European seas. Data sources for the latest figures of CSI32 are: ICCAT Research and Statistics (SCRS), Cod and mackerel spawning stock biomass (ICES) and Fishery data (FAO).

4.3 Analysis of data and information flows

BSC
According to BSC (2010) the BSC fisheries indicators relevant to EEA and MSFD indicators are well reported to the BSC; however, stock assessments for most of the fish species are in need for harmonization.
A list of parameters on BSC fisheries indicators relevant to EEA and MSFD indicators can be found bellow:

- Total catches
- Catches of major commercial species
- Total Allowable Catch (TAC) and quotas
- Number of commercial stocks
- Number of assessed stock (assessed stocks in the BS are only two sprat and turbot)
- Number of non-assessed stocks (all the other stocks are not assessed based on harmonised methodologies)
- Percentage of non-assessed/stocks of economic importance
- Percentage of overfished/stocks of economic importance
- Percentage of safe/stocks of economic importance

According to the II Diagnostic Report produced by the MISIS project (Velikova et al., 2013) considering data availability for D3 in RO, BG and TR (evaluated by questionnaires to stakeholders), no substantial gaps have been identified for MSFD Descriptor 3, however, the stakeholders have not specified whether they can provide the listed indicators for all commercial species or only for a few of them. A confirmation is needed that stock assessments are carried out for all commercial species and that maximum sustainable yield and others are known for all of these species as well.

EEA
The CSI32 indicator tracks the ratio of the number of over-fished stocks to the total number of commercial stocks per fishing area in European seas.
Commercial stocks are the stocks of economic importance on which the fishing effort is focused in each area aiming at a profit, i.e. a subset of exploited stocks. Overfished stocks are stocks outside safe biological limits.
The indicator also contains information on:

- Numbers of commercial, assessed and over-fished stocks by sea area

- The state of commercial stocks (over-fished stocks per area), safe stocks, stocks for which an assessment has not been carried out
- Fish catch in specific seas from assessed and non-assessed stocks
- Status of stocks by species and seas

4.4 Indicators and assessments for P/S/I

BSC
The following BSC indicators are relevant to MSFD D3 indicators (BSC, 2010a)[3]:_

- Fish stock biomass and its sub-indicators, fish catches/biomass relevant to MSFD indicator 3.1.2 (State/Impact indicator)
- Fishing mortality, relevant to MSFD indicator 3.1.1 (Pressure indicator)
- Spawning stock biomass relevant to MSFD indicator 3.2.1. (State/Impact indicator)

BSC uses fisheries parameters also for biodiversity assessment (see previous Chapter).

EEA
CSI32 provides an indication of the sustainability of fisheries in a particular area as the ratio of the number of over-fished stocks (those that are outside safe biological limits) to the total number of commercial stocks (for which an assessment of status has been carried out). A high value of this ratio identifies areas under heavy pressure from fishing. CSI32 is in line with the Common Fisheries Policy (CFP).

OSPAR
The OSPAR EcoQOs provide information on the number of healthy fish stocks and on the impact of fishing on demersal fish stocks.

4.5 Information flow processes and management systems

HELCOM, OSPAR, and UNEP/MAP do not have data streams on commercial fish stocks; the data are reported by the countries through other instruments such as the DCF.

4.6 Conclusions

Among RSCs, only BSC has data streams and uses indicators on fisheries pressure relating to D3. In the HELCOM, OSPAR, and UNEP/MAP areas stock assessments are reported by ICES (NE Atlantic, Baltic) and under GFCM, DCF and ICCAT (Mediterranean).

[3] *The type of indicator (state/pressure/impact) isaccording to SEC (2011).*

Table 4.1. *Linkages of the RSC objectives and indicators to MSFD criteria and indicators for the GES Descriptor D3. Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator*

MSFD			**HELCOM**		**OSPAR**		**UNEP/MAP**		**BSC**	
D3: Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.			**Strategic goal**: Favourable conservation status of Baltic Sea biodiversity		**Strategic objective** :To halt and prevent by 2020 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems, and to restore, where practicable, marine areas which have been adversely affected		**Ecological objective (EO) 3:** Populations of select commercially exploited fish and shellfish are within biologically safe limits, exhibiting a population age and size distribution that is indicative of a healthy stock		**Ecosystem Quality Objective EcoQO 1 -** Preserve commercial marine living resources	
Criteria	**Indicators**	**Type**	**Ecological objectives**	**Core/ pre-core Indicators**	**Ecological Quality Objective**	**Common/ Candidate Indicators**	**Operational objectives**	**Common Indicators**	**Sub EcoQOs**	**Indicators**
3.1. Level of pressure of the fishing activity	3.1.1 Fishing mortality	P				*				
	3.1.2 Ratio between catch and biomass index (hereinafter 'catch/biomass ratio')	P								
3.2. Reproductive capacity of the stock	3.2.1 Spawning Stock Biomass (SSB)	S/I				*				
	3.2.2 Biomass indices	S/I								
3.3. Population age and size distribution	3.3.1 Proportion of fish larger than the mean size of first sexual maturation	S/I								

MSFD			HELCOM		OSPAR		UNEP/MAP		BSC	
Criteria	**Indicators**	**Type**	**Ecological objectives**	**Core/ pre-core Indicators**	**Ecological Quality Objective**	**Common/ Candidate Indicators**	**Operational objectives**	**Common Indicators**	**Sub EcoQOs**	**Indicators**
3.3. Population age and size distribution	3.3.2 Mean maximum length across all species found in research vessel surveys	S/I								
	3.3.3 95 % percentile of the fish length distribution observed in research vessel surveys (3.3.3).	S/I								
	3.3.4 Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation.	S/I								

*OSPAR indicators on spawning stock biomass and fishing mortality under OSPAR EcoQO for commercial fish species.

5 RSC and EEA data and information holdings and data flows related to eutrophication

5.1 Introduction

The MSFD addresses eutrophication in the GES Descriptor D5: Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters. Commission Decision 2010/477/EU requires assessments of eutrophication in marine waters to combine information on nutrient levels and those direct effects and indirect effects that are closely linked to nutrient enrichment. The Decision sets out eight indicators to describe those three criteria. Nutrient inputs are not included in the list of indicators for D5 in the COM Decision 210/477/EU as such but article 8 on initial assessments and annex III of the MSFD specifies the importance of locating the sources of the nutrient inputs determining the level of eutrophication.

RSCs (HELCOM, OSPAR, UNEP/MAP, BSC) have adopted key indicators for eutrophication covering objectives set by their strategies. The objectives and indicators of the four RSCs as well as the key policy questions of the EEA in parallel to the corresponding criteria and indicators of MSFD for GES descriptor D5 can be found in Annex 2. Table 5.1 present an overview of links between RSC objectives-indicators and MSFD criteria-indicators for D5. The colour coding in Table 5.1 is as follows

- blue: existing relevant objective or common/core indicator
- light blue: existing candidate/pre-core indicator
- red: no relevant objective or common/candidate/core/pre-core indicator

The HELCOM eutrophication core indicators have been selected on the basis of the HELCOM ecological objectives and the MSFD criteria for eutrophication (HELCOM, 2013b). The five eutrophication core indicators cover four of the five HELCOM ecological objectives and all three MSFD criteria of the Qualitative Descriptor 5. The recent thematic assessment of eutrophication in the Baltic Sea also utilised two biodiversity core indicators, namely the multimetric faunal indices and the macrophyte depth distribution, which in the Baltic Sea have a strong response to eutrophication. These indicators cover the eutrophication status; HELCOM assesses the inputs of nutrients (water- and airborne nutrient loads, point sources) through a separate parallel process, pollution load compilation, PLC (HELCOM 2011). Inputs of nutrients have been included in the HELCOM first thematic assessment of eutrophication (HELCOM 2009b). Pressure core indicator addressing nutrient inputs to the Baltic Sea are currently under development.

OSPAR has adopted a first set of common indicators including those that are contributing to Eutrophication indicators “Nutrients Levels”, “Direct Enrichment Effects” and “Indirect Enrichment Effects” based on the Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area[4]. The assessment is based on a two-step analysis starting with a “screening procedure”. All areas not being identified as non-problem areas with regard to eutrophication through the Screening Procedure are subject to the Comprehensive Procedure which comprises a checklist of qualitative parameters for a holistic assessment, integrating further supporting parameters into the total assessment. There is a large overlap between the data needs for the OSPAR assessment, and the requirements for

[4] *Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area(Reference number: 2013-8)*

the MSFD[5] and therefore a great potential for streamlining of data and information flows. Potentially additional parameters that can be used in the comprehensive procedure which are not included in the EEA and MSFD eutrophication assessments include for example transboundary transport of nutrients and changes in ecosystem structure.

UNEP/MAP has agreed on common indicators for eutrophication that is addressed by Ecological Objective 5 (EO5) of the Ecosystem Approach (UNEP/MAP, 2014a). The common indicators take into account practices of other RSCs and on the basis of experience already gained by the Contracting Parties through their regular MED POL monitoring activities as well as the experience gained by EU Mediterranean countries through their implementation of EU Directives such as the Marine Strategy Framework Directive and the Water Framework Directive. In the Integrated Correspondence Groups of GES and Targets (CorGEST) meeting held in February 2013, (UNEP/MAP, 2014a) two EO5 common indicators were agreed that cover two EO5 operational objectives and two of the MSFD criteria (5.1. nutrient levels and 5.2 direct effects). As agreed by the Integrated CorGEST, EO5 common indicators will be complemented in line with ongoing practice of the MEDPOL programme, with nutrient ratios, water transparency and oxygen concentration.

Under the Bucharest Convention, eutrophication is addressed in the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (BSSAP) 2009 by the Ecosystem Quality Objective3 (EcoQO3): Reduce eutrophication. BSC has eutrophication indicators under BSIMAP. The B2B Project had the objective to further develop them and propose new ones. BSC in the implementation of BSIMAP (Black Sea Integrated Monitoring and Assessment Program) used four indicators for eutrophication (nutrients in water, Chl, Transparency, Oxygen – concentration and saturation) that cover the three MSFD criteria (BSC, 2010). An indicator on input of nutrients from point sources was also applied. Additional indicators relevant to MSFD indicators 5.2.3, 5.2.4 and 5.2.1 were considered and proposed by the CBD AG (Advisory Group on Conservation of Biodiversity) in 2013 but further work is needed in this direction (personal communication with BSC Secretariat).

All RSCs use indicators similar to the two EEA eutrophication indicators CSI021 and CSI023. These indicators address the key policy questions 1) Are nutrient concentrations in our surface waters decreasing? and 2) Is eutrophication in European surface waters decreasing?
Indicator CSIO21- Nutrients in transitional, coastal and marine waters shows annual winter concentrations, classification of concentration levels (i.e. low, moderate, high) and trends in winter nutrient concentrations in the regional seas of Europe.
Indicator CSIO23- Chlorophyll in transitional, coastal and marine waters shows annual mean summer surface concentrations, classification of concentration levels (i.e. low, moderate, high) and trends in mean summer surface concentrations of chlorophyll-a in the regional seas of Europe.

The used regional and sub-regional seas of Europe are in line with the geographical regions and sub-regions specified in the MSFD.

[5] *MRAG/UNEP-WCMC/URS to European Commission for contract on Development of WISE-Marine for the Marine Strategy Framework Directive 2008/56/EC (070307/2011/610594/ENV.D.2/SER).*

Table 5.1 . Linkages of the RSCs objectives and indicators to MSFD criteria and indicators for the GES Descriptor D5. Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator

MSFD			**HELCOM**		**OSPAR**		**UNEP/MAP**		**BSC**		**EEA**	
D5: Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom			**Strategic goal**: A Baltic Sea unaffected by eutrophication		**Strategic objective:** To combat eutrophication in the OSPAR maritime area, with the ultimate aim to achieve and maintain a healthy marine environment where anthropogenic eutrophication does not occur.		**Ecological Objective (EO):** Human-induced eutrophication is prevented, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms, and oxygen deficiency in bottom waters		**BSSAP 2009-Ecosystem Quality Objective (EcoQO) 3:** Reduce eutrophication		Is eutrophication in European surface waters decreasing?	
Criteria	**Indicators**	**Type**	**Ecological Quality Objectives (EcoQO)**	**Core/ pre-core Indicators**	**Ecological objectives**	**Common/ candidate Indicators**	**Operational objectives**	**Common Indicators**	**Key policy questions in BSIMAP**	**BSIMAP Indicators**	**Key policy questions**	**Indicators**
5.1 Nutrients level	5.1.1 Nutrients concentration in the water column	S/P										
	5.1.2 Nutrient ratios (silica, nitrogen and phosphorus), where appropriate	S/P										
5.2 Direct effects of nutrient enrichment	5.2.1 Chlorophyll concentration in the water column	I										
	5.2.2 Water transparency related to increase in suspended algae, where relevant	I										
Criteria	**Indicators**		**Ecological Quality Objectives (EcoQO)**	**Core/ pre-core Indicators**	**Ecological objectives**	**Common/ candidate Indicators**	**Operational objectives**	**Common Indicators**	**Key policy questions in BSIMAP**	**BSIMAP Indicators**	**Key policy questions**	**Indicators**

MSFD			HELCOM		OSPAR		UNEP/MAP		BSC		EEA	
5.2 Direct effects of nutrient enrichment	5.2.3 Abundance of opportunistic macroalgae	I		*								
	5.2.4 Species shift in floristic composition such as diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms (e.g. cyanobacteria) caused by human activities	I										
5.3 Indirect effects of nutrient enrichment	5.3.1 Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency	I		*								
	5.3.2 Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned	I										

*HELCOM Biodiversity core indicator under development in HELCOM CORESET II project

5.2 Identification of data

This chapter describes the current RSC data streams providing data on eutrophication with respect to the RSC objectives and indicators as well as the relevant databases. The RSC data sets and the MSFD relevant data/parameters reported per country are listed in Annex 4 and Annex 5 respectively.

5.2.1 HELCOM

Information on the parameters relevant to eutrophication indicators that the HELCOM data streams include can be found below:

- COMBINE database holding CP data on Temperature, Salinity, Oxygen, Phosphate, Total Phosphorus, Silicate, Nitrate, Nitrite, Ammonium, Total Nitrogen, Hydrogen Sulphide, pH, Alkalinity, Chlorophyll a, Secchi depth
- HELCOM Pollution Load Compilation 5.5 (PLC 5.5) dataset containing all waterborne nutrient and hazardous substances loads gathered by HELCOM contracting parties within pollution load monitoring
- HELCOM Pollution Load Compilation 6 (PLC 6): ongoing comprehensive assessment of water- and airborne inputs and their sources to the Baltic Sea during the period 1994-2014 with more detailed assessment for 2014
- Ship-of opportunity (Ferry-box) DIN, DIP & chl-a
- Ship-of opportunity (Ferry-box) in situ fluorescence-based chl-a (validated)
- Earth observation-based chl-a (validated)

5.2.2 OSPAR

Information on the parameters relevant to eutrophication indicators that the OSPAR data streams include can be found below:

- “Comprehensive Atmospheric Monitoring Programme (CAMP)” includes data and model results on wet and dry deposition of nitrogen compounds (oxidized and reduced).
- “Comprehensive Study of Riverine Inputs and direct Discharges (RID)” includes data compilations of yearly loads from nitrogen (NH4, NO3, TotN) and phosphorus (PO4, TP) compounds, based on measurements (large rivers) and estimates (smaller tributaries).
- “Models used for quantification and reporting of nutrient discharges and losses”. This datastream is currently under development. It is anticipated that model results will provide information on source appointments and trans-boundary nutrient transport of nutrients, that can be used in eutrophication assessments and plans of measures.
- “Comprehensive Environmental Monitoring Programme (CEMP)” contains data on NH4, NO3, NO2, PO4, SiO4, TotN, TotP, Dissolved Oxygen and Chlorophyll-a, as well as a limited amount of data on phytoplankton species counts.

5.2.3 UNEP/MAP

MED POL monitoring data reported by the Contracting Parties to UNEP/MAP for the Barcelona Convention.

Information on the parameters relevant to eutrophication indicators that the UNEP/MAP data streams include can be found below:

- MED POL data base holding data on NO_3, NO_2, NH_4, PO_4 (or Total N, Total P) and SiO_4 (occasionally) and general oceanographic parameters (temperature, salinity, dissolved oxygen).

- Land-based pollution sources database holding national data on pollutants industrial and municipal discharges collected by national surveys

5.2.4 BSC

Information on the parameters relevant to eutrophication indicators that the BSC data streams include can be found below:

- Regional Data base on Pollution holding data on NO_2, NO_3, NH_4, Total N, PO_4, Total P, SiO_4, Chl a, T, Salinity, O_2, O_2 %.

Data on input of nutrients from direct sources. The data are stored in the BSC information system as excel files and are not accessible online

5.2.5 EEA

The WISE SoE TCM dataset contains data on physical characteristics of the transitional, coastal and marine water monitoring and flux stations, proxy pressures on the upstream catchment, basin and River Basin District associated with transitional and coastal waters, chemical quality data on nutrients in seawater and hazardous substances in biota, sediment and seawater, as well as data on direct discharges and riverine input loads.

5.3 Analysis of data and information flows

It must be noted that data are not regularly reported to the RSCs for all parameters and by all contracting parties and for some parameters monitoring is currently developing. Thus an analysis was performed on data relevant to MSFD reporting requirements for D5 that are actually reported to the RSCs by the Contracting Parties. The parameters/methods used by the MS for reporting under articles 8, 9 and 10 of the MSFD, summarized and evaluated by JRC (Palialexis et al. 2014) were the ones considered for the analysis of existing data flows. These included almost all parameters described in the previous section (except pH, alkalinity, temperature, salinity, hydrogen sulphide). Data reported to the RSCs in 2012 by the contracting parties that are EU MS was used in this analysis except for nutrient inputs data (see below). The CPs of the RSCs (which are EU MS) included in the analysis are listed in Table 5.2 (HELCOM: 8 CPs, OSPAR: 10 CPs, UNEP/MAP: 8 CPs, BSC: 2 CPs). Overviews of data reported to HELCOM and OSPAR was obtained from ICES, of UNEP/MAP data was obtained from the MED POL data base and of BSC data was provided by the IRIS SES project[6]. Overview of the data that are submitted via EIONET Central Data Repository (CDR) were provided by ICES. The countries reporting via EIONET CDR that are EU MS listed in Table 5.2 were included in the analysis (23 EU MS). The data submitted via EIONET CDR can be data that are collected as part of HELCOM, OSPAR, MEDPOL, etc. so in that sense there is no strict “boundaries” between data submitted via the various routes (ICES or EIONET CDR). The inventory of data flows used for the analysis including information on sampling frequencies, reporting programmes, duration of data flows, data provider, database name, database holder etc. can be found in Annex 5. It must be noted that the inventory of data flows in Annex 5 includes countries reporting to HELCOM, OSPAR and via EIONET CDR that are not EU MS which were not used in this analysis.

[6] *Integrated Regional monitoring Implementation Strategy in the South European Seas IRIS-SES*

Table 5.2. Contracting Parties of the RSCs and EEA countries (which are EU MS) included in the analysis.

RSC/EEA	CPs/Member Countries
HELCOM	DE, DK, EE, FI, LT, LV, PL, SE
OSPAR	BE, DE, DK, ES, FR, IE, NL, PT, SE, UK,
UNEP/MAP	CY, EL, ES, FR, HR, IT, MT, SI
BSC	BG, RO
EEA	BE, BG, CY, DE, DK, EE, EL, ES, FI, FR, HR, IE, IT, LT, LV, MT, NL, PL, PT, RO, SE, SI, UK

Summary
An overview of data relevant to MSFD reporting requirements for D5 that are actually reported to the RSCs by the CPs and at what frequencies across RSCs is shown in Tables 5.3-5.7. The parameters are organised according to the 2012 reporting sheet categories: nutrient inputs (Table 5.3), nutrient levels in the marine environment (Table 5.4), impacts on water column – physical (Table 5.5), impacts on water column-biological (Table 5.6) and impacts on seabed – biological (Table 5.7). The frequency of CPs reporting to each RSC (% of CPs which are EU MS reporting to each RSC) and via EIONET CDR (% of EU MS reporting via EIONET CDR) for each parameter is categorized in classes represented by different colors. The frequency of use of the parameters reported by MS for the implementation of Art 8, 9 and 10 of the MSFD in each Region assessed by JRC (Palialexis et al. 2014) is also shown.

Data flows per country as regards nutrient inputs from rivers and point sources as well as atmospheric deposition are shown in Table 5.3. All HELCOM CPs reported on nutrient input parameters in 2012 as regards inputs from rivers and point sources. OSPAR CPs apart from two reported on water-borne nutrient input parameters in 2011. BSC data used in the analysis were reported in the period 2001-2008 (BSC, 2010). The two CPs reported nutrient inputs from municipal, industrial and riverine sources during that period. Nutrient inputs from point sources in the UNEP/MAP region are reported in the National Baseline Budget (NBB) assessing the current trends of the pollutants emissions and releases every 5 years (2003-2008) (UNEP/MAP, 2012c). All UNEP/MAP CPs apart from one reported nutrient releases from point sources in 2008. Indicators on nutrient inputs are developed for OSPAR and BSC and are under development for HELCOM and UNEP/MAP.

Only OSPAR and HELCOM CPs are reporting on atmospheric deposition. All OSPAR CPs apart from one reported on atmospheric nutrient inputs (nitrogen species in precipitation and air) in 2011 under CAMP. 'Atmospheric nutrient inputs' is one of OSPAR common indicators. All HELCOM CPs report nitrogen emissions to UN ECE under the Convention on Long-range Transboundary Air Pollution (CLRTAP). Calculations of atmospheric transport and depositions of nitrogen compounds are performed on the basis of emission data officially submitted by CPs to CLRTAP Convention and expert estimates using the EMEP model.

Nutrients levels in the marine environment, oxygen and chlorophyll a are reported by most contracting parties across RSCs and via EIONET CDR. The percentage of CPs reporting to UNEP/MAP in 2012 was <40%; the reporting is ongoing (e.g. data will be updated by the CPs with respect to missing elements). Nutrients, oxygen and chlorophyll a present high frequency of use by MS in reporting for the implementation of Art 8, 9 and 10 of the MSFD and are also used in the WFD. These parameters are indicators adopted by all RSCs (except oxygen by UNEP/MAP at this stage). EEA also uses nutrients and chlorophyll a data for the two eutrophication indicators CSI021 and CSI023.

Nutrients levels in the marine environment were reported by >50% of CPs of all the RSCs, apart from UNEP/MAP. The percentage of MS reporting under the MSFD was lower partly because they are expressed differently. 70% of MS reported nutrients via EIONET CDR. Various N and P elements are reported. N is reported to the RSCs and via EIONET CDR as NO3, NO2, NH4, DIN and TN; P is reported to the RSCs and via EIONET CDR as PO4, DIP and TP; OxN, DON as well as nitrogen composition and phosphorus composition were additionally used in MSFD reporting. The various N species reported are indicative of different N sources; NO3 and NO2 indicate mostly inputs from agricultural sources whereas NH4 is mostly associated with municipal sources. DIN (Dissolved Inorganic Nitrogen) is the sum of NO3, NO2 and NH4; OxN (Oxidised Nitrogen) is the sum of NO3 and NO2; TN (Total Nitrogen) includes DIN and DON (Dissolved Organic Nitrogen). PO4 is DIP (Dissolved Inorganic Phosphorus) and TP (Total Phosphorus) is the sum of DIP and DOP (Dissolved Organic Phosphorus). Some laboratories include particulate forms of N and P in TN and TP reporting. Nitrogen composition and phosphorus composition represent aggregated expressions of individual reported parameters. Different N and P species are reported depending on the requirements of the monitoring programmes and the analytical capabilities of the laboratories. When considering the N and P elements with maximum reporting frequencies (NO3 and PO4), these are reported by > 60% of all RSCs apart from UNEP/MAP. SI is also reported by > 60% of all RSCs apart from UNEP/MAP and via EIONET CDR.

Oxygen was reported by >70% of CPs of all the RSCs, apart from UNEP/MAP. The percentage of MS reporting under the MSFD was lower (>40%). 57% of MS reported oxygen via EIONET CDR.

Water transparency was reported by more than 60% of CPs to HELCOM and BSC and 20% of CPs to OSPAR although it was used in all regions for MSFD reporting. Water transparency was reported by 35% of MS via EIONET CDR. Among RSCs, only HELCOM and BSC have an indicator on water transparency.

Chlorophyll a was reported by >70% of CPs of all the RSCs, apart from UNEP/MAP, and by >80% of MS under the MSFD. 65% of MS reported chlorophyll a via EIONET CDR.

It must be noted that data flows through ICES in fact refers to RSC data flows that are recycled as EIONET data flows, so although agreements are made with RSC or the EIONET it is in fact possible to use the same data flow for multiple purposes.

Phytoplankton species abundance was reported only to HELCOM and BSC by 50% of the CPs. Blooms were reported only to BSC.

Phytobenthos species level taxonomy, phytobenthos species biomass and total biomass were reported only to BSC (by both CPs).

The analysis of CPs reporting to RSCs showed data flows for nutrient inputs, nutrient levels in the marine environment, impacts on the water column-physical, impacts on the water column-biological, but no data flows for impacts on the sea bed-biological (except in BSC). Considering MSFD indicators, data flows were identified for MSFD indicators 5.1.1 Nutrients, 5.2.1 Chlorophyll, 5.2.2 Water transparency, 5.3.2 Dissolved oxygen, but not for MSFD indicators 5.1.2 Nutrient ratios, 5.2.3 Abundance of opportunistic macroalgae, 5.2.4 Species shift, bloom events of nuisance/toxic algal blooms (except in HELCOM and BSC), 5.3.1 Abundance of perennial seaweeds and seagrasses (except in BSC).

For OSPAR, MSFD indicator 5.1.2 Nutrient ratios is calculated from reported parameters and not directly reported. Although OSPAR Monitoring guidelines for biological variables relevant to MSFD indicators 5.2.3, 5.2.4 and 5.3.1 are developed under the JAMP programme for OSPAR CPs, at this stage, no such data are gathered at OSPAR level, but may be available at national level.

MSFD indicators 5.2.3 Abundance of opportunistic macroalgae, 5.2.4 Species shift, bloom events of nuisance/toxic algal blooms and 5.3.1 Abundance of perennial seaweeds and seagrasses are more typical of WFD (being coastal and thus shallow enough for algal growth).

Table 5.3 Parameters relevant to nutrient inputs to the marine environment: Frequency of reporting by CPs to the RSCs. Nutrient loads from rivers (a), unmonitored coastal areas (b), point sources (c), and atmospheric deposition of nutrients (d).

a. Nutrient loads from rivers

Region	RSC	Monitored rivers (MR) flow	MR PO4	MR TP	MR NH4	MR NO2	MR NO3	MR NO2+NO3
Baltic	HELCOM							
NE Atlantic	OSPAR							
Mediterranean	UNEP/MAP							
Black Sea	BSC							

b. Nutrient loads unmonitored coastal areas

Region	RSC	Unmonitored coastal (UC) flow	UC PO4	UC TP	UC NH4	UC NO2	UC NO3	UC NO2+NO3
Baltic	HELCOM							
NE Atlantic	OSPAR							
Mediterranean	UNEP/MAP							
Black Sea	BSC							

c. Nutrient loads point sources

Region	RSC	Point sources (PS) flow	PS PO4	PS TP	PS NH4	PS NO2	PS NO3	PS TN	PS DIN
Baltic	HELCOM								
NE Atlantic	OSPAR								
Mediterranean	UNEP/MAP								
Black Sea	BSC								

d. Atmospheric deposition

Region	RSC	wet NO3	wet NH4	dry NO2	dry NO2+HNO3	dry NH4 +NH3
Baltic	HELCOM *					
NE Atlantic	OSPAR	x	x	x	x	x
Mediterranean	UNEP/MAP					
Black Sea	BSC					

* Calculations of atmospheric transport and depositions of nitrogen compounds are performed on the basis of emission data officially submitted by HELCOM CPs to CLRTAP Convention and expert estimates. http://helcom.fi/baltic-sea-trends/environment-fact-sheets/eutrophication/nitrogen-atmospheric-deposition-to-the-baltic-sea

TP: Total Phosphorus
TN: Total Nitrogen

Frequency	100-81%	80-61%	60-41%	40-21%	20-1%	No reporting

Table 5.4 Parameters relevant to nutrient levels in the marine environment (MSFD indicator 5.1.1): Frequency of reporting by CPs to the RSCs, frequency of use by MS for MSFD reporting and frequency of EU MS reporting via EIONET CDR.

Region	Reporting	MSFD indicator 5.1.1														
		P species				N species								SI	Nutrient concentration***	POC
		PO4	DIP	TP	Phosphorous composition***	NO3	NO2	NH4	DIN	TN	OxN	DON	Nitrogen composition***			
Baltic	HELCOM								**							
	MSFD art 8,9,10 *															
NE Atlantic	OSPAR								**							
	MSFD art 8,9, 10 *															
Mediterranean	UNEP/MAP								**							
	MSFD art 8,9, 10 *															
Black Sea	BSC								**							
	MSFD art 8,9, 10 *															
EU	EIONET								**							

* Palialexis et al. 2014
** DIN can be calculated
*** These are aggregated expressions of the individual reported parameters used in MSFD reporting under MSFD article 8, 9, 10.

DIP: Dissolved Inorganic Phosphorus
TP: Total phosphorus
DIN: Dissolved Inorganic Nitrogen
TN: Total Nitrogen
OxN: Oxidized Nitrogen
DON: Dissolved Organic Nitrogen
POC: Particulate Organic Carbon

Frequency	100-81%	80-61%	60-41%	40-21%	20-1%	No reporting

Table 5.5 Parameters relevant to impacts on the water column-physical (MSFD indicators 5.2.2, 5.3.2): Frequency of reporting by CPs to the RSCs, frequency of use by MS for MSFD reporting and frequency of EU MS reporting via EIONET CDR.

Region	Reporting	MSFD indicator 5.2.2		MSFD indicator 5.3.2							
		Water Transparency	Total suspended solids	DO	Organic content	BOD5	BQI	M-AMBI	Anoxia	COD	Benthic mortality
Baltic	HELCOM										
	MSFD art 8,9, 10 *										
NE Atlantic	OSPAR										
	MSFD art 8,9, 10 *										
Mediterranean	UNEP/MAP										
	MSFD art 8,9, 10 *										
Black Sea	BSC										
	MSFD art 8,9, 10 *										
EU	EIONET										

* Palialexis et al. 2014

DO: Dissolved Oxygen
BOD5: Biochemical Oxygen Demand
BQI: Benthic Quality Index
M-AMBI: Multivariate AMBI (AZTI Marine Biotic Index)
COD: Chemical Oxygen Demand

Frequency	100-81%	80-61%	60-41%	40-21%	20-1%	No reporting

Table 5.6 Parameters relevant to impacts on the water column-biological (MSFD indicators 5.2.1, 5.2.4): Frequency of reporting by CPs to the RSCs, frequency of use by MS for MSFD reporting and frequency of EU MS reporting via EIONET CDR.

Region	Reporting	MSFD indicator 5.2.1			MSFD indicator 5.2.4						
		Chl a	Phytoplankton biomass	Phytoplankton biovolume	Pelagic shift	Phytopla-nkton blooms	Toxic algae	% of Dinoflagellates	Phytopla-nkton quality	Phycocyanin	
Baltic	HELCOM										
	MSFD art 8, 9, 10*										
NE Atlantic	OSPAR										
	MSFD art 8, 9, 10*										
Mediterranean	UNEP/MAP										
	MSFD art 8, 9, 10*										
Black Sea	BSC										
	MSFD art 8, 9, 10 *										
EU	EIONET										

Region	Reporting	MSFD indicator 5.2.4									
		Eutro_plankt_index	Benthic shift	Cyanobact blooms	Phytopl. Abundance**	Phytopl. wet weight **	Phytopl. carbon content **	Phytopl. cell volume **	Phytopl. species level taxonomy **	Phytopl. relative abundance **	Phytopl. relative biomass **
Baltic	HELCOM										
	MSFD art 8, 9, 10*										
NE Atlantic	OSPAR										
	MSFD art 8, 9, 10*										
Mediterranean	UNEP/MAP										
	MSFD art 8, 9, 10*										
Black Sea	BSC										
	MSFD art 8, 9, 10 *										
EU	EIONET										

Frequency	100-81%	80-61%	60-41%	40-21%	20-1%	No reporting

** Palialexis et al. 2014, **not used in MSFD art 8, 9, 10 reporting*

Table 5.7 Parameters relevant to impacts on the sea bed-biological (MSFD indicator 5.3.1): Frequency of reporting by CPs to the RSCs, frequency of use by MS for MSFD reporting and frequency of EU MS reporting via EIONET CDR.

Region	Reporting	Perennial seaweeds abundance	Phytobenthos distribution	Seagrasses distribution	Macroalgae abundance	MM Skew index	Macroalgae condition
Baltic	HELCOM						
	MSFD art 8, 9, 10*						
NE Alantic	OSPAR						
	MSFD art 8, 9, 10*						
Mediterranean	UNEP/MAP						
	MSFD art 8, 9, 10*						
Black Sea	BSC						
	MSFD art 8, 9, 10 *						

* Palialexis et al. 2014

Frequency	100-81%	80-61%	60-41%	40-21%	20-1%	No reporting

5.4 Indicators and assessments for P/S/I

5.4.1 HELCOM

HELCOM has developed core indicators with measurable targets to assess the progress towards reaching the eutrophication objectives set by the HELCOM Baltic Sea Action Plan (HELCOM, 2013b). HELCOM eutrophication core indicators are the following[7]:

- Concentration of dissolved inorganic nitrogen (Pressure/State indicator)
- Concentration of dissolved inorganic phosphorus (Pressure/State indicator)
- Concentration of chlorophyll a (Impact indicator)
- Oxygen concentration (Impact indicator)
- Water transparency (Secchi depth) (Impact indicator)

In addition, the following HELCOM biodiversity core indicators are to be included in eutrophication assessments:

- State of soft-bottom macrozoobenthos (Impact indicator)
- Lower depth distribution limit of macrophytes (Impact indicator)

The links between HELCOM objectives/core indicators/parameters and MSFD criteria/indicators can be found in Annex 2. A summary of the links between HELCOM eutrophication indicators and MSFD indicators is shown in Table 5.1.

HELCOM core indicators cover 6 of the 8 MSFD indicators and the 3 MSFD criteria for D5. HELCOM Core pressure indicator on nutrient loads is under development.

HELCOM eutrophication core indicators are operational. The required parameters are monitored under the HELCOM COMBINE programme by methods documented in the HELCOM's COMBINE manual. They have been used for the assessment of eutrophication status in the Baltic Sea in the HELCOM Eutrophication Assessment Tool (HEAT).

The two HELCOM biodiversity core indicators are semi ready (see Chapter 3).

The HELCOM Eutrophication Assessment Tool (HEAT)

HELCOM uses the multi-metric indicator-based HELCOM Eutrophication Assessment Tool (HEAT) to assess the eutrophication status of the Baltic Sea (HELCOM 2009b, HELCOM, 2014). HEAT builds on the OSPAR Common Procedure developed for assessment and identification of 'eutrophication problem areas' in the OSPAR convention (see next section on OSPAR). HEAT is based on existing indicators that are combined into groups and ultimately combined into an assessment of 'overall eutrophication status'. The final step makes use of the 'One out – All out' principles sensu the Water Framework Directive which means that the overall classification of an assessed area is based on the most sensitive quality element.

The HEAT tool (fist version HEAT 1.0) was applied in the HELCOM thematic assessment of eutrophication in the Baltic Sea (HELCOM 2009b), in the HELCOM Initial Holistic Assessment (HELCOM 2010b) and in the demonstration set of core eutrophication indicators (HELCOM 2010c).

[7] *The type of indicators (Pressure, State, Impact) are according to SEC (2011).*

In the latest assessment of the eutrophication status of the open sea areas of the Baltic Sea, version HEAT 3.0 was applied (HELCOM, 2014). The assessment of the open sea sub-basins was based on an integration of commonly agreed core indicators: inorganic nitrogen (DIN), inorganic phosphorus (DIP), chlorophyll a, water transparency (Secchi depth) and oxygen conditions (oxygen debt, for six sub-basins). The indicators were grouped into three "Criteria" as described in the Commission Decision (EC 2010): 1) Nutrient levels, 2) Direct Effects and 3) Indirect Effects. The HEAT Tool 3.0 compares an agreed eutrophication target for each indicator with the current status value derived from monitoring data. For each of the indicators an Eutrophication Ratio (ER) is calculated reflecting if GES has been reached (GES if ER≤1, sub-GES if ER>1). For each criterion the status was determined as the weighted average of the ERs of the individual indicators (e.g. ER for 'nutrient levels' is given by average of DIP-ER and DIN-ER). The status for the criterion was then assessed as GES where ER≤1 and sub-GES where ER>1.In the final step, the one-out-all-out principle was used between the criteria status classifications to determine the overall eutrophication status for each basin; i.e. the worst of the three results on criterion level determined the final status classification.

Details on methodologies of the HEAT tool and indicators used in its application can be found in Annex 6.

Figure 5.8 shows the steps of assessing eutrophication status of the open sea sub-basins of the Baltic Sea from monitoring data to core indicator –based integrated assessment results for each sub-basin (HELCOM, 2014).

Assessments of nutrient loads

HELCOM collects data on nutrient inputs and produces assessments of pollution loads since the mid-1980s. The first Baltic Sea Pollution Load Compilation (PLC-1) was published in 1987 and the latest (PLC-5) in 2011 (HELCOM, 2011) covering water- and airborne inputs to the sea (see Review of the Fifth Baltic Sea Pollution Load Compilation for the 2013 HELCOM Ministerial Meeting http://www.helcom.fi/helcom-at-work/projects/plc-5-5/). The Sixth Pollution Load Compilation will compile information on waterborne inputs of pollutants, primarily nitrogen and phosphorus, monitored by the HELCOM CPs, and airborne input of nitrogen, phosphorus and selected hazardous substances using information delivered by EMEP for the period 1994-2014.

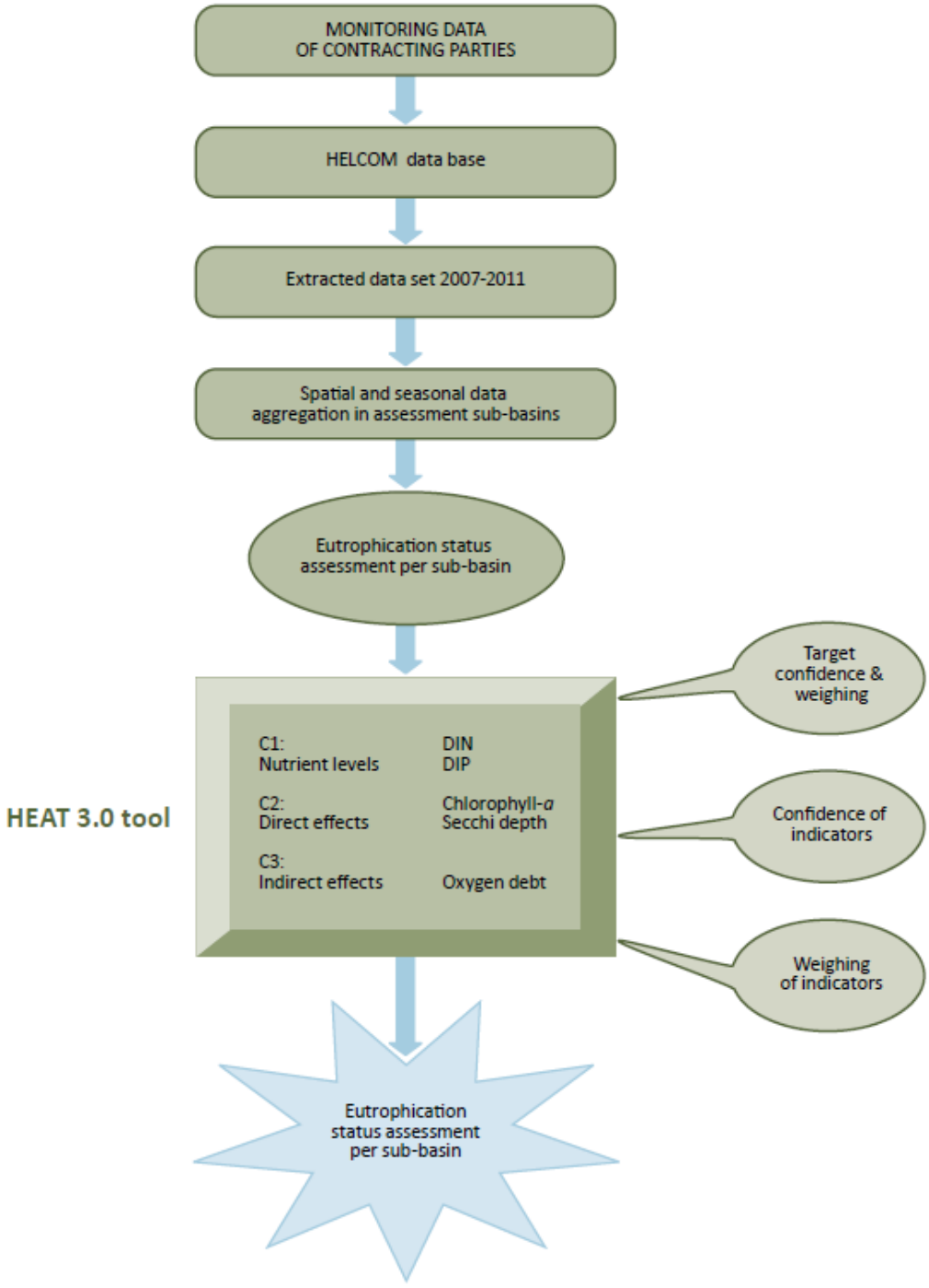


Figure 5.8 Steps of assessing eutrophication status of the open sea sub-basins of the Baltic Sea from monitoring data to core indicator –based integrated assessment results for each sub-basin (Source: HELCOM, 2014).

5.4.2 OSPAR

The set of agreed OSPAR common indicators (OSPAR, 2013a) include the following eutrophication indicators[8]:

- Waterborne nutrient inputs (Pressure indicator)
- Atmospheric nutrient inputs (Pressure indicator)
- Winter nutrient concentrations (State/Pressure indicator)
- Chlorophyll concentrations (Impact indicator)
- Species shift/indicator species: Nuisance species Phaeocystis (Impact indicator)
- Oxygen (Impact indicator)

The linkages between OSPAR EcoQOs, OSPAR common and candidate biodiversity indicators and relevant parameters, with MSFD criteria and indicators are shown in Annex 2. A summary of the links between OSPAR eutrophication indicators and MSFD indicators is shown in Table 5.1.

OSPAR common and candidate indicators contribute to 4 of the 8 MSFD indicators and the 3 MSFD criteria for D5 and also address waterborne and atmospheric nutrient inputs.

OSPAR eutrophication common indicators are operational. They are among the assessment parameters used for the assessment of eutrophication status of the OSPAR maritime area by the Common Procedure.

The Common Procedure
The definition of marine eutrophication given by the Eutrophication Strategy in a generalised and qualitative way is implemented and made operational through the Common Procedure for the Identification of the Eutrophication Status of the OSPAR maritime area (OSPAR, 2005;OSPAR, 2013b). The Common Procedure is based on a holistic scheme of qualitative assessment criteria which combines aspects of nutrient enrichment with aspects of direct, indirect and other possible effects of excessive nutrient enrichment on water quality and ecosystem components. The Common Procedure is supported under the eutrophication related part of the OSPAR Joint Assessment and Monitoring Programme (JAMP) by collective OSPAR monitoring. The Eutrophication Monitoring Programme (OSPAR, 2005) is supplemented by monitoring guidelines, as part of the OSPAR Co-ordinated Environmental Monitoring Programme (CEMP). Under the JAMP, monitoring and periodic assessments of temporal trends of waterborne and atmospheric inputs of nutrients to the OSPAR maritime area under the OSPAR Comprehensive Study of Riverine Inputs and Direct Discharges (RID) and the OSPAR Comprehensive Atmospheric Monitoring Programme (CAMP) also inform the assessment of the eutrophication status.

The Common Procedure comprises two procedural phases:

1. The first phase, the one-off “Screening Procedure”, was completed in 2001 and identified those areas of the OSPAR maritime area which are likely to be areas where eutrophication is not a problem. Those areas were classified as “non-problem areas” without further detailed assessment.

2. In the second phase, the “Comprehensive Procedure” of the Common Procedure, a comprehensive assessment of the eutrophication status of the areas which could not

[8] *The type of indicators (Pressure, State, Impact) are according to SEC (2011).*

be set aside as obvious non-problem areas was carried out. The Comprehensive Procedure is a reiterative process which was first applied by Contracting Parties in 2002 (OSPAR, 2003) and secondly in 2007(OSPAR 2008a). The first application of the Comprehensive Procedure roughly covered the years 1990-2000 (OSPAR, 2003) and the second application applied by the CPs in 2007 assesed the period 2001 – 2005 (OSPAR, 2008a).

Ten assessment parameters (indicators), grouped in 4 categories have been selected from a list of assessment criteria, for the harmonised application of the eutrophication assessment by Contracting Parties as shown in Table 5.8. For each parameter, area-specific assessment levels (thresholds) are derived in relation to the relevant background conditions.

Table 5.8 OSPAR harmonized assessment parameters (Source: OSPAR, 2008a).

Category I	**Degree of nutrient enrichment**
	1 Riverine inputs and direct discharges (area-specific)
	Elevated inputs and/or increased trends of total N and total P (compared with previous years)
	2 Nutrient concentrations (area-specific)
	Elevated level(s) of winter DIN and/or DIP
	3 N/P ratio (area-specific)
	Elevated winter N/P ratio (Redfield N/P = 16)
Category II	**Direct effects of nutrient enrichment (during growing season)**
	1 Chlorophyll *a* concentration (area-specific)
	Elevated maximum and mean level
	2 Phytoplankton indicator species (area-specific)
	Elevated levels of nuisance/toxic phytoplankton indicator species (and increased duration of blooms)
	3 Macrophytes including macroalgae (area-specific)
	Shift from long-lived to short-lived nuisance species (e.g. *Ulva*).
	Elevated levels (biomass or area covered) especially of opportunistic green macroalgae.
Category III	**Indirect effects of nutrient enrichment (during growing season)**
	1 Oxygen deficiency
	Decreased levels (< 2 mg/l: acute toxicity; 4 - 6 mg/l: deficiency) and lowered % oxygen saturation
	2 Zoobenthos and fish
	Kills (in relation to oxygen deficiency and/or toxic algae)
	Long-term area-specific changes in zoobenthos biomass and species composition
	3 Organic carbon/organic matter (area-specific)
	Elevated levels (in relation to III.1) (relevant in sedimentation areas)
Category IV	**Other possible effects of nutrient enrichment (during growing season)**
	1 Algal toxins
	Incidence of DSP/PSP mussel infection events (related to II.2)

In previous OSPAR common procedure the Contracting Parties provided the national assesments that are summarized in the integrated report.
The assessment process used by Contracting Parties has generally followed the guidance of the Common Procedure which entails:

1. the assignment of a score corresponding to the level of each assessment parameter which has been monitored;
2. an initial assessment based on a combination of these scores according to an agreedframework, and;
3. an overall final assessment of all relevant information relating to harmonised assessment parameters, their corresponding assessment levels and supporting environmental factors.

The agreed harmonised assessment parameters have not been applied by all Contracting Parties. Inorganic winter nutrients, chlorophyll and oxygen concentrations are the main parameters that have been considered in estuaries, including fjords, and in coastal waters.

Offshore, mainly winter nutrients and chlorophyll have been used in the assessment. Overall, chlorophyll is the most applied effect parameter, followed by oxygen. The more complicated analyses of phytoplankton indicator species, macrophytes and zoobenthos were less often performed. Details on methodologies of the Common Procedure and indicators used in its application can be found in Annex 6.

Assessment of nutrient inputs

OSPAR assessments of trends in atmospheric concentrations and deposition of nitrogen and trends in riverine inputs and direct discharges of nutrients in the period 1990 – 2006 in the OSPAR maritime area are available at http://qsr2010.ospar.org/en/qsr_assessments.html.

The assessments analyse trends in nitrogen and hazardous substances data collected under CEMP as well as model calculations of atmospheric deposition of nitrogen and selected hazardous substances prepared by the Co-operative Programme for Monitoring and Evaluation of the Long Range Transport of Air Pollutants in Europe (EMEP) (OSPAR, 2009c), and trends in riverine inputs and direct discharges of nutrients and selected hazardous substances data collected under RID (OSPAR, 2009d).

5.4.3 UNEP/MAP

The Contracting Parties to the Barcelona Convention in the process of implementing the Ecosystem Approach have adopted Mediterranean Ecological Objectives (EOs) including EO5 Eutrophication, associated with Operational Objectives and Indicators (UNEP/MAP, 2012c). Following RSCs practices, the establishment of common indicators is the next step to put forward. For EO5, the following common indicators have been adopted[9] (UNEP/MAP, 2014c):

- Concentration of key nutrients in the water column (State/Pressure indicator).
- Chlorophyll-a concentration in the water column (Impact indicator).

The process of identifying targets and corresponding GES for EO5 was initiated in 2012 (UNEP/MAP 2012e). GES and targets for EO5 can be found in Annex 6. Thresholds values are not yet available but MED POL has made some preparatory work to provide initial background information on methodologies for the establishment of threshold values for eutrophication (UNEP/MAP, 2011a). This work will be further discussed during national expert meetings organized by MAP MED POL during 2014-2015. A Monitoring Guidance on EO5 was presented by the Secretariat in the meeting of Correspondence Group on Monitoring (CORMON) Pollution and Litter in May 2014 (UNEP/MAP. 2014d).

Common Indicator 7: Concentration of key nutrients in the water column
Data for this indicator have been generated by a number of Contracting Parties for the purpose of the MED POL Phase IV eutrophication monitoring programme. The parameters monitored include NO_3, NO_2, NH_4, PO_4 (or Total N, Total P) and SiO_4 (occasionally). Additional data generation for MED POL in terms of additional parameters to address this indicator would not be required. However the existing geographical coverage in terms of contribution of monitoring data by Contracting Parties for this indicator would need to be improved (UNEP/MAP, 2014b).

[9] *The type of indicators (Pressure, State, Impact) are according to SEC (2011).*

Common Indicator 8: Chlorophyll-a concentration in the water column
Data for this indicator have been generated by a number of Contracting Parties for the purpose of the MED POL Phase IV eutrophication monitoring programme. Methodologies considered include chlorophyll-a concentration measured in winter and in early spring (November–March) when phytoplankton bloom occurs following the deep winter mixing (<0.1 µg/l), data from a 25 meters top layer and /or surface data and satellite imagery to identify hotspots (different productivity areas). The existing geographical coverage in terms of contribution of monitoring data by Contracting Parties for this indicator would need to be improved (UNEP/MAP, 2014b). For a wider sub-regional and regional scale, the possibility to assess the actual condition for chl-a concentrations using satellite images is considered. These values could then be used as reference conditions for any subsequent GES monitoring based on trends.

NO_3, NO_2, NH_4, PO_4 and chlorophyll a are mandatory parameters set by the Eutrophication Marine Strategy of MED POL and guidance on relevant sampling and analysis techniques to support the Eutrophication Monitoring Strategy of MED POL are available (UNEP/MAP, 2005, 2007). As regards quality assurance, an intercalibration exercise for eutrophication parameters was completed in 2010 using the services of QUASIMEME. MED POL supported the participation of 19 Mediterranean laboratories in the exercise for the determination of nutrients and chlorophyll-a in seawater (UNEP/MAP, 2011b).

The linkages between UNEP/MAP eutrophication operational objectives, common indicators and relevant parameters with MSFD criteria and indicators are shown in Annex 2. A summary of the links between UNEP/MAP indicators and MSFD indicators is shown in Table 5.1.

UNEP/MAP common indicators contribute to 2 of the 8 MSFD indicators and the 2 of the 3 MSFD criteria for D5.

No standard methodologies and procedures have been developed for the regional assessment of eutrophication in the Mediterranean Sea. However, in a number of countries national eutrophication assessment methods are performed. Among the indices used for eutrophication assessment, the Trophic Index (TRIX) (Vollenweider, 1998) is the most widely used in Mediterranean waters over the last 10 years.
The TRIX index uses the following parameters:

- ChA = Chlorophyll a concentration as µg/L
- aD%O = Oxygen as absolute % deviation from saturation
- DIN = Dissolved Inorganic Nitrogen, N-(NO_3+NO_2+NH_4) as µg/L
- TP = Total Phosphorus as µg/L

A description of the TRIX Index can be found in UNEP/MAP (2011a).

UNEP/MAP collects data on nutrient inputs and produces assessments of pollution loads (see MEDPOL; Releases, emissions and sources of pollutants in the Mediterranean region. An assessment of 2003-2008 trends; 2012). Meanwhile a UNEP/MAP indicator on “Release of toxic substances and nutrients from industrial sector’ representing the emissions from industrial sources from individual facilities within the Mediterranean coastal zone with regard to nutrients and oxygen depleting substances, halogenated hydrocarbons, hydrocarbons and heavy metals is developed.

In the process of the implementation of the Ecosystems Approach, UNEP/MAP prepared an Initial Integrated Assessment of the Mediterranean Sea (UNEP/MAP, 2012d). UNEP MAP assessment follows the ECAP approach and addresses nutrient and organic matter enrichment, eutrophication, and anoxia under pressures and impacts. The assessment is text based and uses parameters such as: nitrogen and phosphorus inputs, nutrient

concentrations, dissolved oxygen, chlorophyll concentrations, algal blooms, harmful algal blooms and primary productivity.

5.4.4 BSC

The BSIMAP indicators[10] include inputs of nutrients from point sources (pressure indicator), NO3+NO2 +NH4, PO4 (state/pressure), Chlorophyll-a (impact), water transparency (Secchi) (impact), oxygen concentration (impact), and hypoxic situations-expansion of zones of hypoxia (impact) (BSC, 2010a).

BSIMAP provides recommendations on parameters, and methodologies to be used by the CPs in their monitoring programmes. Manuals on sampling and analysis have been developed for phytoplankton (Moncheva & Parr, 2005, Moncheva, 2010) and soft-bottom macrozoobenthos (Todorova and Konsulova 2005). Good drafts are available for zooplankton (micro-, meso-, macro-), macroalgae and zoobenthos (macro-hard bottom, meio-). BSIMAP parameters are optional or compulsory, depending on the priorities. Nutrients and phytoplankton are compulsory parameters. Nutrients are regularly reported. Chlorophyll is occasionally reported and not by all countries. Data on expansion of hypoxic zone indicator is limited. Loads (Inputs of nutrients from point sources i.e. municipal and industrial sources of waste waters) are well reported and there is sufficient data on rivers and hot spots.

The linkages between BSC eutrophication indicators and relevant parameters with MSFD criteria and indicators are shown in Annex 2. A summary of the links between BSC indicators and MSFD indicators is shown in Table 5.1.

BSC indicators contribute to 4 of the 8 MSFD indicators and the 3 MSFD criteria for D8 and also address nutrient inputs.

BSIMAP does not contain specific methodologies how to calculate eutrophication indicators or recommend tools for assessment of eutrophication.

In the regional BSC report on the State of the Environment of the Black Sea (BSC, 2008), eutrophication is assessed analyzing:

- Nutrient loads
- Nutrient concentrations (surface and in characteristic layers of the Black Sea – e.g.Nitricline)
- Chl
- Bottom layer oxygen

The Trophic Index (TRIX index) is proposed for assessment of eutrophication status but its implementation at regional scale is not currently possible as chlorophyll data are not provided by all countries

There are mathematical models developed to simulate eutrophication evolution, however, their results are not yet used in the regional reports. The project B2B (Baltic to Black, EC DG Environment project, implemented by the BSC in cooperation with HELCOM) worked to improve the assessments of eutrophication.

The overview shown in Table 5.9 provided in BSC (2010a) shows the status of nutrient and chlorophyll monitoring in the Black Sea countries as well as the improvements needed.

[10] *The type of indicators (Pressure, State, Impact) are according to SEC (2011).*

Currently the BSC is updating the Black Sea Integrated Monitoring and Assessment Program (BSIMAP) for 2013-2018. The updated BSIMAP has been drafted in the framework of the EU funded project “Support to the Black Sea Commission for the Implementation of the MSFD” (MSFD Project) which was finalized in 2012 and will undergo the national consultations. The main approaches of the updated draft BSIMAP are harmonized with the MSFD as well as aimed to be compliant with relevant assessment processes within the Black Sea SoE Report

Table 5. 9. Status of nutrient monitoring in the Black Sea countries and improvements needed. Source: BSC (2010a).

Priority parameters to be monitored	Issue to be addressed (Policy questions)	Monitoring	Initial Actions	Status of implement ation	Improvements needed
Nutrients (mandatory)	Are agreed measures effective in reducing eutrophication? What are the levels of nutrients in water and sediments, what are the loads from rivers and other land-based sources of pollution?	monitor concentrations and discharges, assess loads of nutrients	outline indicators and trends for loads and concentrations, introduce monitoring of nutrients in sediments (where possible) to assess the level of secondary eutrophication TRIX index for estimation of eutrophication processes.	Monitored – loads and water concentrations. Data available for sediments. Indicators developed.	Monitoring of sediments and open sea waters
Phytoplankton (mandatory)	How often phytoplankton blooms occur? What are the areas of most frequent phytoplankton blooms? What are the consequences for the Black Sea flora and fauna?	monitor chlorophyll, phytoplankton abundance, biomass and species composition	outline indicators, background values, trends	Monitored, reported with gaps. Indicators, background values, trends known.	Open-sea monitoring

5.4.5 Eutrophication related assessment in the WFD

One of the parameters reflecting the direct effects of nutrient enrichment is Phytoplankton which is also one of the three biological quality elements (BQE) of the WFD. According to Annex V of WFD (EC, 2003) the parameters defining the quality status of this element in coastal and transitional waters are:

- The composition and abundance of the phytoplanktonic taxa
- The average phytoplankton biomass
- Planktonic blooms

Among these, the phytoplankton biomass expressed as Chlorophyll a concentrations is the most region-wide inter-calibrated parameter for the BQE phytoplankton under the Geographical Inter-calibration Groups of the four MSFD regions.

Nutrient status is included in the physicochemical quality elements which together with the hydro morphological and primarily the biological quality elements determine the ecological status.

5.4.6 EEA eutrophication indicators

Indicator CSIO21-Nutrients in transitional, coastal and marine waters. The indicator shows 1) annual winter concentrations; 2) classification of concentration levels (i.e. low, moderate, high) and 3) trends in winter oxidized nitrogen (nitrate + nitrite) and phosphate concentration in the regional seas of Europe. Levels and trends of winter concentrations of dissolved inorganic nutrients are used for this indicator, as it is assumed that winter concentrations are not significantly reduced due to uptake by primary producers. The winter period is January, February and March for stations east of longitude 15 degrees (Bornholm) in the Baltic Sea and January and February for all other stations. Nutrient concentrations are expressed in micromol/l. Annual concentrations for Nitrogen (i.e. Nitrates, Nitrites and Total Oxidised Nitrogen) and Phosphate (i.e. Orthophosphates) are calculated per station. For each (sub)regional sea, the observed concentrations are classified as Low, Moderate or High. Concentrations are classified as Low when they are lower than the 20-percentile value of concentrations within a (sub)region and as High when they are higher than the 80-percentile value of concentrations within a (sub)region. For trend analysis of nitrogen and phosphate concentrations, stations must have at least data in the last four years of the current assessment (2007 or later), and 5 or more years in the period since 1985. Details on methodology for the calculation of this indicator can be found at http://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-transitional-coastal-and/nutrients-in-transitional-coastal-and-4

Indicator CSIO23- Chlorophyll in transitional, coastal and marine waters. The indicator shows 1) annual mean summer surface concentrations 2) classification of concentration levels (i.e. low, moderate, high) and 3) trends in mean summer surface concentrations of chlorophyll-a in the regional seas of Europe. The concentration of chlorophyll-a is expressed as microgram /l in the uppermost 10 m of the water column during summer. Summer period is June to September for stations north of latitude 59 degrees in the Baltic Sea (Gulf of Bothnia and Gulf of Finland) and May to September for all other stations. Annual mean summer surface concentrations of Chl-a, are calculated per station. For each (sub)regional sea, the observed concentrations are classified as Low, Moderate or High. Concentrations are classified as Low when they are lower than the 20-percentile value of concentrations within a (sub)region and as High when they are higher than the 80-percentile value of concentrations within a (sub)region. For trend analysis stations must have at least data in the last four years of the current assessment (2007 or later), and 5 or more years in the period since 1985. Details on methodology for the calculation of this indicator can be found at http://www.eea.europa.eu/data-and-maps/indicators/chlorophyll-in-transitional-coastal-and/chlorophyll-in-transitional-coastal-and-3

The data used for the EEA eutrophication indicators is part of the WISE - State of the Environment (SoE) data, available in Waterbase - TCM (Transitional, Coastal and Marine) waters.

5.4.7 Gaps in RSC indicator contribution to MSFD indicators

The following gaps are identified in RSC common/core indicator coverage of MSFD indicators (Table 5.1).
MSFD indicator *5.1.2 Nutrient ratios (silica, nitrogen and phosphorus), where appropriate* is not covered by the RSCs
MSFD indicators *5.2.2 Water transparency related to increase in suspended algae, where relevant, 5.2.3 Abundance of opportunistic macroalgae* and 5.3.1 *Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency* are not covered by OSPAR and UNEP/MAP
MSFD indicator *5.2.4 Species shift in floristic composition such as diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms (e.g. cyanobacteria) caused by human activities* is not covered by HELCOM and UNEP/MAP

5.5 Information flow processes and management systems

5.5.1 ICES

ICES is the responsible data centre for selected marine environmental monitoring data of HELCOM and OSPAR. Contracting Parties are obliged to report COMBINE (HELCOM Cooperative Monitoring in the Baltic Marine Environment) and CEMP (Comprehensive Environmental Monitoring Programme) monitoring data to ICES on an annual basis (by 15 September every year) using the agreed reporting formats (csv or tab separated formats). The submission is done by email. Data are visualized and QCed using dedicated web-based checking program. Data are then inserted in a relational database (MS-SQL) and the metadata are ISO19115 compliant. Both data and their metadata are available on-line through Web Services.

5.5.2 HELCOM

- COMPINE data: are held by the ICES Oceanographic data base and are freely available as shape file or ascii (csv, odv) formats through the web applications at: http://ices.dk/marine-data/data-portals/Pages/ocean.aspx.
- HELCOM pollution load compilation database is hosted and maintained by HELCOM data consultant SYKE with direct email submissions on river-borne, coastal and point source loads by 1st of November every year and more detailed reporting including sources on land approximately every sixth year.
    - HELCOM Pollution Load Compilation data set 5.5 (PLC 5.5): CP submissions to HELCOM data consultant (SYKE) by email once per year. There is maintained a PCL database but with no online access and the data can be accessed only upon request. SYKE is responsible for the quality control.
    - HELCOM Pollution Load Compilation 6 (PLC-6): CP submissions to HELCOM data consultant (SYKE) by email. Currently there is no online access point for the whole database. Need for developing SQL database and interface to modernize reporting, QA and maximize the use of and access to data. Development work is ongoing within HELCOM PLUS project. Planned to be included into HELCOM operational eutrophication indicator database (EUTRO-OPER project) hosted by ICES
- Ships of opportunity data: Planned to be included into HELCOM operational eutrophication indicator database (EUTRO-OPER project) hosted by ICES.

- Earth observation-based chl-a: Planned to be included into HELCOM operational eutrophication indicator database (EUTRO-OPER project) hosted by ICES.

5.5.3 OSPAR

- CAMP data: Data are submitted once per year. Each data provider (monitoring programme or research project) is responsible for its own data QC/QA (quality checks and assurance). Data can be downloaded from EBAS database operated by NILU – Norwegian Institute for Air Research, through its web-portal (http://ebas.nilu.no/) in a format based on the NASA Ames 1001 format (https://cloud1.arc.nasa.gov/solve/archiv/archive.tutorial.html), both human and machine readable format. The portal also provides plot capabilities. The latest CAMP report and data (2011) are available for download in pdf format at: http://www.ospar.org/documents/dbase/publications/p00597/p00597_camp_2011_data_report.pdf. Data are QCed by each data centre which provide data
- RID data: The latest RID report and data are available for download in pdf format at:(http://www.ospar.org/documents/dbase/publications/p00598/p00598_rid_2011_data_report.pdf). No other on-line application was discovered for access to the RID data.
- CEMP data: the database is held by ICES Oceanographic and DOME data base (see previous link of COMPINE data)

5.5.4 UNEP/MAP

The data are reported by the end of the year. The reporting format is excel and the data are sent to UNEP/MAP by email. However not all Contracting Parties report data on a regular basis and there are gaps both in terms of temporal and spatial coverage. Prior to their organization in a MS database, data are QCed by experts following internal procedures. Metadata are standardized using internal conventions and rules but are not INSPIRE compliant.

The MED POL Info System is a networked information system intended to provide the Contracting Parties and MED POL Unit with the tools to manage, share, preserve and analyse MED POL data to MED POL users. The Info System is not yet operational but it is expected to be ready in December 2014.

MED POL monitoring data on eutrophication are not currently available on-line, it is expected to be done with the publication of the MED POL info system end of 2014.

5.5.5 BSC

The Black Sea Integrated Monitoring and Assessment Programme (BSIMAP) provides common data/information reporting formats and the contracting parties have the obligation to report to the BSC on an annual basis using these agreed formats (excel forms). Data are annually collected and submitted beginning of August each year.

The BSC Regional Database on Pollution is a component of the Black Sea Information System (BSIS) held by the Regional Activity Center for Pollution Monitoring and Assessment (RAC PMA). Nutrients data constitute the major part of the database.The BSC Regional Database is available through the web site:http://rdbp.sea.gov.ua. Password is required for external users to access it. Data can be exchanged in ascii format (odv) or as data layers (shape files). The database is built using a relational database management system (RDBMS). Metadata descriptions and their standards follow the SeaDataNet approach. Detailed description of the BSC database can be found in the report “The development of a new version of the Regional Data base on Pollution of BSIS” prepared by the RAC PMA under the BSC-Baltic2Black Service contract (rdbp.sea.gov.ua/docs/FINAL_REPORT_RDB.doc)

5.5.6 EEA

EEA has organized its data flows with the European environment information and observation network (Eionet), a partnership network of the EEA and 33 members and 6 cooperating countries. Eionet consists of the EEA itself, a number of European Topic Centres (ETCs) – ETC/ICM (Inland, Coastal and Marine Waters) being the water thematic center - and a network of National Focal Points (NFPs) and National Reference Centres (NRCs).

In the context of the implementation of the Water Framework Directive (WFD), EEA´s Eionet-Water annual data flow for waters was transferred into the WISE 'State of the Environment' (SoE) data flow in 2008 and gained full integration into the reporting under WISE complementary with data reported under the WFD (i.e. information reported already under the WFD obligatory reporting would not be required again, but used as available in WISE).
The WISE SoE TCM (Transitional, Coastal and Marine Waters) dataset results from data collected annually both from EEA member countries and from the RSCs through the WISE-SoE TCM data collection process.

WISE-SoE data collection process is based on the existing monitoring networks in the EEA member countries, where a representative sub-sample of national monitoring sites in rivers, lakes, groundwater and transitional, coastal and marine waters were selected for the European network with no additional demands for new data gathering. WISE-SoE data collection runs annually and traditionally starts at the end of July/beginning of August.

WISE SoE data on transitional, coastal and marine waters (WISE SoE TCM) is reported annually to the EEA by the Eionet countries using the ReportNet tools based on agreed set of specifications, schemas, templates and common dictionaries available to countries for structuring and formatting their deliveries. Countries are responsible for the quality control and assurance of their national datasets. WISE SoE datasets are then further handled by the European Topic Centre on Inland, Coastal and Marine waters (ETC/ICM), where a series of QA and validation routines are performed in order to ensure that the data delivered to the EEA are comparable at the European level.

To manage the duplicate submissions within the WISE SoE TCM data flow, an agreement was reached whereby countries were to provide only data that had not already been submitted to the RSC. Data submitted to the RSC is obtained from ICES directly.

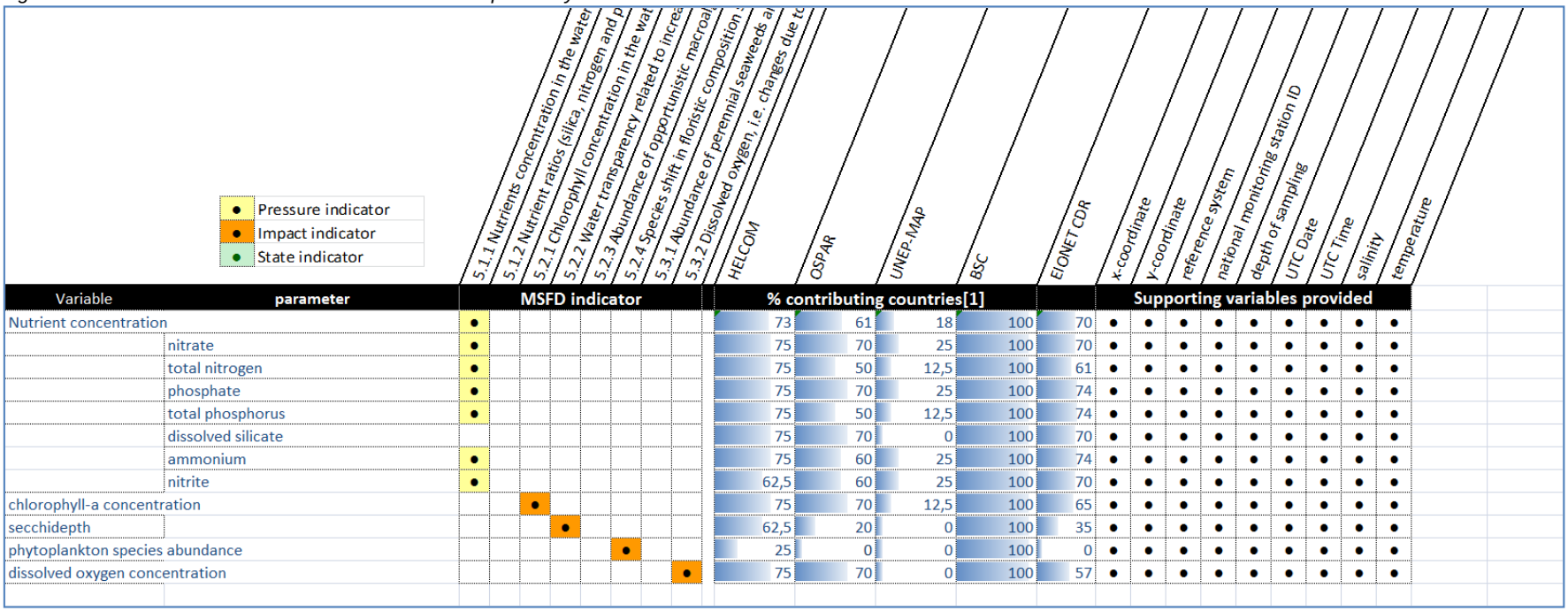
Data and information obtained through the above processes are used to produce indicators upon which EEA assessment reports are based. Collected data are also published in Waterbase, a series of water topic-specific databases and web pages, publicly accessible via the EEA Data Service's web site. The most recent WISE SoE TCM data can be viewed, analysed and downloaded in excel format from the Waterbase – TCM, an EEA data service available at the following website: http://www.eea.europa.eu/data-and-maps/data/waterbase-transitional-coastal-and-marine-waters-9

5.6 Conclusions

There are current RSC data streams relevant to eutrophication that can be used for MSFD requirements concerning nutrient levels in the marine environment, impacts on the water column-physical and impacts on the water column-biological, whereas no data flows were identified for impacts on the sea bed-biological except in BSC. However, not all Contracting Parties report data on a regular basis and there are gaps both in terms of temporal and spatial coverage, most apparent in UNEP/MAP.

There are also WISE SoE TCM data flows concerning nutrient levels in the marine environment, impacts on the water column-physical and impacts on the water column-biological reported by EU MS via EIONET CDR.
A summary of the parameters relevant for MSFD D5 indicators reported by the CPs which are common to RSCs is shown in Figure 5.9.
The strategy applied within the WISE SoE TCM data flow, to avoid duplicate submissions, e.g. countries to provide only data that had not already been submitted to the RSC which are obtained from ICES directly, is a best practice that can be applied in the current and the future monitoring activities in other regions.
Most of the available data are organized in common databases, using common formats and standards for discovery and access, however not all databases are accessible on line yet (UNEP/MAP and BSC databases).
Efforts for providing homogenized and standardized regional data and products at European level (including part of RSC data) are being undertaken in other currently on-going projects such as EMODnet chemistry which provides services in terms of access of aggregated, validated data sets and products (maps) for MSFD Descriptors 5 (eutrophication), 8 (chemical pollution) and 9 (contaminants in seafood) to support the MSFD implementation

Fig 5.9. Parameters relevant for MSFD D5 indicators reported by the CPs in 2012 which are common to RSCs.



● Pressure indicator
● Impact indicator
● State indicator

Variable	parameter	MSFD indicator							% contributing countries[1]					Supporting variables provided								
		5.1.1 Nutrients concentration in the water	5.1.2 Nutrient ratios (silica, nitrogen and p	5.2.1 Chlorophyll concentration in the wat	5.2.2 Water transparency related to increa	5.2.3 Abundance of opportunistic macroalg	5.2.4 Species shift in floristic composition	5.3.1 Abundance of perennial seaweeds al	5.3.2 Dissolved oxygen, i.e. changes due to	HELCOM	OSPAR	UNEP-MAP	BSC	EIONET CDR	x-coordinate	y-coordinate	reference system	national monitoring station ID	depth of sampling	UTC Date	UTC Time	salinity	temperature
Nutrient concentration		●								73	61	18	100	70	●	●	●	●	●	●	●	●	●
	nitrate	●								75	70	25	100	70	●	●	●	●	●	●	●	●	●
	total nitrogen	●								75	50	12,5	100	61	●	●	●	●	●	●	●	●	●
	phosphate	●								75	70	25	100	74	●	●	●	●	●	●	●	●	●
	total phosphorus	●								75	50	12,5	100	74	●	●	●	●	●	●	●	●	●
	dissolved silicate									75	70	0	100	70	●	●	●	●	●	●	●	●	●
	ammonium	●								75	60	25	100	74	●	●	●	●	●	●	●	●	●
	nitrite	●								62,5	60	25	100	70	●	●	●	●	●	●	●	●	●
chlorophyll-a concentration			●							75	70	12,5	100	65	●	●	●	●	●	●	●	●	●
secchidepth				●						62,5	20	0	100	35	●	●	●	●	●	●	●	●	●
phytoplankton species abundance						●				25	0	0	100	0	●	●	●	●	●	●	●	●	●
dissolved oxygen concentration								●		75	70	0	100	57	●	●	●	●	●	●	●	●	●

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6 RSC and EEA data holdings and data flows related to hydrographical changes

6.1 Introduction

The MSFD addresses permanent hydrographical changes that can occur due to changes in the thermal or salinity regimes, changes in the tidal regime, sediment and freshwater transport, current or wave action and changes in turbidity, by GES descriptor D7: *Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems*. Permanent hydrographical changes can be due to building activities, such as extensions or alterations to the coast, or the building of artificial islands and other infrastructural works in the marine environment. Commission Decision 2010/477/EU sets out two criteria for D7 addressing spatial characterisation of permanent alterations (7.1) and Impact of permanent hydrographical changes (7.2) and three indicators to describe these criteria (Table 6.1).

Currently only OSPAR (OSPAR, 2013c) and UNEP/MAP (UNEP/MAP 2014a,b,c) have specific indicators addressing hydrographical changes relating to D7 (Table 6.1).

The objectives and indicators of the RSCs in parallel to the corresponding criteria and indicators of MSFD for GES descriptors D 7 can be found in Annex 2. Table 6.1 presents an overview of links between RSC objectives-indicators and MSFD criteria-indicators for D7. The colour coding in Tables 6.1 is as follows:

- blue: existing relevant objective or common/core indicator
- light blue: existing candidate/pre-core indicator
- red: no relevant objective or common/candidate/core/pre-core indicator

EEA does not use a relevant indicator on permanent hydrological changes.

6.2 Identification of data

No data streams have been identified.

6.3 Analysis of data and information flows

No data streams have been identified.

6.4 Indicators and assessments for P/S/I

OSPAR plans to apply the following indicators for hydrographical changes (OSPAR, 2013c).

Extent of area affected – physical (Common indicator). The indicator measures surface area (m^2) of activity and physically impacted area around it e.g. salinity change, stratification, bottom stress, tidal range. First of all, the ‘area affected’ needs to be defined and a baseline study is also needed for optimal use of a modelling approach to design post-construction monitoring strategies (for large infrastructure projects). The indicator is not operational yet. Further development needs include more work on methodologies, standardization, analytical techniques, with definitions of significance.

There is also a clear need to collate information from EIA-based monitoring. This indicator is a pressure indicator relevant to MSFD indicator 7.1.1

Spatial extent of habitats affected (Candidate indicator). This indicator can be used in the area defined by the previous indicator. For each habitat (defined at EUNIS 3 level) the vulnerability or sensitivity should be defined by direct and indirect influences. Proposed parameters are m^2 and/or % of habitats affected, species abundance, biomass and biodiversity and habitat models. In this regard, more work is needed on guidelines for methodologies, standardization, analytical techniques, with definitions of significance before this indicator can be applied. This indicator is an impact indicator relevant to MSFD indicator 7.2.1.

Changes in habitat functions (Candidate indicator). This indicator comprises habitat functions such as spawning, migratory patterns, breeding, feeding areas due to altered or changed hydrographic conditions. The parameters to be measured are biomass, spawning stocks, breeding and feeding areas, migration routes, species composition of habitats/benthic fauna. The indicator is under development by most CPs and more research is needed before it can be used at a subregional level. This indicator is an impact indicator relevant to MSFD indicator 7.2.2. It has potential links to other indicators such as MSFD 6.2.2.

UNEP/MAP has agreed on the following common indicator for hydrographical changes (UNEP/MAP, 2014a,b,c).

Extent of area affected by permanent alterations. There is no parameter proposed yet for this indicator. It is considered to be closely linked to the biodiversity indicators reflecting habitat condition in as much as it may bear a reference to the extent of area of habitat affected, as well as to the Ecological Objective on seafloor integrity to be developed at a later stage of the ECAP process.
This indicator is an impact indicator relevant to MSFD indicator 7.2.1.

The linkages between OSPAR and UNEP/MAP ecological objectives, common indicators and parameters, with MSFD criteria and indicators are shown in Annex 2.

6.5 Information flow processes and management systems

There are gaps in MSFD D7 coverage across RSCs: OSPAR and UNEP/MAP indicators and relevant methodologies for assessing hydrographical changes are not yet fully developed; and HELCOM and BSC do not use relevant indicators. In this context, information flow processes and management systems relevant to D7 could not be evaluated.

6.6 Conclusions

No current RSC data streams have been identified on hydrological changes relevant to MSFD descriptor 7. Only OSPAR and UNEP/MAP plan to use relevant indicators but methodologies are not yet developed.

Table 6.1. Linkages of the RSC objectives (O) and indicators (I) to MSFD criteria and indicators for the GES Descriptor D7. O: HELCOM Ecological objectives, OSPAR Ecological Quality Objectives, UNEP/MAP Operational objectives, BSC Sub Ecological Quality objective; and I: Indicators Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator.

MSFD			**HELCOM**		**OSPAR**		**UNEP/MAP**		**BSC**	
D7: Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.			**Strategic goal**: Favourable conservation status of biodiversity		**Strategic objective** :To halt and prevent by 2020 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems, and to restore, where practicable, marine areas which have been adversely affected		**Ecological objective EQ7:** Alteration of hydrographic conditions does not adversely affect marine ecosystems		**LBSA Protocol 2009, art 3 (iii)** This Protocol shall apply to: iii) Activities that may directly or indirectly affect the marine environment or coastal areas of the Black Sea such as works which cause physical alteration of the natural state of the coastline, including alteration or destruction of the landscape or habitats.	
Criteria	**Indicators**	**Type**	**O**	**I**	**O**	**I**	**O**	**I**	**O**	**I**
7.1. Spatial characterisation of permanent alterations	7.1.1 Extent of area affected by permanent alterations	P								
7.2. Impact of permanent hydrographical changes	7.2.1 Spatial extent of habitats affected by the permanent alteration	I								
	7.2.2 Changes in habitats, in particular the functions provided (e.g. spawning, breeding and feeding areas and migration routes of fish, birds and mammals), due to altered hydrographical conditions.	I								

7 RSC and EEA data and information holdings and data flows related to hazardous substances

7.1 Introduction

Commission Decision 2010/477/EU sets out four criteria for GES Descriptors D8: *Concentrations of contaminants are at levels not giving rise to pollution effects* and D9: : *Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards* and five indicators to describe these criteria. MSFD indicators address contaminant concentrations in the marine environment and their effects and contaminant concentrations in seafood as well as occurrence, origin and extent of significant pollution events from oil spills. Other hazardous substances inputs are not included in the list of indicators for D8 and D9 in the COM Decision 210/477/EU but article 8 on initial assessments and annex III to the MSFD Directive lists hazardous substances introduction in the marine environment among the elements to be addressed in the assessment of marine waters.

RSCs have adopted (HELCOM, OSPAR, UNEP/MAP) or are in the process of adopting (BSC) indicators for hazardous substances covering objectives set by their strategies. The objectives and indicators of the four RSCs as well as the key policy questions of the EEA in parallel to the corresponding criteria and indicators of MSFD for GES descriptors D8 and D9 can be found in Annex 2. Table 7.1 present an overview of links between RSC objectives-indicators and MSFD criteria-indicators for D8 and D9. The colour coding in Table 7.1 is as follows

- blue: existing relevant objective or common/core indicator
- light blue: existing candidate/pre-core indicator
- red: no relevant objective or common/candidate/core/pre-core indicator

The four HELCOM ecological objectives for hazardous substances under Baltic Sea Action Plan cover concentrations of hazardous substances, their effects, radioactivity and safe seafood (HELCOM, 2007). HELCOM's CORESET expert group for hazardous substances developed and proposed 13 core indicators that address all four ecological objectives (HELCOM, 2013b). The core indicators were selected on the basis of their policy relevance, adverse effects to the environment, cost-efficient analyses and available targets. Among these indicators eight were recommended by HELCOM MONAS to the HELCOM Heads of Delegation for approval in 2013 and five were considered as pre-core indicators, which are to be further developed and resubmitted by 2015 for further evaluation. Among the thirteen proposed core indicators, nine measure concentrations of hazardous substances and four measure their effects. The substance indicators include organic contaminants as well as metals and a radioactive isotope. TBT and PAH substance indicators also include effect aspects, imposex and PAH metabolites. The HELCOM core indicators cover the MSFD criteria sufficiently. Oil pollution addressed by the MSFD indicator 8.2.2 was not included in the set of core indicators from the hazardous substances expert group but the biodiversity expert group proposed an indicator for oiled water-birds – addressing the effects of oil in the water, that was considered as pre-core indicator to be further developed. The information of the number of oil spills is included in the oiled bird indicator as supplementary information, which is also published annually as a Baltic Sea Environment Fact Sheet. The indicators for food safety are the same as for the environment, with the exception that not all substances currently have a GES boundary and therefore they cannot be used in quantitative assessments.

The OSPAR Hazardous Substances Strategy sets the objective of preventing pollution of the maritime area by continuously reducing discharges, emissions and losses of hazardous substances, with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances (OSPAR web page). Tasks considering hazardous substances are implemented through the HASEC committee. Data streams that potentially are used for these assessments include atmospheric inputs, riverine inputs, and assessment of concentrations in the water. The latest assessment includes concentrations of a selection of hazardous substances in marine sediment and in fish and shellfish tissues. The ICON project (2008 – 2012) aimed to demonstrate the application of methodology developed through OSPAR/ICES on larger scales. The ICON assessment is considered to be suitable for the assessment of GES for Descriptor 8 under the MSFD. The analysis led by OSPAR on trends in hazardous substances[11] was used in the part dealing with marine waters of the EEA technical report on hazardous substances in European waters[12].

UNEP/MAP has agreed on common indicators for hazardous substances addressed by Ecological Objective 9: *Contaminants cause no significant impact on coastal and marine ecosystems and human health* of the Ecosystem Approach (UNEP/MAP, 2014a). The common indicators have been proposed by the Secretariat taking into account practices of other RSCs and on the basis of experience already gained by the Contracting Parties through their regular MED POL monitoring activities as well as the experience gained by EU Mediterranean countries through their implementation of EU Directives such as the Marine Strategy Framework Directive and the Water Framework Directive. In the Integrated Correspondence Group of GES and Targets meeting held in February 2013, (UNEP/MAP, 2014a) five EO9 common indicators were agreed that cover the five EO9 operational objectives and the three MSFD criteria for GES Descriptors 8 and 9.

The hazardous substances theme is addressed in the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (BSSAP) 2009 under Ecosystem Quality Objective 4 (EcoQO 4): *Ensure Good Water Quality for Human Health, Recreational Use and Aquatic Biota*. EcoQO 4 is subdivided into Eco QO 4a - *Reduce pollutants originating from land based sources, including atmospheric emissions and EcoQO* 4b - *Reduce pollutants originating from shipping activities and offshore installations*. BSC in the implementation of BSIMAP (Black Sea Integrated Monitoring and Assessment Program) used indicators for hazardous substances concerning two of the MSFD criteria for D8 (BSC, 2010a). Indicators on hazardous substances in sediments and biota, shipping density, accidental oil spills from shipping and loads (Inputs of HSs from point sources) were applied.

The EEA marine thematic indicator on hazardous substances in marine organisms (MAR001) addresses the key policy question: *Are the concentrations and trends of hazardous substances in marine organisms acceptable*? This indicator describes the levels and trends in European seas of hazardous substances concentrations in marine biota. The indicator is based on the assessment of seven substances (sub-indicators): cadmium, lead, mercury, DDT, lindane, HCB and PCBs.

[11] *OSPAR, 2009: CEMP 2008/2009 Assessment of trends and concentrations of selected hazardous substances in sediments and biota. OSPAR Publication Number: 390/2009. ISBN 978-1-906840-30-3.*

[12] *Hazardous Substances in European waters - Analysis of the data on hazardous substances in groundwater, rivers, transitional, coastal and marine waters reported to the European Environment Agency from 1998 - 2010*

Table 7.1. Linkages of the RSCs objectives and indicators to MSFD criteria and indicators for the GES Descriptors D8 and D9. Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator.

MSFD		HELCOM		OSPAR		UNEP/MAP		BSC		EEA	
D8: Concentrations of contaminants are at levels not giving rise to pollution effects **D9:** Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.		**Strategic goal:** The Baltic Sea life undisturbed by hazardous substances		**Strategic objective:** To prevent pollution of the OSPAR maritime area by continuously reducing discharges, emissions and losses of hazardous substances (as defined in Annex 1), with the ultimate aim to achieve concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances		**Ecological Objective** (**EO) 9:** Contaminants cause no significant impact on coastal and marine ecosystems and human health		**LBSA Protocol 2009** **BSSAP 2009** **Ecosystem Quality Objective (EcoQO) 4:** Ensure Good Water Quality for Human Health, Recreational Use and Aquatic Biota			
Criteria	**Indicators**	**Ecological Quality Objectives**	**Core Indicators**	**Ecological objectives**	**Common/ candidate Indicators**	**Operational objectives**	**Common Indicators**	**Key policy questions in BSIMAP**	**BSIMAP Indicators**	**Key policy questions**	**Indicators**
8.1 Concentration of contaminants	8.1.1 Concentration of the contaminants mentioned above, measured in the relevant matrix (such as biota, sediment and water) in a way that ensures comparability with the assessments under Directive 2000/60/EC										
8.2 Effects of contaminants	8.2.1 Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored										

MSFD		HELCOM		OSPAR		UNEP/MAP		BSC		EEA	
Criteria	**Indicators**	**Ecological Quality Objectives**	**Core Indicators**	**Ecological objectives**	**Common/ candidate Indicators**	**Operational objectives**	**Common Indicators**	**Key policy questions in BSIMAP**	**BSIMAP Indicators**	**Key policy questions**	**Indicators**
8.2 Effects of contaminants	8.2.2 Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil and oil products) and their impact on biota physically affected by this pollution										indicator not active any more
9.1 Levels, number and frequency of contaminants	9.1.1 Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels										
	9.1.2 Frequency of regulatory levels being exceeded										

7.2 Identification of data

This chapter describes the current RSC data streams providing data on hazardous substances with respect to the RSC objectives and indicators as well as the relevant databases. The RSC data sets and the MSFD relevant data/parameters reported per country are listed in Annex 4 and Annex 7 respectively.

7.2.1 HELCOM

Information on the parameters on hazardous substances that the HELCOM data streams include can be found below:

- HELCOM COMBINE database holding data on hazardous substances in sediment, seawater and biota
- HELCOM Pollution Load Compilation 5.5 (PLC 5.5) dataset containing all waterborne nutrient and hazardous substances loads gathered by HELCOM contracting parties within pollution load monitoring[1]
- HELCOM Pollution Load Compilation 6 (PLC 6) ongoing comprehensive assessment of water- and airborne inputs and their sources to the Baltic Sea during the period 1994-2014 with more detailed assessment for 2014
- HELCOM Shipping accidents database
- HELCOM Monitoring of Radioactive Substances Expert Group (HELCOM MORS EG) reporting to HELCOM MORS environmental database that holds data on radioactive substance concentrations in Baltic Sea seawater, sediment and biota
- HELCOM Monitoring of Radioactive Substances Expert Group (HELCOM MORS EG) reporting to HELCOM MORS discharge database[3] that holds data on discharges of radionuclides to the Baltic Sea

7.2.2 OSPAR

Information on the parameters on hazardous substances that the OSPAR data streams include can be found below:

- “Comprehensive Atmospheric Monitoring Programme (CAMP)” includes data and model results on wet and dry deposition of hazardous substances.
- “Comprehensive Study of Riverine Inputs and direct Discharges (RID)” includes data compilations of yearly loads of hazardous substances (Cd, Hg, Cu, Pb, Zn, g-HCH, PCBs) based on measurements (large rivers) and estimates (smaller tributaries).
- “Comprehensive Environmental Monitoring Programme (CEMP)” contains data on Metals and metalloids, Organobromines, Chlorobiphenyls, Organochlorines (general), Dichloro-diphenyl-trichloroethane (DDTs), Cyclodienes, Dioxins, Hexachlorocyclohexanes, Organic esters, Organofluorines, Pesticides (general), Major organic constituents, Organo-metallic compounds, Polycyclic aromatic hydrocarbons (PAHs).
- Discharges of Radionuclides from the non-nuclear sectors
- Environmental Monitoring of Radioactive Substances

7.2.3 UNEP/MAP

Information on the parameters that the UNEP/MAP data streams include can be found below:

- MED POL data base holding data on contaminants in sediments: total mercury, total cadmium (mandatory), chromium, copper, lead, zinc, halogenated hydrocarbons, PAHs); contaminants in biota: total mercury, total cadmium (mandatory), halogenated hydrocarbons, PAHs, arsenic, chromium, copper, lead, zinc; and biological effects:

micronuclei frequency, DNA damage, EROD activity, lysosomal membrane stability and metallothionein content.
- Land-based pollution sources database holding national data on pollutants industrial and municipal discharges
- Regional Marine Pollution Emergency Response Centre (REMPEC) database on alerts and accidents in the Mediterranean Sea holding data on oil-related accidents reported since 1977 and other hazardous and noxious substances (HNS) related accidents reported since 1988.

7.2.4 BSC

Information on the parameters that the BSC data streams include can be found below:
- The Regional Data base on Pollution holds data on contaminants in water (PAHs, PCBs, pesticides, petroleum hydrocarbons, trace (heavy) metals, bacteria, phenols, detergents, radionuclides), in sediment (PAHs, PCBs, pesticides, petroleum hydrocarbons, radionuclides, trace (heavy) metals, phenols) and in biota (PAHs, pesticides, trace (heavy) metals). Data on contaminants in water are scarce (they are poorly reported). Data are reported to the BSC by the Advisory Group on Pollution Monitoring and Assessment (AG PMA)
- Data on pressures from Hot Spots (rivers, municipal and industrial sources) reported to the BSC by the Advisory Group on Control of Pollution from Land Based Sources (AG LBS). The data are stored in the BSC information system as excel files and are not accessible online.
- Data on number of ships calling at ports, accidental oil spills from shipping and imposed fines are reported to the BSC by the Advisory Group on Environmental Safety Aspects of Shipping (AG ESAS). The data are stored in the BSC information system as excel files and are not accessible online.

7.2.5 EEA

The WISE SoE TCM dataset contains among other data, chemical quality data on hazardous substances in biota, sediment and seawater, as well as data on direct discharges and riverine input loads.

7.3 Analysis of data and information flows

It must be noted that data are not regularly reported to the RSCs for all parameters and by all contracting parties and for some parameters monitoring is currently developing. Thus an analysis was performed on hazardous substances data relevant to MSFD requirements that are actually reported to the RSCs by the Contracting Parties. A list of the hazardous substances reported to the RSCs is shown in Annex 7. Among these, only the priority substances covered by the WFD directive (2008/105/EC, 2013/39/EC) were considered for the analysis of data flows (since MSFD indicator 8.1 requires comparability with the assessments under Directive 2000/60/EC). Data reported to the RSCs by the CPs which are EU MS was used in this analysis (HELCOM: 8 CPs, OSPAR: 10 CPS, UNEP/MAP: 8 CPS, BSC: 2 CPs). The CPs of the RSCs included in the analysis are listed in Table 5.2 (see Chapter 5). Overviews of data reported to HELCOM and OSPAR was obtained from ICES, of UNEP/MAP data was obtained from the MED POL database and of BSC data was provided by the IRIS SES project[13]. Overview of the data that are submitted via EIONET Central Data

[13] *Integrated Regional monitoring Implementation Strategy in the South European Seas IRIS-SES*

Repository (CDR) were provided by ICES. The countries reporting via EIONET CDR which are EU MS listed in Table 5.2 (see Chapter 5) were included in the analysis (23 EU MS). The data submitted via EIONET CDR can be data that are collected as part of HELCOM, OSPAR, MEDPOL, etc. so in that sense there is no strict “boundaries” between data submitted via the various routes (ICES or EIONET CDR). Data reported in 2012 was used in this analysis unless otherwise stated. The inventory of data flows used for the analysis including information on sampling frequencies, reporting programmes, duration of data flows, data provider, database name, database holder etc. can be found in Annex 6. It must be noted that the inventory of data flows in Annex 6 includes countries reporting to HELCOM, OSPAR and via EIONET CDR that are not EU MS which were not used in this analysis.

Summary
An overview of data on hazardous substances relevant to MSFD requirements on inputs as well as levels in the marine environment (MSFD indicator 8.2.1) that are actually reported to the RSCs by the CPs and at what frequencies across RSCs is shown in Table 7.2. The frequency of countries reporting to each RSC (% of CPs that are EU MS reporting to each RSC) and via EIONET CDR (% of EU MS reporting via EIONET CDR) for each parameter is categorized in classes represented by different colors. The chemical contaminants used by the EU MS for reporting under articles 8, 9 and 10 of the MSFD, summarized and evaluated by JRC (named as in the MS reports) (Palialexis et al. 2014) can be found in Annex 8.

The list of WFD priority substances does not exactly match the priority substances of the RSCs and in some cases the grouping of substances by each RSC differs. In order to use a common grouping of substances, the WFD priority substances were grouped using the ICES typology.

Concerning hazardous substances inputs, over 40% of the OSPAR (2011 data) and 60% of the HELCOM CPs reported on riverine and direct inputs (point sources) including WFD priority substances i.e. Cd, Hg, Cu, Pb, g-HCH, and PCBs. The BSC data on inputs used in the analysis were reported in the period 2001-2008 (BSC, a). Considering WFD substances, Cd, Hg and Pb from municipal, industrial and riverine sources were reported by the two BSC CPs during that period. Pollutant inputs in the UNEP/MAP region are reported in the National Baseline Budget (NBB) assessing the current trends of the pollutants emissions and releases every five years (2003-2008) (UNEP/MAP, 2012c). In 2008 only 2 CPs did not submit data, one of which is EU MS. 100% of EU MS submitted data in 2003 and 7 out of 8 EU MS submitted data in 2008. In 2008, releases of 29 WFD substances were reported by the EU MS. Cd, Pb, Hg and Ni releases were reported by more than 60% of the EU MS.
OSPAR CPs report on atmospheric deposition of hazardous substances. 60 to 90% of the CPs reported Cd, Hg, Cu, Pb in precipitation and in air, 30 to 60% of the CPs reported anthracene, fluoranthene and polyaromatic hydrocarbons in precipitation and in air, 10 to 40% of the CPs reported dioxins and dioxin-like compounds, dieldrin, endrin, para DDT, hexachlorocyclohexane in precipitation and in air, and 10% of the CPs reported hexachlorobenzene and heptachlorin precipitation (2011 data). In the HELCOM area calculations of atmospheric transport and depositions of metals and POPs are performed on the basis of emission data officially submitted by HELCOM CPs to CLRTAP Convention and expert estimates.

As regards levels in the marine environment, the CPs in each RSC show inconsistency in the substances they measure. Although the data reported to OSPAR and HELCOM overall cover a good number of the 45 WFD priority substances (OSPAR: up to 30, HELCOM: up to 33), the percentage of countries reporting for each substance is low particularly for water (less than 40%).

Seven substances in sediments (anthracene, cadmium, fluoranthene, lead, mercury, nickel, polyaromatic hydrocarbons) and 12 substances in biota (anthracene, brominated diphenylethers, cadmium, fluoranthene, hexachlorobenzene, hexachlorocyclohexane, lead, mercury, nickel, polyaromatic hydrocarbons, dioxins and dioxin-like compounds, para-para-DDT) were reported to OSPAR by more than 40% of the CPs (cadmium, brominated diphenylethers, dioxins and dioxin-like compounds (PCB 118), lead and mercury in biota by at least 60% of the CPs); these parameters are included in OSPAR common indicators and/or EEA indicators. Three substances in sediment (cadmium, mercury and lead) and 5 substances in biota (hexachlorobenzene, hexachlorocyclohexane, mercury, lead, para-para-DDT) were reported to HELCOM by 40-60% of the CPs; these parameters are included in HELCOM core indicators and/or EEA indicators.

UNEP/MAP and BSC CPs reported a lower number of the WFD priority substances. The percentage of countries reporting to UNEP/MAP is low, whereas percentage of counties reporting to BSC is 50% since one of the two MS included in the analysis is reporting data on hazardous substances.

Twenty five of the WFD substances were reported to at least two of the RSCs in water and 21 of the WFD substances were reported to at least two of the RSCs in sediment and biota.

Across RSCs, a higher consistency in the reported substances is shown between OSPAR and HELCOM.

All the hazardous substances reported to the RSCs were used by MS in reporting for the implementation of Art 8, 9 and 10 of the MSFD. .

Data submitted via EIONET CDR include 41 and 38 of the WFD substances in water and sediment respectively; less WFD substances are reported in biota. The percentage of EU MS reporting is up to 40%. More EU MS report substances in water than in sediment and biota.
It must be noted that data flows through ICES in fact refers to RSC data flows that are recycled as EIONET data flows, so although agreements are made with RSC or the EIONET, it is in fact possible to use the same data flow for multiple purposes.

Data relevant to MSFD descriptor 8.2.1 on pollution effects is reported to OSPAR and HELCOM and some data has been reported to UNEP/MAP in previous years. Biological effects data availability in the ICES database (see Annex 8) showed inconsistency with what was reported at least to OSPAR (personal communication with OSPAR Secretariat) and did not reflect the current situation, suggesting blockages in the data flow. It seems that part of OSPAR data on biological effects was not reported to ICES. All OSPAR CPs started the implementation, for 3-yr trial adoption and application (March 2012-March 2015) of the JAMP Integrated Guidelines on the Integrated Monitoring and Assessment of contaminants and biological effects. In relation to the application of biological effects, the CPs will make a sub-selection from the recommended list of biomarkers (OSPAR 2013d). Some HELCOM biological effects data is reported to ICES but not yet used in HELCOM core indicators. Biological effects data on lysosomal stability was reported to UNEP/MAP under the MED POL Phase IV programme.

Shipping accidents, number of spills and amount of substances released (see Annex 8) are reported to HELCOM by all CPs; EMSA (European Maritime and Safety Administration) reports satellite data on number of spills and amount of substances released. Information on number of spills from shipping accidents, and amount of substances released are collected for UNEP/MAP by REMPEC.

Accidental oil spills from shipping and number and imposed fines are reported to BSC by the CPs. Information on the number of oil spills, illegal discharges and quantities released within the Celtic Sea, Greater North Sea and its approaches is covered by the Bonn Agreement.

The analysis of CPs reporting to RSCs in 2012 showed data flows for MSFD indicator 8.1.1, but with gaps since not all WFD substances were reported and the percentage of countries reporting for each substance is low. There are also data flows for MSFD indicator 8.2.2. Existing data flows for MSFD indicator 8.2.1 are limited; however relevant flows are being planned particularly for OSPAR and HELCOM.

Table 7.2 WFD priority substances measured at source (R: riverine sources, P: point sources, C: coastal areas, AP: in precipitation, AA: in air) and in the marine environment (W: water, S: sediment, B: biota): Frequency of reporting to the RSCs by the CP and frequency of EU MS reporting via EIONET ECDR.

ICES Chemical groups	WFD priority substances	Baltic						NE Atlantic							Mediterranean				Black Sea					EU		
		HELCOM						OSPAR							UNEP/MAP				BSC					EIONET		
		Source			Marine environment			Source				Marine environment			Source	Marine environment			Source		Marine environment			Marine environment		
		R	P	C	W	S	B	R	P	AP	AA	W	S	B	P	W	S	B	P	R	W	S	B	W	S	B
Chlorinated paraffins	Chloroalkanes, C 10-13																									
Chlorobiphenyls	Dioxins and dioxin-like compounds							*	*						**											
Cyclodienes	Aldrin																									
	Dieldrin																									
	Endrin																									
	Isodrin																									
Dichloro-diphenyl-trichloroethane (DDTs)	DDT total																									
	para-para-DDT																									
Herbicides	Terbutryn																									
Hexachlorocyclohexanes	Hexachlorocyclohexane																									
Metals and metalloids	Cadmium and its compounds																									
	Lead and its compounds																									
	Mercury and its compounds																									
	Nickel and its compounds																									
Monocyclic aromatic hydrocarbons	Benzene																									
Organic esters	Di(2-ethylhexyl)phthalate (DEHP)																									
Organobromines	Brominated diphenylethers																									
	Hexabromocyclododecanes (HBCDD)																									
Organochlorines (general)	Alachlor																									
	1,2-dichloroethane																									

ICES Chemical groups	WFD priority substances	Baltic						NE Atlantic							Mediterranean				Black Sea					EU		
		HELCOM						OSPAR							UNEP/MAP				BSC					EIONET		
		Source			Marine environment			Source				Marine environment			Source	Marine environment			Source		Marine environment			Marine environment		
		R	P	C	W	S	B	R	P	AP	AA	W	S	B	P	W	S	B	P	R	W	S	B	W	S	B
	Dichloromethane																									
	Endosulfan																									
	Hexachlorobenzene																									
	Hexachlorobutadiene																									
	Pentachlorobenzene																									
	Pentachlorophenol																									
	Trichlorobenzenes																									
	Trichloromethane (chloroform)																									
	Trifluralin																									
	Heptachlor and heptachlor epoxide																									
	Carbon-tetrachloride																									
	Tetrachloro-ethylene																									
	Trichloro-ethylene																									
Organofluorines	Perfluorooctane sulfonic acid and its derivatives (PFOS)																									
Organo-metallic compounds	Tributyltin compounds																									
Organophosphorus pesticides	Chlorpyrifos (Chlorpyrifos-ethyl)																									
	Dichlorvos																									
Pesticides (general)	Chlorfenvinphos																									
	Diuron																									
Pesticides (general)	Isoproturon																									

ICES Chemical groups	WFD priority substances	Baltic						NE Atlantic							Mediterranean				Black Sea					EU		
		HELCOM						OSPAR							UNEP/MAP				BSC					EIONET		
		Source			Marine environment			Source				Marine environment			Source	Marine environment			Source		Marine environment			Marine environment		
		R	P	C	W	S	B	R	P	AP	AA	W	S	B	P	W	S	B	P	R	W	S	B	W	S	B
	Nonylphenols																									
	Octylphenols																									
Polycyclic aromatic hydrocarbons (PAHs)	Anthracene																									
	Fluoranthene																									
	Naphthalene																									
	Polyaromatic hydrocarbons (PAH)																									
Triazine pesticides	Atrazine																									
	Simazine																									
N/A	Dicofol																									
	Quinoxyfen																									
	Aclonifen																									
	Bifenox																									
	Cybutryne																									
	Cypermethrin																									

* no information on individual PCB congeners reported, recommended congeners include PCB 118
** no information on individual PCB congeners reported

Frequency	100-81%	80-61%	60-41%	40-21%	20-1%	No reporting
For groups of substances, the highest frequency of individual substance is shown						

7.4 Indicators and assessments for P/S/I

7.4.1 HELCOM

HELCOM hazardous substances indicators are shown in Table 7.3. These include 8 core and 5 pre-core indicators. For all the proposed core indicators, targets showing the boundary for good environmental status (GES) have been determined (HELCOM, 2013b). The status of the hazardous substances core indicators is presented in three status classes: good, moderate and bad. 'Good' environmental status and 'moderate' status are determined by the GES boundary or GES threshold, while 'bad' represents a condition of particularly high concentration or adverse impacts. The GES boundaries were primary selected using EU Environmental Quality Standards (EQSs) and also the OSPAR Environmental Assessment Criteria (EAC). HELCOM guidelines on hazardous substances core indicators methodologies can be found at http://www.helcom.fi/baltic-sea-trends/hazardous-substances/indicators/. An overview of the HELCOM guidelines on hazardous substances indicators methodologies is presented in Table 7.3.

The indicators for food safety are the same as for the environment, with the exception that not all substances currently have a GES boundary and therefore they cannot be used in quantitative assessments. Core indicators to assess concentrations in seafood against specific limit levels include the following substances: Cadmium, Lead, Mercury, dl-PCBs, dioxins, Benzo[a]Pyrene and Cesium-137.

The links between HELCOM objectives/core, pre-core indicators/parameters and MSFD criteria/indicators can be found in Annex 2. A summary of the links between HELCOM biodiversity indicators and MSFD indicators is shown in Table 7.1

HELCOM core and pre-core indicators contribute to:

- the 3 MSFD indicators and the 2 MSFD criteria for D8
- 1 MSFD indicator and 1 MSFD criterion for D9

The core indicators will be included as mandatory parameters to the coordinated monitoring programme. Guidelines for monitoring of contaminants and their effects are available in the Manual for Marine Monitoring in the COMBINE Programme of HELCOM at http://helcom.fi/action-areas/monitoring-and-assessment/manuals-andguidelines/combine-manual. A short overview of the revisions needed in the coordinated monitoring programme (HELCOM 2013a, see table 7.4) showed that six of the 13 core and precore indicators are at least somehow included in the manual and seven substances or effect indicators need to be included in the manual. In addition, there is a need to consider adding and removing species from the manual, changing sampled tissue, sharpening the details of the sample and agreeing on an effective placement of the monitoring stations. Guidelines for revised HELCOM monitoring programmes addressing all core indicators are being developed in the HELCOM MORE project by the end of year 2014.

Table 7.3 Overview of HELCOM hazardous substances indicators, their type (P/S/I), level of readiness (core, pre-core), preferred matrix and assessment criteria according to HELCOM guidelines on methodologies for core indicators.

Indicator	Type*	Status	Preferred matrix	Assessment criteria	Reference
Metals (lead, cadmium and mercury)	P	Core	Shellfish or sediment for local surveys Fish muscle (Hg) and liver (Cd, Pb) for regional surveys	• OSPAR Background Assessment Criteria (BAC) as the GES boundary • EU food safety limits for the boundary of 'bad' status in mussels and fish • ERL threshold in sediment	Nyberg *et al.* 2013a
Polyaromatic hydrocarbons (PAH) and their metabolites - US EPA 16 PAHs / selected metabolites	P/I	Core	Bivalves and sediment for PAHs Fish for PAH metabolites	• Environmental Assessment Criteria of OSPAR (EAC) or Environmental Quality Standards (EQS) of the EU • Background Assessment Criteria for PAHS for which EAC or EQS are not available	Nyberg *et al*. 2013b
Caesium-137 (Radioactive substances) in fish and surface waters	P	Core	Herring, flounder, plaice, surface seawater (0–10 m)	• Average concentrations of ^{137}Cs prior the Chernobyl accident used as target values • Herring (2.5 Bq/kg), flounder and plaice (2.9 Bq/kg) and seawater (15 Bq/kg).	Herrmann *et al.* 2013
Tributyltin (TBT) and imposex	P/I	Core	Biota: mussels or gastropoda snails (alternative: fish liver) Sediment (Secondary approach) Water (Optional)	• GES boundary follows the OSPAR Environmental Assessment Criteria (EAC) and the EU Environmental Quality Standards (EQS) • Biological effects assessment classes for ECOQO on imposex/intersex established for six gastropod species	Nyberg *et al*. 2013c
Hexabromocyclododecane (HBCD)	P	Core	Biota Sediment	• GES boundary is the Environmental Quality Standard (EQS) of EU (EQS: 167 µg/kg fish ww) • Alternative approach to use the Quality Standard for sediment (170 µg/ kg dw) (WFD WG E Dossier 19.1.2012).	Nyberg *et al*. 2013d
Perfluorooctane sulphonate (PFOS)	P	Core	Fish Sediment	• GES boundary is the EU Environmental Quality Standard (EQS) (EQS: 9.1 µg /kg fish ww) • Alternative approach to use the EU Quality Standard for water (0.23 µg/l) • No QS for benthic organisms (sediment)	Nyberg *et al*. 2013e
PolybrominatedDiphenyl Ethers (PBDE)	P	Core	Biota e.g. fish and mussels (primary matrix)	• GES boundary is the EU Environmental Quality Standard for the sum of polybrominated diphenyl ethers (congeners 28, 47, 99, 100,	Nyberg *et al*. 2013f

Indicator	Type*	Status	Preferred matrix	Assessment criteria	Reference
			Sediment (secondary matrix.)	153 and 154): 0.0085 µg /kg ww fish • GES boundary for sediment (a secondary approach) is proposed to be 4.5 µg kg-1 dw..	
Polychlorinated biphenyls (PCB) and dioxins and furans	P	Core	Sediments Biota	• The seven PCBs should be monitored but the core indicator assesses primarily two congeners only: CB-118 (dioxin like) and CB-153 (non-dioxin like) • OSPAR EACs for these two congeners suggested to be used • GES boundary of 4.0 ng/kg ww WHO-TEQ for dioxins and 8.0 ng/kg ww WHO-TEQ for dioxins and dl-PCBs	Boalt *et al*. 2013
Pharmaceuticals: Diclofenac, EE2 (+E1, E2, E3 + in vitro yeast essay	P	Pre-core	No info	No info	
Fish diseases – a fish stress indicator	I	Pre-core	No info	No info	
Lysosomal Membrane Stability – a toxic stress indicator	I	Pre-core	No info	No info	
Micronuclei test - a genotoxicity indicator	I	Pre-core	No info	No info	
Eelpout and amphipod embryo malformations	I	Pre-core	No info	No info	
Number of waterbirds being oiled annually	I	Pre-core (Biodiversity	No info	No info	

**Indicator type is according to SEC (2011)*

Table 7.4 Identified needs to revise the monitoring manuals of the hazardous substances core indicators by the CORESET Project SOURCE: HELCOM, 2013b.

Proposed core indicators	Manuals	Species	Tissue	Sample details	Stations
21. Polybrominated biphenyl ethers	Yes	New spp.	To be decided	To be decided	To be decided
22. Hexabromocyclododacene	No	New spp.	To be decided	To be decided	To be decided
24. Perfluorooctane sulphonate	No	New spp.	To be decided	To be decided	To be decided
25. Polychlorinated biphenyls and dioxins and furans	PCBs: Yes Dioxins: No	PCBs: OK	PCB: OK	PCB: OK	PCB: OK
26. Polyaromatic hydrocarbons and their metabolites	Yes	New spp.	To be decided	To be decided	To be decided
27. Metals	Yes	OK	OK	OK	OK
28. Radioactive substances	Yes	OK	OK	OK	OK
29. Tributyltin compounds / imposex index	Yes	New spp.	To be decided	To be decided	To be decided
30. Pharmaceuticals	No	To be decided	To be decided	To be decided	To be decided
31. Lysosomal membrane stability (LMS)	Yes	To be decided	To be decided	To be decided	To be decided
32. Fish diseases	Yes	To be decided	To be decided	To be decided	To be decided
33. Micronuclei test	Yes	To be decided	To be decided	To be decided	To be decided
34. Amphipod and eelpout reproductive success	Yes	To be decided	To be decided	To be decided	To be decided

The HELCOM integrated thematic assessment of hazardous substances (HELCOM, 2010d), is the first comprehensive attempt to compile the most recent data on hazardous substances in the Baltic Sea and to integrate the data using an assessment tool. The assessment covers all hazardous substances for which sufficient data are available covering the Baltic Sea area. The data used in the assessment derive from national monitoring activities including those carried out under the HELCOM COMBINE as well as separate assessment reports, HELCOM indicator fact sheets and research projects. It includes assessment of pollution sources from land based point and diffuse sources, sources at sea as well as emissions to air and atmospheric deposition of hazardous substances. As mentioned in Chapter 5, HELCOM collects data on nutrient and hazardous substance inputs and produces assessments of pollution loads under the HELCOM Pollution Load Compilation (http://helcom.fi/helcom-at-work/projects/plc-6/).

For the integrated thematic assessment of hazardous substances in the Baltic Sea HELCOM developed a multimetric indicator-based tool, the HELCOM Hazardous Substances Status Assessment Tool (CHASE),

The quantification of the “hazardous substances status” is based on a Contamination Ratio (CR), which is the ratio of the current status (measurement of the concentration of a substance or biological effect) and a threshold level or quality criterion, which is used as an approximation for an environmental target for that particular substance or biological effect. For each of the four HELCOM ecological objectives dealing with hazardous substances, the CRs of all substances or indicators are integrated to yield a status classification (“high”, “good”, “moderate”, “poor” or “bad”) of that particular ecological objective. CR values are summed within an element and then divided by the square root of the number of indicators. As a result, the status is not totally dependent on the number of indicators in the element, it does not give much weight to several low-CR indicators and it does not “mask” individual indicators with high CR values.

The primary classification is based on the threshold level, which defines a moderate or good status for each element. This boundary is ecotoxicologically justifiable (if the threshold is based on ecotoxicology). The further classification is not intended to be understood strictly as an ecotoxicological status of the environment, but rather as a deviation from the boundary condition. Moderate status is defined as a CR sum value >1.0. Poor status is assigned for a CR sum value >5.0 and bad status is reached at a value of 10.0. A high status is a CR sum value <0.5.

Subsequently, the CHASE tool makes use of a 'one out, all out' principle among the four ecological objectives. The ecological objective receiving the lowest status classification serves as the overall classification of the assessed site or area, giving the classification of the "hazardous substances status" of that site or area according to one of five classes. "High" and "good" classes indicate that areas are not disturbed by hazardous substances, while "moderate", "poor" and "bad" indicate different degrees of disturbance by hazardous substances. The tool also carries out an estimate of the quality of the assessment results.

The selection of indicators for CHASE was based on two primary criteria: (1) an indicator must have a threshold level which is preferably ecotoxicologically or statistically justified, and (2) an indicator must reliably describe the status of hazardous substances in the Baltic Sea. In addition, the following criteria were set: (3) a substance cannot be entered into an element more than once, and (4) the indicators under elements 1 and 4 are to be based on measurements primarily from bivalves, secondarily from fish, and thirdly from sediment.

7.4.2 OSPAR

The set of agreed OSPAR common indicators (OSPAR, 2013a) include the following common and candidate indicators for hazardous substances[14]:

Common indicators

- Inputs of Hg, Cd and Pb via water and air (Pressure)
- Metal (Hg, Cd, Pb) concentrations in biota (Pressure)
- Metal (Hg, Cd, Pb) concentrations in sediment (Pressure)
- PCB concentrations in biota (Pressure)
- PCB concentrations in sediments (Pressure)
- PAHs concentrations in sediments (Pressure)
- Organotin concentrations in sediments (Pressure)
- PBDE concentrations in biota (Pressure)
- PBDE concentrations in sediments (Pressure)
- Imposex/intersex (Impact)

Candidate indicators

- PAHs concentrations in biota (Pressure)
- Organotin concentrations in biota (Pressure)
- HCB (hexachlorobenzene) concentrations in biota (Pressure)
- HCB (hexachlorobenzene) concentrations in sediments (Pressure)
- HCBD (hexachlorobutadiene) concentrations in biota (Pressure)
- HCBD (hexachlorobutadiene) concentrations in sediments (Pressure)
- Externally visible fish diseases (Impact)
- Lysosomal stability (LMS) (Impact)
- Bile metabolites (of PAHs) (Impact)
- Micronuclei (MN) (Impact)

[14] Indicator type is according to SEC (2011)

- EROD (Impact)
- Oiled birds (EcoQO) (Pressure/Impact)

The links between OSPAR objectives/common, candidate indicators/parameters and MSFD criteria/indicators can be found in Annex 2. A summary of the links between OSPAR biodiversity indicators and MSFD indicators is shown in Table 7.1.

OSPAR common and candidate indicators contribute to the 3 MSFD indicators and the 2 MSFD criteria for D8 and include an indicator on contaminant inputs.

The OSPAR assessment of levels and trends in marine hazardous substances is prepared using the methods for data screening, treatment of quality assurance information, temporal trend assessment and assessment against assessment criteria which have been used in previous CEMP assessments and are described in the CEMP Assessment Manual[15] . The assessment criteria used to assess environmental concentrations of hazardous substances are set out in OSPAR agreement on CEMP Assessment Criteria for the QSR 2010 (OSPAR agreement 2009-2). The derivation of these assessment criteria for hazardous substances is discussed in a Background Document on CEMP Assessment Criteria for the QSR 2010 (OSPAR, 2009b). The assessment criteria reflect a two stage process in which data are compared to concentrations that are unlikely to give rise to unacceptable biological effects (c.f. Environmental Assessment Criteria, EACs) and then against Background Concentrations (BCs) or zero, expressed as Background Assessment Concentrations (BACs). The latter reflects the objective of the OSPAR Hazardous Substances Strategy that concentrations should be at or close to background levels for naturally occurring substances or to zero for man-made substances.

The OSPAR report "Status and trend of marine chemical pollution" (OSPAR, 2009e) summarises the evaluation of status and trend in data and information collected through the monitoring strategies for each of the substances in open use on the OSPAR list of chemicals for priority action. It builds on detailed assessments prepared under JAMP relating to data collected on emissions, discharges and losses, waterborne and atmospheric inputs and concentrations and effects in the marine environment of OSPAR priority chemicals. This includes the data collected and assessed under the three OSPAR monitoring programmes: CEMP, CAMP and RID.

OSPAR's quality status assessments on hazardous substances can be found at http://qsr2010.ospar.org/en/qsr_assessments.html.

7.4.3 UNEP/MAP

Five common indicators have been agreed for Ecological Objective (EO) 9 of the ECAP approach, addressing contaminants, (Table 7.5, UNEP/MAP, 2014c). The process of identifying targets and corresponding GES for EO9 has initiated in 2012 (UNEP/MAP 2012e). Thresholds values are not yet available but MED POL has made some preparatory work to provide initial background information on the methodology to be followed for the definition of the assessment criteria for hazardous substances in the Mediterranean (UNEP/MAP, 2011c). The proposed methodology is the one developed by OSPAR. Using Mediterranean data from the MED POL database and applying the OSPAR methodology, a first estimate of the background concentrations (BCs) and the background assessment concentrations (BACs) of trace meals (mercury, cadmium and lead) and organic contaminants (chlorinated

[15]. *Co-ordinated Environmental Monitoring Programme Assessment Manual for contaminants in sediment and biota. Monitoring and Assessment Series.OSPAR 2008, London. http://www.ospar.org/documents/dbase/publications/p00379/p00379_cemp_assessment_manual.pdf*

hydrocarbons and PAHs) in sediments and biota in the Mediterranean basin was provided (UNEP/MAP, 2011c). This work will be further discussed during national expert meetings organized by MAP MED POL during 2014-2015. A Monitoring Guidance on EO9 was presented by the Secretariat in the meeting of the Correspondence Group on Monitoring (CORMON) Pollution and Litter in May 2014 (UNEP/MAP, 2014e).

The linkages between UNEP/MAP objectives, common indicators and relevant parameters with MSFD criteria and indicators are shown in Annex 2. A summary of the links between BSC indicators and MSFD indicators is shown in Table 7.1

The UNEP/MAP common indicators on hazardous substances follow the MSFD indicators and thus contribute to all of the MSFD indicators and criteria for D8 and D9.

Table 7.5 Common indicators, GES and targets for EO9 contaminants, adapted from UNEP/MAP (2014c).

Common Indicator	GES	Targets
Concentration of key harmful contaminants[1]in biota, sediment or water	Level of pollution is below a determined threshold defined for the area	**State:** Concentrations of specific contaminants below EACs or below reference concentrations[2] No deterioration trend in contaminants concentrations in sediment and biota from human impacted areas, statistically define **Pressure:** Reduction of contaminants emissions from land based sources[3]
Level of pollution effects of key contaminants where a cause and effect relationship has been established	Concentrations of contaminants are not giving rise to pollution effects	**State:** Contaminants effects below threshold[4]
Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution	Occurrence of acute pollution events are reduced to the minimum	**State:** Decreasing trend in the occurrences of acute pollution events. **Pressure:** Decreasing trend in the operational releases of oil and other contaminants from coastal, maritime and off-shore activities
Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood[5]	Concentrations of contaminants are within the regulatory limits for consumption by humans	**State:** Concentrations of contaminants are within the regulatory limits set by legislation[6]
Percentage of intestinal enterococci concentration measurements within established standards	Concentrations of intestinal enterococci are within established standards	**State:** Increasing trend in the percentage of intestinal enterococci concentration measurements within established standards

[1]Priority contaminants as listed under the Barcelona Convention and LBS Protocol found at http://www.unep.ch/regionalseas/main/med/mlbsprot.html (see Annex 2)
[2]Use for further work on reference conditions ERL for sediments taking into account specifics of the Mediterranean.
[3]Thresholds to be set by COP19.
[4]Reduction programmes are already in place through the Protocols of the Barcelona Convention and the Marine Litter Regional Strategy.
[6]Thresholds to be set by COP19.

Common Indicator 11: Concentration of key harmful contaminants measured in the relevant matrix (biota, sediment, seawater)
Data and relevant methodologies for common indicator 11 are provided in the framework of the MED POL monitoring programme (UNEP/MAP, 2011b). The information reported by countries for the assessment of this indicator ranges from heavy metals and petroleum hydrocarbons only, to 3 groups of contaminants in water, sediment and biota: synthetic contaminants (PAHs, PCBs, DDTs, aldrin, endrin and dieldrin), non –synthetic contaminants (Cd, Pb, Cu, Zn, Hg) and petroleum hydrocarbons, and radionuclides (137 Cs). However, several countries do not provide monitoring data on a regular basis and there are gaps in spatial and temporal coverage of the Mediterranean coastline.

Common Indicator 12: Level of pollution effects of key contaminants where a cause and effect relationship has been established
Biological effects of contaminants are less measured in the Mediterranean coastal environment than contaminant concentrations. Data on biological effects of contaminants have been generated for the MED POL Phase IV contaminants monitoring programme, involving the biomarker lysosomal membrane stability. Outside of the MED POL biological effects monitoring activities, biomarkers including EROD activity, lysosomal membrane stability, stress on stress, acetylcholinesterase activity, metallothionein content and frequency of micronuclei occurrence measured by a small number of Mediterranean countries. Sentinel organisms include *Mullus barbatus* and *Mytilus edulis*. Since the most widely used specific technique where a cause and effect relationship has been established, is the measurement of TBT effects (imposex) on gastropods, the possibility to use available information for TBT thresholds from other regions in order to propose similar effects thresholds for the Mediterranean is considered. However it has been mentioned that the “imposex" indicator for the biological effect of TBT is not suitable for the French Mediterranean Sea, and is operational only in coastal areas. For the time being, it is not considered possible to define thresholds in relation to effects, using a quantitative approach, for other contaminants. The need to develop and test more contaminant-specific techniques is pointed out and will be the objective of expert group meetings organized by MAP during 2014-2015.

Common Indicator 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)
Acute pollution events (oil spills) are followed and recorded in the framework of the Prevention and Emergency Protocol, 2002 by the MAP Regional Marine Pollution Emergency Centre (REMPEC), which is also reviewing the maritime traffic in the Mediterranean providing information on routine operations. REMPEC has data on shipping accidents that caused oil or other hazardous and noxious substances (HNS) pollution in the Mediterranean or were likely to cause it. Moreover, in the field of scientific assistance for oil spill drift forecast, during the last few years, REMPEC developed a strong relationship with the Mediterranean Operational Oceanographic Network (MOON) with regard to operational use of forecasting and backtracking system for oil spills based on meteo, oceanographic observations and models. REMPEC and MOON have also signed a co-operation agreement to formalise their working relationship and define the type of common activities to be implemented.

Common Indicator 14: Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood
The information reported by countries for the assessment of this indicator includes concentrations of heavy metals (Pb, Cd and Hg) in fish tissues, heavy metals and different persistent organic pollutants according to EU regulations with partial availability of data for regulated substances, contaminants data on a wide variety of marine commercial species, and trends of bioaccumulation in the biota and functional groups used as bio-indicators

(*Mytilus galloprovincialis* and *Mullus barbatus/ Boops boops*, respectively). Some monitoring programmes still need improvements to provide an appropriate assessment. No corresponding data has been collected under MED POL Phase IV.

UNEP/MAP has published a Thematic Assessment Report on Hazardous Substances in the Mediterranean coastal environment based on the MED POL database and available international literature (UNEP/MAP, 2011d). The report presents a spatial and temporal assessment on hazardous substances in sediment and biota from the Mediterranean marine and coastal environment. For this assessment, only trace metals were found suitable for assessment at the regional level in sediments, and trace metals and organochlorinated compounds in marine biota. As regards species applied, the report focused on the bivalve *Mytilus galloprovincialis* and the benthic fish *Mullus barbatus* that were the more common and widely analyzed species in the region.

UNEP/MAP collects data and produces assessments of pollution loads (MEDPOL; Releases, emissions and sources of pollutants in the Mediterranean region. An assessment of 2003-2008 trends; 2012). UNEP/MAP is currently developing an indicator on “Release of toxic substances and nutrients from industrial sector’ representing the emissions from industrial sources from individual facilities within the Mediterranean coastal zone with regard to nutrients and oxygen-depleting substances, halogenated hydrocarbons, hydrocarbons and heavy metals.

7.4.4 BSC

BSIMAP mandatory parameters under the PMA (Pollution Monitoring and Assessment) Advisory Group, include heavy metals (Hg, Cu, Cd, Pb) and Total Petroleum Hydrocarbons (TPHs) in water; heavy metals (Hg, Cu, Cd, Pb), pesticides (DDT, DDD, DDE, α-HCH, β-HCH, γ-HCH), PCBs total, TPHs and phenols in sediments; and heavy metals (Hg, Cu, Cd, Pb), pesticides (DDT, DDD, DDE, γ-HCH) and PCBs in biota. Proposed species for contaminants in biota are bivalves, anchovies, sprat, turbot, horse mackerel. Pressures from hot spots (rivers, municipal and industrial sources) are mandatory parameters under the LBS (Control of Pollution from Land Based Sources) Advisory Group.

The BSIMAP indicators include:

- Loads of trace metals from point sources (municipal, industrial, rivers)
- Trace metals in biota (for mussels - Pb, Cd and Cu, for fish - Pb, Cd and Hg)
- Trace metals in sediments (15 metals are included, among hazardous - Hg, Cd, Pb, Cu, etc.)
- PCBs (total) in biota
- PCBs (total) in sediments
- PAHs in sediments
- Organotins in sediments
- Accidental oil spills from shipping
- Shipping density

The linkages between BSIMAP indicators and relevant parameters with MSFD criteria and indicators are shown in Annex 2. A summary of the links between BSC indicators and MSFD indicators is shown in Table 7.1.

BSC indicators contribute to 2 of the 3 MSFD indicators and the 2 MSFD criteria for D8 and also address hazardous substances inputs.

There are no methodologies on how to calculate hazardous substances indicators. The assessments are based on common scientific practices. In the regional BSC report on the State of the Environment of the Black Sea (BSC, 2008), chemical pollution is assessed analyzing:

- Total petroleum hydrocarbons in water and sediment
- Chlorinated pesticides (DDTs and HCHs) in water and sediment
- Trace metals in water and sediments

7.4.5 Hazardous substances assessment in the WFD

Article 16 of the Water Framework Directive 2000/60/EC requires the establishment of a list of priority substances, to be selected amongst those presenting a significant risk to or via the aquatic environment at EU level. Risk to or via the aquatic environment is identified by: (a) risk assessment carried out under Council Regulation (EEC) No. 793/93 (1), Council Directive 91/414/EEC (2), and Directive 98/8/EC of the European Parliament and of the Council (3), or (b) targeted risk-based assessment (following the methodology of Regulation (EEC) No. 793/93) focusing solely on aquatic ecotoxicity and on human toxicity via the aquatic environment. When necessary in order to meet the timetable set by WFD, risk to, or via the aquatic environment, can be identified by a simplified risk-based assessment procedure based on scientific principles taking particular account of evidence regarding the intrinsic hazard of the substance concerned and in particular its aquatic ecotoxicity and human toxicity via aquatic exposure routes, and evidence from monitoring of widespread environmental contamination and other proven factors which may indicate the possibility of widespread environmental contamination.

Decision 2455/2001/EC established the first list of priority substances, and Directive 2008/105/EC (the Environmental Quality Standards Directive – EQSD) set environmental quality standards (EQS) for 33 priority substances and certain other pollutants in surface waters (river, lake, transitional and coastal). According to Annex V, point 1.4.3 of the WFD and Article 1 of the EQSD, good chemical status is reached for a water body when it complies with the EQS for all the priority substances and other pollutants listed in Annex I of the EQSD. Directive 2013/39/EU amended Directives 2000/60/EC and 2008/105/EC as regards priority substances, adding 8 substances in the list.

7.4.6 EEA indicator: Hazardous substances in marine organisms

The EEA indicator Hazardous substances in marine organisms (MAR 001) describes the levels and trends in European seas of hazardous substances concentrations in marine biota, based on the individual assessment of monitoring data for the following substances: Cadmium, Lead, Mercury, DDE, p,p', Gamma-HCH (Lindane), Hexachlorobenzene (HCB), PCB101 (2,2',4,5,5'-pentachlorobiphenyl), PCB118, PCB138 (2,2',3,4,4',5'-hexachlorobiphenyl), PCB153 (2,2',4,4',5,5'-hexachlorobiphenyl), PCB180 (2,2',3,4,4',5,5'-heptachlorobiphenyl), PCB28 (2,4,4'-trichlorobiphenyl), PCB52 (2,2',5,5'-tetrachlorobiphenyl). The indicator is based on data for substances measured in Atlantic herring (*Clupea harengus*) in the Baltic Sea, blue mussel (*Mytilus edulis*), Atlantic cod (*Gadus morhua*) and flounder (*Platichtys flesus*) in the North-east Atlantic Ocean, the Mediterranean mussel (*Mytilus galloprovinicialis*) in the Mediterranean Sea and the Black Sea.

The data used in this indicator is part of the WISE - State of the Environment (SoE) data, available in Waterbase - TCM (Transitional, Coastal and Marine) waters. There is generally good data coverage for concentrations in the north-east Atlantic, except for Portugal, and in the Baltic Sea. The Mediterranean Sea was only represented by data from Croatia, France and Italy and for the Black Sea, the only available data were Romanian mussel data.

Details on methodologies for calculation of this indicator can be found at http://www.eea.europa.eu/data-and-maps/indicators/hazardous-substances-in-marine-organisms/hazardous-substances-in-marine-organisms-3.

7.4.7 Gaps in RSC indicator coverage of MSFD indicators

The following gaps are identified in RSC common/core indicator coverage of MSFD indicators for D8 and D9 (Table 7.1).

MSFD indicator *9.1.2 Frequency of regulatory levels being exceeded* is not covered by HELCOM, OSPAR and BSC

MSFD indicator *9.1.1 Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels* is not covered by OSPAR and BSC

MSFD indicator *8.2.1 Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored* is not covered by BSC

7.5 Information flow processes and management systems

7.5.1 ICES

ICES is the responsible data centre for selected marine environmental monitoring data of HELCOM and OSPAR. Contracting Parties are obliged to report COMBINE (HELCOM Cooperative Monitoring in the Baltic Marine Environment) and CEMP (Comprehensive Environmental Monitoring Programme) monitoring data to ICES on an annual basis (by 15 September every year) using the agreed reporting formats (csv or tab separated formats). The submission is done by email. Data are visualized and QCed using dedicated web-based checking program. Data are then inserted in a relational database (MS-SQL) and the metadata are ISO19115 compliant. Both data and their metadata are available on-line through Web Services.

7.5.2 HELCOM

HELCOM pollution load compilation database is hosted and maintained by HELCOM data consultant SYKE with direct email submissions by Contracting Parties on river-borne, coastal and point source loads by 1st of November every year and more detailed reporting including sources on land approximately every sixth year. MORS Radionuclide discharge database (Including discharges of Cesium-137) from nuclear installations is hosted by Finnish radiation safety authority STUK and MORS environmental database containing information on radionuclide concentrations in water and biota by HELCOM secretariat. Radionuclide data is reported by email once a year by 1stof September.

- COMPINE data: are held by the ICES DOME database, available as shapes files or ascii (csv, odv) formats through the web at: http://ices.dk/marine-data/data-portals/Pages/DOME.aspx (Database on Oceanography and Marine Ecosystems)..
- HELCOM Pollution Load Compilation 5.5 (PLC 5.5): CP submissions to HELCOM data consultant (SYKE) by email. Currently there is no online access point. The development work is underway in HELCOM PLUS project.
- HELCOM Pollution Load Compilation 6 (PLC 6): CP submissions to HELCOM data consultant (SYKE) by email. Currently there is no online access point. The development work is underway in HELCOM PLUS project.
- HELCOM Shipping accidents database: CP report data to HELCOM secretariat once per year. The complete HELCOM dataset on shipping accidents from 1989-2012 can

be accessed via the HELCOM map and data service (http://maps.helcom.fi/website/mapservice/index.html) under "Maritime & Response" for viewing, querying and/or free downloading as shape files (GIS layers). Annual reports on shipping accidents in the Baltic Sea area have been compiled by HELCOM since 2000. The latest report (2012) is available at: http://helcom.fi/Lists/Publications/Annual%20report%20on%20shipping%20accidents%20in%20the%20Baltic%20Sea%20area%20during%202012.pdf

- Radioactive substance concentrations-MORS environmental database: CP submit to HELCOM secretariat.

Radioactive substance concentrations-MORS discharge database: CP submission to HELCOM data consultant (STUK, Finnish Radiation and Nuclear Safety Authority).

7.5.3 OSPAR

- CAMP data: Data are submitted once per year. Each data provider (monitoring programme or research project) is responsible for its own data QC/QA (quality checks and assurance). Data can be downloaded from EBAS database operated by NILU – Norwegian Institute for Air Research, through its web-portal (http://ebas.nilu.no/) in a format based on the NASA Ames 1001 format (https://cloud1.arc.nasa.gov/solve/archiv/archive.tutorial.html), both human and machine readable format. The portal also provides plot capabilities. The latest CAMP report and data (2011) are available for download in pdf format at: http://www.ospar.org/documents/dbase/publications/p00597/p00597_camp_2011_data_report.pdf. Data are QCed by each data centre which provide data
- RID data: The latest RID report and data are available for download in pdf format at:(http://www.ospar.org/documents/dbase/publications/p00598/p00598_rid_2011_data_report.pdf). No other on-line application was discovered for access to the RID data.
- CEMP data: the database is held by ICES Oceanographic and DOME data base (see previous link of COMPINE data)
- Discharges of Radionuclides from the non-nuclear sectors: The database is available for download in MS-Access format at: http://www.ospar.org/html_documents/ospar/html/data/OSPAR_Non_nuclear_discharges-2011.zip. The latest report and data are available at: http://www.ospar.org/documents/dbase/publications/p00605/p00605_Discharges_from_the_non-nuclear_sectors_2011.pdf
- Environmental Monitoring of Radioactive Substances: No on-line database is available.

7.5.4 UNEP/MAP

MED POL monitoring data reported by the Contracting Parties to UNEP/MAP for the Barcelona Convention and held in the MED POL database (http://195.97.36.231/medpol/). The data are reported by the end of the year. The reporting format is excel and the data are sent to UNEP/MAP by email. However not all Contracting Parties report data on a regular basis and there are gaps both in terms of temporal and spatial coverage. Prior to their organization in a MS database, data are QCed by experts following internal procedures. Metadata are standardized using internal conventions and rules but are not INSPIRE compliant. Only a limited part of data as of Trace Metals and Chlorinated-Hydrocarbons and for the period 1975-1993 are available on-line for download in ascii/csv format.

The MED POL Info System is a networked information system intended to provide the Contracting Parties and MED POL with the tools to manage, share, preserve and analyse MED POL data to MED POL users. The Info System is not yet operational but it is expected

to be ready in December 2014. The whole MED POL monitoring data are expected to be done with the publication of the MED POL info system end of 2014.

7.5.5 BSC

The Black Sea Integrated Monitoring and Assessment Programme (BSIMAP) provides common data/information reporting formats and the contracting parties have the obligation to report to the BSC on an annual basis using these agreed formats (excel forms). Data are annually collected and submitted beginning of August each year.
The BSC Regional Database on Pollution is a component of the Black Sea Information System (BSIS) held by the Regional Activity Center for Pollution Monitoring and Assessment (RAC PMA). Nutrients data constitute the major part of the database.The BSC Regional Database is available through the web site:http://rdbp.sea.gov.ua. Password is required for external users to access it. Data can be exchanged in ascii format (odv) or as data layers (shape files). The database is built using a relational database management system (RDBMS). Metadata descriptions and their standards follow the SeaDataNet approach. Detailed description of the BSC database can be found in the report “The development of a new version of the Regional Data base on Pollution of BSIS” prepared by the RAC PMA under the BSC-Baltic2Black Service contract (rdbp.sea.gov.ua/docs/FINAL_REPORT_RDB.doc)

7.5.6 EEA

EEA data flows are described in paragraph 5.5.5

7.6 Conclusions

There are current RSC data streams relevant to hazardous substances that can be used for MSFD requirements concerning hazardous substances levels at sources and in the marine environment (water, sediment and biota). However, the CPs in each RSC and across RSCs show inconsistency in the substances they measure with highest consistency of reporting between OSPAR and HELCOM. Furthermore not all CPs report data on a regular basis and, there are gaps both in terms of temporal and spatial coverage, most apparent in UNEP/MAP and BSC.

There are also WISE SoE TCM data flows concerning hazardous substance levels in the marine environment reported via EIONET CDR. The strategy applied within the WISE SoE TCM data flow , to avoid duplicate submissions, e.g. countries to provide only data that had not already been submitted to the RSC which are obtained from ICES directly, is a best practice that can be applied in the current and the future monitoring activities in other regions.

RSC data flows concerning oil spills and shipping accidents are available; RSC data flows concerning pollution effects are limited; however relevant flows are being planned particularly for OSPAR and HELCOM.

A summary of the parameters relevant for MSFD D8 indicators reported by the CPs which are common to RSCs are shown in Figure 7.6.

Most part of the available data are organized in common databases, using common formats and standards for discovery and access, however not all databases are accessible on line yet (e.g. MEDPOL database and BSIS).

Figure 7.6 Parameters relevant for MSFD D8 indicators reported by the CPs in 2012 which are common to RSCs (w: water, s: sediment, b: biota)

Pressure indicator
Impact indicator
State indicator

Variable	ICES chemical groups	Hazardous substances parameter	MSFD indicator			% contributing countries[1]												Supporting variables provided									
			8.1.1 :Concentration of the co	8.2.1 level of pollution effects	8.2.2 Occurrence, origin (wher	HELCOM			OSPAR			UNEP-MAP			BSC			EIONET CDR				x-coordinate	y-coordinate	reference system	national monitoring station ID	depth of sampling	UTC Date	UTC Time	salinity	temperature	species name	matrix
						w	s	b	w	s	b	w	s	b	w	s	b	w	s	b												
Concentration in water, sediment and biota	Chlorinated paraffins	Chloroalkanes C10-13	•			0	0	12,5	0	0	10	0	0	0	0		0	0	0	0		•	•	•	•					•	•
Concentration in water, sediment and biota	Chlorobiphenyls	dioxins and dioxin-like compounds	•			12,5	25	37,5	10	40	70	0	0	0	50	50	50	4	13	13		•	•	•	•					•	•
Concentration in water, sediment and biota	Cyclodienes	aldrin	•			12,5	12,5	13	10	20	10	0	0	0	50	50	50	26	13	17		•	•	•	•					•	•
Concentration in water, sediment and biota	Cyclodienes	dieldrin	•			12,5	12,5	12,5	10	10	20	0	0	0	50	50	50	26	13	13		•	•	•	•					•	•
Concentration in water, sediment and biota	Cyclodienes	endrin	•			12,5	12,5	25	10	0	30	0	0	0	50	50	50	26	9	13		•	•	•	•					•	•
Concentration in water, sediment and biota	Cyclodienes	Isodrin	•			12,5	0	0	10	0	0	0	0	0	0	0	0	26	0	0		•	•	•	•					•	•
Concentration in water, sediment and biota	Dichloro-diphenyl-trichloroethane (DDTs	para-para-DDT	•			25	25	50	10	20	50	0	0	0	50	50	50	26	13	17		•	•	•	•					•	•
Concentration in water, sediment and biota	Hexachlorocyclohexanes	hexachlorocyclohexane	•			25	25	50	10	20	50	0	0	12,5	50	50	50	22	17	9		•	•	•	•					•	•
Concentration in water, sediment and biota	Metals and metalloids	cadmium	•			25	50	40	40	50	70	0	0	25	50	50	50	39	22	26		•	•	•	•					•	•
Concentration in water, sediment and biota	Metals and metalloids	lead	•			25	50	50	40	50	70	0	0	12,5	50	50	50	39	22	0		•	•	•	•					•	•
Concentration in water, sediment and biota	Metals and metalloids	nickel	•			25	37,5	25	40	50	60	0	0	0	50	50	50	39	22	13		•	•	•	•					•	•
Concentration in water, sediment and biota	Metals and metalloids	Mercury	•			25	50	50	30	50	70	0	0	25	0	0	0	39	22	16		•	•	•	•					•	•
Concentration in water, sediment and biota	Monocyclic aromatic hydrocarbons	Benzene	•			12,5	0	0	10	0	0	0	0	0	0	0	0	26	0	0		•	•	•	•					•	•
Concentration in water, sediment and biota	Organic esters	Di(2-ethylhexyl)phthalate (DEHP)	•			12,5	12,5	0	10	10	0	0	0	0	0	0	0	26	4	0		•	•	•	•						•
Concentration in water, sediment and biota	Organobromines	Brominated diphenylethers	•			12,5	12,5	37,5	20	30	70	0	0	0	0	0	0	9	8	0		•	•	•	•					•	•
Concentration in water, sediment and biota	Organochlorines (general)	hexachlorobenzene	•			25	25	50	10	30	60	0	0	12,5	50	50	50	26	17	22		•	•	•	•					•	•
Concentration in water, sediment and biota	Organochlorines (general)	1,2-dichloroethane	•			12,5	0	0	10	0	0	0	0	0	0	0	0	26	0	0		•	•	•	•						•
Concentration in water, sediment and biota	Organochlorines (general)	Dichloromethane	•			12,5	0	0	10	0	0	0	0	0	0	0	0	26	0	0		•	•	•	•						•
Concentration in water, sediment and biota	Organochlorines (general)	Hexachlorobutadiene	•			25	12,5	12,5	10	10	30	0	0	0	0	0	0	35	13	13		•	•	•	•					•	•
Concentration in water, sediment and biota	Organochlorines (general)	Pentachlorobenzene	•			25	12,5	0	10	10	0	0	0	0	0	0	0	22	17	0		•	•	•	•						•
Concentration in water, sediment and biota	Organochlorines (general)	Trifluralin	•			25	0	0	10	0	0	0	0	0	0	0	0	26	0	0		•	•	•	•						•
Concentration in water, sediment and biota	Organochlorines (general)	Endosulfan	•			0	0	25	0	0	10	0	0	0	0		0	0	0	17		•	•	•	•					•	•
Concentration in water, sediment and biota	Organochlorines (general)	Heptachlor and heptachlor epoxide	•			0	0	0	0	0	10	0	0	0	0		50	0	0	9		•	•	•	•					•	•
Concentration in water, sediment and biota	Pesticides (general)	Nonylphenols	•			12,5	12,5	0	10	10	0	0	0	0	0	0	0	9	0	0		•	•	•	•						•
Concentration in water, sediment and biota	Pesticides (general)	Octylphenols	•			12,5	12,5	0	10	10	0	0	0	0	0	0	0	22	4	0		•	•	•	•						•
Concentration in water, sediment and biota	Polycyclic aromatic hydrocarbons (PAHs)	anthracene	•			12,5	25	12,5	30	50	60	0	12,5	12,5	50	50	50	22	17	9		•	•	•	•					•	•
Concentration in water, sediment and biota	Polycyclic aromatic hydrocarbons (PAHs)	fluoranthene	•			12,5	25	25	30	50	60	0	12,5	12,5	50	50	50	22	17	13		•	•	•	•					•	•
Concentration in water, sediment and biota	Polycyclic aromatic hydrocarbons (PAHs)	naphthalene	•			0	25	12,5	0	40	40	0	12,5	0	0	50	50	0	17	4		•	•	•	•					•	•
Concentration in water, sediment and biota	Polycyclic aromatic hydrocarbons (PAHs)	polyaromatic hydrocarbons (PAH)	•			12,5	25	25	30	50	60	0	12,5	12,5	50	50	50	22	17	13		•	•	•	•					•	•
Concentration in water, sediment and biota	Organo-metallic compounds	Tributyltin compounds	•			0	0	12,5	0	0	40	0	0	0	0		0	0	0	0		•	•	•	•					•	•
Concentration in water, sediment and biota		**summary**	•			15	18	20	15	22	30	0	2	4	22	27	24	22	17	8		•	•	•	•					•	•
Imposex in gastropods				•				0			40			0			0					•	•	•	•					•	•
Ethoxyresorufin-O-deethylase (EROD) activity in fish				•				0			20			0			0					•	•	•	•					•	•
Fish liver pathologies				•				0			10			0			0					•	•	•	•					•	•
Levels of bile metabolite 1-hydroxypyrene in fish				•				12,5			10			0	0		0					•	•	•	•					•	•
number of spills					•	100			*			25			100							•	•	•	•						
illegal discharges					•	100			*			0			0							•	•	•	•						
amount of substances released					•	100			*			25			0							•	•	•	•						

*covered by the Bonn Agreement

8 RSC and EEA data holdings and data flows related to marine litter

8.1 Introduction

The MSFD addresses the marine litter issue in the GES Descriptor D10: *Properties and quantities of marine litter do not cause harm to the coastal and marine environment*. Commission Decision 2010/477/EU sets out two criteria for D10 covering characteristics of litter in the marine and coastal environment (10.1) and impacts of litter on marine life (10.2) and four indicators to describe these criteria (Table 8.1).

Currently only OSPAR (OSPAR, 2013c) and UNEP/MAP (UNEP/MAP 2014a,b,c) have specific objectives and indicators addressing marine litter relating to D10 (Table 8.1).

HELCOM acknowledges the problem of marine litter in a series of HELCOM recommendations (HELCOM MONAS, 2014). Recently CPs adopted the Ministerial Declaration 2013 (in HELCOM Copenhagen Ministerial Meeting 3 October) where they have agreed “to prevent and reduce marine litter from land- and sea-based sources, causing harmful impacts on coastal and marine habitats and species, and negative impacts on various economic sectors, such as fisheries, shipping or tourism, and to this end decide to develop a regional action plan by 2015 at the latest with the aim of achieving a significant quantitative reduction of marine litter by 2025, compared to 2015, and to prevent harm to the coastal and marine environment.” Thus, work has initiated by HELCOM MONAS forming a marine litter expert group for the development of core indicators for a regional marine litter monitoring (HELCOM MONAS, 2014).

The BSC Strategic Action Plan for the Environmental Protection and Rehabilitation of the Black Sea (BSSAP 2009) seems to be the most appropriate framework for addressing marine litter issues. This document includes a series of paragraphs relevant for marine litter. A Black Sea Regional Activity on Marine Litter ran from the end of 2005 till in mid-2007, resulting in “A Review of the Problem and a Draft Strategic Action Plan for Management and Abatement of Marine Litter in the Black Sea Region (BS-ML-SAP)” (BSC, 2007).

The objectives and indicators of the RSCs in parallel to the corresponding criteria and indicators of MSFD for GES descriptor D10 can be found in Annex 2. Table 8.1 presents an overview of links between RSC objectives-indicators and MSFD criteria-indicators for D10.The colour coding in Table 8.1 is as follows:

- blue: existing relevant objective or common/core indicator
- light blue: existing candidate/pre-core indicator
- red: no relevant objective or common/candidate/core/pre-core indicator

EEA does not have an indicator relevant to marine litter, but has developed the Marine Litter Watch, that aims to collect data on marine litter on beaches to support official monitoring, with the help of interested citizens and communities. It also allows the collection of data from non-official initiatives such as beach clean-ups.

Table 8.1. Linkages of the RSC objectives (O) and indicators (I) to MSFD criteria and indicators for the GES Descriptor D10. O: HELCOM Ecological objectives, OSPAR Ecological Quality Objectives, UNEP/MAP Operational objectives, BSC Sub Ecological Quality objective, I: Indicators Colour coding: blue: existing relevant objective or common/core indicator; light blue: existing candidate/pre-core indicator; and red: no relevant objective or common/candidate/core/pre-core indicator.

MSFD			HELCOM		OSPAR		UNEP/MAP		BSC	
D10: Properties and quantities of marine litter do not cause harm to the coastal and marine environment.					**Strategic objective** To halt and prevent by 2020 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems, and to restore, where practicable, marine areas which have been adversely affected		**Ecological objective EO10:** Marine and coastal litter do not adversely affect biodiversity and ecosystem services		**BSSAP 2009 – EcoQO 2b -** Conserve coastal and marine habitats and landscapes; Convention on the Protection of the Black Sea Against Pollution /Dumping Protocol	
Criteria	**Indicators**	**Type**	**O**	**I**	**O**	**I**	**O**	**I**	**O**	**I**
10.1. Characteristics of litter in the marine and coastal environment	10.1.1 Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source.	P								
	10.1.2 Trends in the amount of litter in the water column (including floating at the surface) and deposited on the sea-floor, including analysis of its composition, spatial distribution and, where possible, source	P								
	10.1.3 Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro- plastics).	P								
10.2. Impacts of litter on marine life	10.2.1 Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis).	I								

8.2 Identification of data

This chapter describes the current RSC data streams providing marine litter data.

HELCOM
There are no current data streams from the Contracting Parties to HELCOM. Information on current and planned monitoring and research & development projects on marine litter in the Baltic Sea Area has been compiled by HELCOM MONAS marine litter expert network (HELCOM MONAS, 2014). There are plans for regional marine litter monitoring.

OSPAR
Three data sources have been identified:

- OSPAR Ecological Quality Objective (EcoQO) for litter particles in stomachs of northern fulmars (*Fulmarus glacialis*).
- Marine Beach Litter Monitoring data
- Seabed litter. Plans by several contracting parties to use their fish stock surveys for benthic litter monitoring e.g. IBTS.

UNEP/MAP
There are no current data streams from the CPs to UNEP/MAP.
The future Integrated Monitoring and Assessment Programme for the implementation of the Ecosystem Approach will be based on the UNEP/MAP common indicators and will include relevant marine litter parameters.

BSC
There are no current data streams from the Contracting Parties to BSC.

8.3 Analysis of data and information flows

Since there are rather limited existing data flows and assessments for marine litter, the analysis was performed on both existing and anticipated data flows relevant to MSFD descriptors D10 and was based on the developing indicators of the RSCs.

The inventory of data flows was structured with respect to MSFD indicators. It was focused on the parameters that are planned to be used by the developing RSC indicators and included both existing and proposed data flows. The inventory of marine litter data flows can be found in Annex 7.
The information was compiled from reports on the ongoing work on common/indicators by the RSCs, monitoring guidance documents (OSPAR, 2010, UNEP/MAP, 2014d) and datasets available at OSPAR website. The status of the data flow was indicated as existing, proposed or no data flow. Existing data flows indicate current flows to the RSCs (i.e. OSPAR). Proposed data flows indicate parameters proposed to be used for the development of the RSC common indicators. No data flows indicate no current plans for data flows (e.g. no indicator proposed).
Information on sampling frequencies, reporting programmes, duration of data flows, database name, database holder, etc. were included where available.

An overview of the parameters used or proposed by the RSCs for their marine litter indicators in relation to the MSFD D10 indicators is shown in Table 8.2. A more detailed overview linking MSFD criteria/indicators to RSC objectives/indicators/parameters can be found in Annex 2.

Counts of litter items is the parameter used by OSPAR and proposed by UNEP/MAP for beach litter monitoring (MSFD indicator 10.1.1); size of sampling units are defined by different criteria.
The use of trawl surveys is proposed by both OSPAR and UNEP/MAP for counts of number of items in seabed litter monitoring (MSFD indicator 10.1.2). UNEP/MAP proposes an additional parameter i.e. visual observation in shallow waters.
Abundance of litter in stomach content (by number and by mass) of northern fulmars is used by OSPAR and is proposed by UNEP/MAP for seabirds and sea turtles (MSFD indicator 10.2.1.) OSPAR uses the same parameter for floating litter assessment while UNEP/MAP proposes visual observations from ships (MSFD indicator 10.1.2).
Currently no parameter is defined for microplastics i.e. MSFD indicator 10.1.3.

Major gaps in current and planned data flows are in MSFD indicator coverage by HELCOM and BSC and in parameters relevant to microplastics.

Table 8.2 *Parameters used or proposed by the RSCs for assessment of their marine litter indicators in relation to the MSFD indicators for D10. Proposed parameters (No current data flow to RSC) are in italics.*

MSFD indicators	**RSC parameters**			
	HELCOM	**OSPAR**	**UNEP/MAP**	**BSC**
10.1.1 Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source.		Counts of litter items/unit (100-m for all items, 1-km for items >50 cm)	*Counts of litter items minimum lower limit 2.5 cm in the longest dimension on at least 2 sections of coastline of 100m on lightly to moderately littered beaches and 50m on heavily littered beaches*	
10.1.2 Trends in the amount of litter in the water column (including floating at the surface) and deposited on the sea-floor, including analysis of its composition, spatial distribution and, where possible, source .		Incidence, abundance by number (count of number of items) and abundance by mass (weight in grams) for each litter category/subcategory in stomach content	*Litter in the water column: Items of floating litter, 2.5 to 50cm, per km^2*	
		Abundance and nature of litter items using trawl surveys designed for fish stock assessments	*Litter on the seafloor 20-800m: items/ha or items/km^{2}ofkm^2 of litter collected in bottom trawl survey*	

MSFD indicators	RSC parameters			
	HELCOM	OSPAR	UNEP/MAP	BSC
			Litter on the seafloor shallow coastal waters(0-20m): visually surveyed litter items size above 2.5cm	
10.1.3 Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro- plastics).		*No common method proposed*	*Proposed for microplastics in the water column: samples taken by zooplankton nets (333µm mesh, 6m length, sampling for 30 minutes) or by Continuous Plankton Recorder (CPR)*	
10.2.1 Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis).		Incidence, abundance by number (count of number of items) and abundance by mass (weight in grams) for each litter category/subcategory in stomach content (seabirds)	Quantities of ingested litter (minimum size 1mm), by mass (weight in grams) from stomach contents (seabirds, sea turtle *Caretta caretta*)	

8.4 Indicators and assessments for P/S/I

8.4.1 HELCOM

HELCOM currently does not address marine litter but a Regional Action Plan on marine litter is under development and expected to be adopted in 2015. Thus, there are no HELCOM indicators or assessments of marine litter yet.

8.4.2 OSPAR

The OSPAR Pilot Project on Monitoring Marine Beach Litter (2000–2006) has been the first region-wide attempt in Europe to develop a method for monitoring marine litter on beaches and to assess presence of marine litter on the beaches in the OSPAR region, using this standardised method (OSPAR, 2007, OSPAR 2009b).The final report of the project provides an assessment of marine litter on beaches in the OSPAR region in terms of quantities, most common items, most frequently occurring items, types of marine litter found, and numbers of indicators for five sources of litter. Following this project an Agreement on a Voluntary Marine Beach Litter Monitoring Programme (OSPAR Agreement: 2011-1). The OSPAR Beach litter monitoring protocol was adopted by the OSPAR Commission in 2010 and nowadays the monitoring system is implemented in nine countries (BE, DK, FR, DE, NL, PT, ES, SE and UK).

The OSPAR Ecological Quality Objective (EcoQO) for litter particles in stomachs of Northern Fulmars (*Fulmarus glacialis*) is another OSPAR approach for marine litter assessment. Stomach content analysis of beached Northern Fulmars is a reliable scientific monitoring tool

for changes in the abundance of floating plastic (litter) in the sea. Data go back to 1982 and an international monitoring network has been operational since 2002 (OSPAR, 2008b).

Two established methodologies were adopted in OSPAR common indicators for marine litter: (i) 'Beach litter', and (ii) 'Fulmar litter ingestion' (impact and floating litter). A common indicator 'Seabed litter' was also adopted. Surveys of macro litter loads on the seabed are proposed to be conducted by using trawl surveys designed for fish stock assessments (IBST). A candidate indicator on Microplastics' is under development but a common methodology has not yet been defined. The OSPAR common indicators are pressure indicators apart from the 'Fulmar litter ingestion' that is considered both as a pressure indicator (for floating litter) and as an impact indicator (impact on biota; in relation to ingestion) (OSPAR, 2013c); however there is no defined link to effects on the birds.

The linkages between OSPAR EcoQOs, common and candidate indicators and relevant parameters, with MSFD criteria and indicators are shown in Annex 2.

OSPAR indicators cover all the MSFD criteria and indicators for D10.

8.4.3 UNEP/MAP

UNEP/MAP published an Assessment of Marine Litter in the Mediterranean in 2011 (UNEP/MAP 2011e). The assessment relied on the information collected from the completed questionnaires of fourteen Mediterranean countries, analysis of beach clean-up data, the monitoring and recording of litter floating on the sea surface by HELMEPA member companies with ships travelling in or transiting the Mediterranean, existing literature and other sources such as NGOs, experts, relevant authorities, etc.
Marine litter monitoring has not been addressed previously in the framework of the UNEP/MAP MED POL Programme. Under the ECAP approach, common indicators for marine litter were adopted and a document on guidance for litter monitoring has been developed (UNEP/MAP, 2014f). The guidance follows the methodologies proposed by the Technical Group on Litter and OSPAR (OSPAR fulmar EcoQO). UNEP/MAP common indicators for marine litter that are in line with MSFD indicators are shown below[16]:

- Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (Pressure indicator).
- Trends in amounts of litter in the water column, including micro-plastics, and on the seafloor (Pressure indicator)
- Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds and turtles (Impact indicator)

GES description and Targets for the above indicators have been agreed (Decision IG.21/3) but will continue to be further improved, in line with scientific and policy developments.

The linkages between UNE/MAP common indicators and relevant parameters, with MSFD criteria and indicators are shown in Annex 2.

UNEP/MAP indicators cover all the MSFD criteria and indicators for D10.

[16] *Indicator type (Pressure/State/Impact) is according to SEC (2011)*

8.4.4 BSC

A report on existing data, policies, activities, and institutional arrangements concerning the Marine Litter in the Black Sea region and proposals for several actions to deal with the problem was published in 2009 (BSC, 2007). One of the main suggestions was the inclusion of major appropriate actions into the revised BSC Strategic Action Plan.

8.4.5 Gaps in RSC indicator coverage of MSFD indicators

The major gap in MSFD indicator coverage is the absence of HELCOM and BSC indicators. Another gap is the lack of definition of methodologies for indicators on microplastic particles. The UNEP/MAP indicators and methodologies are defined but since there was no marine litter monitoring up to now within the MEDPOL Programme, there may be a delay before the data starts actually flowing.

8.5 Information flow processes and management systems

There are only few RSC data bases on marine litter data, all holding OSPAR data:

- For the OSPAR EcoQO for litter particles in stomachs of northern fulmar there is no database at OSPAR level; data are currently held by IMARES in the Netherlands. QA/QC is more nationally managed and needs to be ascertained (OSPAR, 2013c).
- The OSPAR Beach Litter Database at http://www.mcsuk.org/ospar/ stores data collected at reference beaches using the standardised OSPAR beach litter monitoring guidelines. The database contains information on beach geography, location, usage, and access, nearest developments, towns, shipping lanes, harbours and beach cleaning. Password is required for access to more information. Marine Beach Litter Monitoring data can be downloaded from OSPAR website http://www.ospar.org/content/content.asp?menu=01511400000000_000000_000000 OSPAR, where it is stored in excel format.

8.6 Conclusions

There are OSPAR data streams providing marine litter data and relevant databases. Currently, only OSPAR and UNEP/MAP have specific objectives and indicators addressing marine litter relating to D10.

9 RSC and EEA data holdings and data flows related to underwater noise

9.1 Introduction

The MSFD addresses underwater noise under GES Descriptor D11: *Energy including underwater noise.* Commission Decision 2010/477/EU sets out two criteria for D11 addressing distribution in time and place of loud, low and mid frequency impulsive sounds (11.1) and continuous low frequency sound (11.2) and two indicators to describe these criteria (Table 7.1)

Currently only OSPAR has common indicators addressing underwater noise relating to D11 (OSPAR, 2013c) (Table 9.1). UNEP/MAP has an Ecological objective for underwater noise and has agreed on relevant Indicators (UNEP/MAP, 2012c) but currently these are not included in the set of UNEP/MAP common indicators (UNEP/MAP, 2014a). HELCOM plans development work on a relevant indicator in 2015. The BS SAP 2009 has no reference to underwater noise.

The objectives and indicators of the RSCs in parallel to the corresponding criteria and indicators of MSFD for GES descriptors D 11 can be found in Annex 2. Table 9.1 presents an overview of links between RSC objectives-indicators and MSFD criteria-indicators for D11. The colour coding in Table 9.1 is as follows:

- blue: existing relevant objective or common/core indicator
- light blue: existing candidate/pre-core indicator
- red: no relevant objective or common/candidate/core/pre-core indicator

EEA has no indicators for underwater noise.

9.2 Identification of data

No current data streams have been identified. The most relevant data stream is OSPAR Database on Offshore Wind-farms, cited in Chapter 2 referring to the activity relating to noise and not to underwater noise data.

9.3 Analysis of data and information flows

No current data streams have been identified.

9.4 Indicators and assessments for P/S/I

OSPAR published in 2009 an overview of the impacts of anthropogenic underwater sound in the marine environment (OSPAR, 2009f), which provides a detailed account on the effects of noise/sound from various activities on marine life. Following this overview an assessment of the environmental impact of underwater noise in the OSPAR area was conducted (OSPAR, 2009g). This assessment was based on the information available in the various JAMP assessments of human activities and the types of expected effects based on the previous

overview of underwater sound impacts. However, there were considerable data gaps for some activities in certain regions to provide even a rough first assessment.

OSPAR plans to use the following common indicators for underwater noise (OSPAR, 2013c):

Impulsive noise addressing the cumulative pressure of impulsive-sound generating activities and possible associated displacement that is relevant to MSFD indicator 11.1.1. This is a pressure indicator that is under development by the TG Noise. The parameter is the "Distribution in space and time of activities generating loud, mid- and high- frequency impulsive sounds". The indicator is practicable because it makes use of existing information and can be applied throughout the OSPAR region. Many CPs have indicated that they intend to use the indicators as developed by the TG Noise (DE, DK, FR, NL, SE, UK).

Ambient noise addressing the cumulative pressure of anthropogenic continuous low frequency sound input, in particular by shipping that is relevant to MSFD indicator 11.2.1. The initial purpose of this indicator is to assess the pressure. This will be done by producing sound maps, based on models and data from monitoring stations. However, no systematic measuring exists yet. The indicator is under development by the TG Noise and many CPs have indicated that they intend to use it (BE, DE, FR, NL, SE, UK).

There are no relevant indicators or assessments in any of the other RSCs.

The linkages between OSPAR EcoQOs, OSPAR common and candidate and relevant parameters, with MSFD criteria and indicators are shown in Annex 2.

9.5 Information flow processes and management systems

There is no current monitoring of underwater noise in any of the RSCs and thus no relevant data flows have been developed.

9.6 Conclusions

Currently, there are no RSC data streams relevant to underwater noise apart from the OSPAR database on off-shore wind farms. Currently only OSPAR has common indicators addressing underwater noise relating to D11.

Table 9.1. Linkages of the RSC objectives and indicators to MSFD criteria and indicators for the GES Descriptor D11. O: HELCOM Ecological objectives, OSPAR Ecological Quality Objectives, UNEP/MAP Operational objectives, BSC Sub Ecological Quality objective, I: Indicators

MSFD			**HELCOM**		**OSPAR**		**UNEP/MAP**		**BSC**	
D11: Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.					**Strategic objective:** To halt and prevent by 2020 further loss of biodiversity in the OSPAR maritime area, to protect and conserve ecosystems, and to restore, where practicable, marine areas which have been adversely affected		**Ecological objective EQ11:** Noise from human activities causes no significant impact on marine and coastal ecosystems			
Criteria	**Indicators**	**Type**	**O**	**I**	**O**	**I**	**O**	**I**	**O**	**I**
11.1. Distribution in time and place of loud, low and mid frequency impulsive sounds	11.1.1 Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as Sound Exposure Level (in dB re 1µPa 2 .s) or as peak sound pressure level (in dB re 1µPa peak) at one metre, measured over the frequency band 10 Hz to 10 kHz.	P								
11.2. Continuous low frequency sound	11.2.1 Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1µPa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate.	P								

10 Synthesis and recommendations

This report presents an overview and analysis of RSC data and information flows that are of MSFD relevance. The topics addressed are human activities and the 11 MSFD descriptors on biodiversity, commercial fish and shellfish, eutrophication, hydrographical changes, hazardous substances, marine litter and underwater noise.
For each topic the RSC relevant data streams are identified and the parameters and indicators used or proposed for P/S/I assessments are reviewed in relation to MSFD requirements. Information flow processes and management systems of the relevant data were also reviewed and analysed.

Human activities
What is reported
Several activities included in the MSFD assessment framework (provided by David Connor, DG Environment1406 MSFD assessment framework) are reported to HELCOM, OSPAR and BSC; urban and industrial discharges and maritime accidents are reported to UNEP/MAP. HELCOM and UNEP/MAP assessments of human activities and pressures include data on activities and relevant parameters obtained from additional sources that are not reported under their current data streams.

The activity themes addressed by all RSCs in their assessments are ‘man-made structures (incl. construction phase)’ and ‘uses of environment and infrastructure’. Sub activities, urban discharges and waste disposal, industry discharges & waste disposal, and land-based structures are used by all RSCs in their assessments.

Overall, a wide range of parameters are used by the RSCs for the quantification of activities, in many cases different parameters are used for the same activity.

A good example of an assessment of human activities and pressures in line with MSFD is the HELCOM application of the Baltic Sea Pressure Index (BSPI) where 52 anthropogenic pressures, classified according to the list of 18 pressures in Annex III, of the MSFD were used, based on a large variety of data sources.

EEA indicators on pressures and activities are aquaculture production CSI33 and fishing fleet capacity CSI34.

Organization of data/information flows
In terms of data management processes, there are several templates and reporting mechanisms across the RSCs. The data and their metadata are organized in different ways: in files, relational databases, or on-line catalogues and no common standards are used for their description.

Accessibility of data
Not all the data types are accessible on-line, nor are all the databases that are developed available on-line. Even if the data can be identified and accessed, they do not always have the same units, names and codes, thus their compilation in aggregated data sets collections is not always trivial. In general, the homogenisation and standardisation of the regional distributed data and metadata systems requires more efforts as the data cannot be easily shared among the different systems.

Biodiversity

RSC data and information relevant to MSFD GES Descriptors D1 – Biological Diversity, D2- Non-indigenous species D4 – Food-webs and D6 – Sea-floor Integrity were reviewed and analysed.

What is reported

Biodiversity relevant data are currently reported by HELCOM, OSPAR and BSC data streams. UNEP/MAP plans to include biodiversity parameters in the Integrated Monitoring and Assessment Programme for the implementation of the Ecosystem Approach. For the development of common/core indicators, RSCs use or plan to use data from additional sources such as ICES, WFD, national monitoring, etc.

Since there are rather limited already existing data flows and assessments for biodiversity, the analysis of data flows was performed on both existing and anticipated data flows and was based on the developing indicators of the RSCs.

The most frequently used parameter across species and species groups (mammals, birds, fish, plankton, benthos) by all RSCs is abundance. Biomass is used for plankton and benthos (by all RSCs) and for fish. Length/size is used for bird, fish, bivalves and zooplankton by HELCOM and OSPAR. Biotic indices and multimetric indices, including WFD methodologies, are used by all RSCs. HELCOM and OSPAR use methodologies combining data on human pressures and benthic habitats. Only for MSFD indicators 1.2.1, 1.4.1, 1.6.1, and 6.2.2, relevant parameters are used by all RSCs.

The coverage of MSFD indicators by the RSC indicators is as follows:

Table 10.1. Coverage of MSFD criteria and indicators by the RSC indicators

MSFD number of criteria and indicators	Number of criteria and indicators covered			
	HELCOM	OSPAR	UNEP/MAP	BSC
D1 criteria (7)	6	6	5	4
D1 indicators (14)	6	9	5	5
D2 criteria (2)	1	1	1	1
D2 indicators (3)	1	1	1	1
D4 criteria (3)	3	3	0	0
D4 indicators (3)	3	3	0	0
D6 criteria (2)	2	2	2	2
D6 indicators (6)	6	4	1	1

The degree of common/core indicator development varies among biodiversity indicators within RSCs and across RSCs. Some indicators of HELCOM and OSPAR are operational.

The following MSFD indicators are not covered by any of the RSCs

- D1 – Biological Diversity indicators
    - 1.1.3 Area covered by the species (for sessile/benthic species)
    - 1.3.2 Population genetic structure, where appropriate
    - 1.4.2 Distributional pattern
    - 1.5.2 Habitat volume, where relevant

    - 1.7.1 Composition and relative proportions of ecosystem components (habitats and species)
- D2 – Non-indigenous species indicators
    - 2.2.1 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)
    - 2.2.2 Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible

EEA has two indicators relevant to D2: MAR002-Trends in introduction of non-indigenous species (NIS) per decade and MAR003-Trends in NIS pathways per decade.

Organization of data/information flows
Currently, only data on few of the parameters planned/used by the RSCs for their indicators are stored in one common database. For most parameters, information on where the data are held was not found.

Accessibility of data
In terms of data management processes, potentially, the data that are held in databases and are accessible through webGIS tools and services, can be combined and shared among the users and applications. Further technical work is required on systems homogenization and interoperability. However, not all RSC data related to biodiversity indicators are organized in a form (such as a database or online system) that can easily be found, visualised and accessed.

Commercial fish and shellfish
RSC data and information relevant to MSFD GES Descriptor D3 – Commercial fish and shellfish were reviewed and analysed. This Descriptor is strongly linked to the Common Fisheries Policy.

What is reported
Among RSCs only BSC has indicators on fisheries pressure relating to D3. UNEP/MAP has an Ecological objective for commercial fish and shellfish, and has agreed on relevant Indicators but currently these are not included in the set of UNEP/MAP common indicators. OSPAR has indicators on the status of fish stocks and the impacts of fisheries on fish communities, based on ICES data.

EEA has an indicator on the status of commercial fish stocks CSI32.

Organization of data/information flows
HELCOM does not collect commercial fish data (only coastal fish data). Commercial fish data are reported directly to ICES by Baltic Sea countries.

OSPAR does not collect data on commercial fish stocks. Data for the NE Atlantic are reported directly to ICES by the NE Atlantic countries.

UNEP/MAP does not collect commercial fish data. Commercial fish data in the Mediterranean are collected within the GFCM mandate; the DCF of CFP (such as MEDITS and MEDIAS campaigns) and the ICCAT.

BSC collects data on fisheries by the FOMLR AG under the BSMAP. According to BSC (2010a) the BSC fisheries indicators relevant to EEA and MSFD indicators are well reported to the BSC; however, stock assessments for most of the fish species are in need for harmonization.
BSC indicators are relevant to MSFD indicators 3.1.1, 3.1.2 and 3.2.1.

Accessibility of data
BSC data are stored in the BSIS system. Stock assessments are reported by ICES (NE Atlantic, and Baltic) and under GFCM, DCF and ICCAT (Mediterranean).

Eutrophication
RSC data and information relevant to MSFD GES Descriptor D5: Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters were reviewed and analysed.

What is reported
Eutrophication relevant data are reported to all RSCs. Existing data flows were analysed using data reported in 2012 (except for nutrient inputs data) by the CPs of the RSCs that are EU MS. Data submitted via EIONET Central Data Repository (CDR) in 2012 by EU MS was included in the analysis.

Nutrient inputs are reported to all RSCs. Nutrient inputs from rivers and point sources were reported by all HELCOM CPs (2012 data) and most of OSPAR CPs (2011 data). Nutrient inputs from municipal, industrial and riverine sources were reported to BSC by both CPs (2001-2008 data). Nutrient inputs from point sources in the UNEP/MAP region are reported in the National Baseline Budget (NBB) assessing the current trends of the pollutants emissions and releases every 5 years. All UNEP/MAP CPs apart from one reported nutrient releases from point sources in 2008.

Atmospheric deposition is reported to OSPAR and HELCOM; OSPAR CPs report on atmospheric nutrient inputs (nitrogen species in precipitation and air), whereas HELCOM CPs report nitrogen emissions to UN ECE under CLRTAP and atmospheric deposition is calculated using the EMEP model.

Indicators on nutrient inputs are developed for OSPAR and BSC and are under development for HELCOM and UNEP/MAP.

Nutrients levels in the marine environment, chlorophyll a and oxygen are the parameters reported by most contracting parties across RSCs and via EIONET CDR. Nutrients, chlorophyll a and oxygen present high frequency of use by MS in reporting for the implementation of Art 8, 9 and 10 of the MSFD and are also used in the WFD. These parameters are indicators adopted by all RSCs (except oxygen by UNEP/MAP at this stage). EEA also uses nutrients and chlorophyll a data for the two eutrophication indicators CSI021 and CSI023.

Water transparency was reported to HELCOM, BSC, OSPAR and via EIONET CDR. Among RSCs, only HELCOM and BSC have an indicator on water transparency, although it was used in all regions for MSFD reporting.

Phytoplankton species abundance was reported only to HELCOM and BSC.

Existing data flows relate to MSFD reporting requirements for nutrient inputs, nutrient levels in the marine environment, impacts on the water column-physical, impacts on the water column-biological, but there are no data flows for impacts on the sea bed-biological (except in BSC). However, not all CPs report data on a regular basis and there are gaps both in terms of temporal and spatial coverage, most apparent in UNEP/MAP. There are also WISE SoE TCM data flows concerning nutrient levels in the marine environment, impacts on the water column-physical and impacts on the water column-biological reported by EU MS via EIONET CDR.

Considering MSFD indicators, there are data flows for MSFD indicators 5.1.1 Nutrients, 5.2.1 Chlorophyll, 5.2.2 Water transparency, 5.3.2 Dissolved oxygen. No current data flows were identified for MSFD indicators 5.1.2 Nutrient ratios, 5.2.3 Abundance of opportunistic macroalgae, 5.2.4 Species shift, bloom events of nuisance/toxic algal blooms (except in HELCOM and BSC), 5.3.1 Abundance of perennial seaweeds and seagrasses (except in BSC).

Organization of data/information flows
Most part of the available data are organized in common databases held by the ICES or the RSCs,
To manage the duplicate submissions within the WISE SoE TCM data flow, an agreement was reached whereby countries were to provide only data that had not already been submitted to the RSC which are obtained from ICES directly. Data flows through ICES in fact refers to RSC data flows that are recycled as EIONET data flows, so although agreements are made with RSC or the EIONET, it is in fact possible to use the same data flow for multiple purposes.

Accessibility of data
The majority of ICES and RSCs data are publicly available (free on-line access). UNEP/MAP MEDPOL and BSC databases are not available on-line yet.

Hydrographical changes
RSC data and information relevant to MSFD GES Descriptor D7: Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems were reviewed and analysed.

What is reported
Currently only OSPAR and UNEP/MAP have specific indicators addressing hydrographical changes relating to D7.
OSPAR plans to apply a common indicator relevant to MSFD indicator 7.1.1 and a candidate indicator relevant to MSFD indicator 7.2.2.
UNEP/MAP has agreed on one common indicator relevant to MSFD indicator 7.2.1.
OSPAR and UNEP/MAP indicators and relevant methodologies for assessing hydrographical changes are not developed.

Organization of data/information flows
In this review, no current data streams were identified.

Hazardous substances
RSC data and information relevant to MSFD GES Descriptors D8: Concentrations of contaminants are at levels not giving rise to pollution effects and D9: Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards were reviewed and analysed.

What is reported
Data on hazardous substances are reported to all RSCs. Existing data flows were analysed using data reported in 2012 (unless otherwise stated) by the CPs of the RSCs that are EU MS. Data submitted via EIONET Central Data Repository (CDR) in 2012 by EU MS was included in the analysis. The analysis was focused on WFD priority substances (additional substances are reported to the RSCs).

Concerning hazardous substances inputs, over 40% of the OSPAR (2011 data) and 60% of the HELCOM CPs reported Cd, Hg, Cu, Pb, g-HCH, and PCBs riverine and direct inputs. Cd, Hg and Pb inputs from municipal, industrial and riverine sources were reported to BSC by both CPs (2001-2008 data). Pollutant inputs from point sources in the UNEP/MAP region are reported in the National Baseline Budget (NBB) assessing the current trends of the pollutants emissions and releases every five years. Releases of 29 WFD substances were reported by the EU MS; Cd, Pb, Hg and Ni releases were reported by more than 60% of the EU MS (2008 data).

Atmospheric deposition is reported to OSPAR and HELCOM; OSPAR CPs report on atmospheric inputs of hazardous substances (in precipitation and air), whereas HELCOM CPs report hazardous substances emissions to UN ECE under CLRTAP and atmospheric deposition is calculated using the EMEP model. 14 WFD priority substances were reported by OSPAR CPs (2011 data), Cd, Hg, Cu, and Pb in precipitation and in air were reported by 60-90% of the CPs.

Regarding common parameters relevant to MSFD indicator 8.1.1, twenty five of the WFD substances were reported to at least two of the RSCs in water and 21 of the WFD substances were reported to at least two of the RSCs in sediment and biota.

Although the data reported to OSPAR and HELCOM overall cover a good number of the WFD priority substances, the percentage of countries reporting for each substance is low particularly for water (less than 40%). Seven substances in sediments and 12 substances in biota were reported to OSPAR by more than 40% of the CPs (5 substances in biota by at least 60% of the CPs); these parameters are included in OSPAR common indicators and/or EEA indicators. Three substances in sediment and 5 substances in biota were reported to HELCOM by 40-60% of the CPs; these parameters are included in HELCOM core indicators and/or EEA indicators. UNEP/MAP and BSC CPs reported a lower number of the WFD priority substances. Data submitted via EIONET CDR include 41 and 38 of the WFD substances in water and sediment respectively; less WFD substances are reported in biota. The percentage of EU MS reporting via EIONET CDR is up to 40%.

All the WFD substances reported to the RSCs were used by MS in reporting for the implementation of Art 8, 9 and 10 of the MSFD.

Data relevant to MSFD descriptor 8.2.1 on pollution effects is reported to OSPAR and HELCOM and some data has been reported to UNEP/MAP in previous years. Biological effects data availability in the ICES database showed inconsistency with what was reported at least to OSPAR and did not reflect the current situation, suggesting blockages in the data flow. Some HELCOM biological effects data is reported to ICES but not yet used in HELCOM core indicators.

With respect to MSFD descriptor 8.2.2, number of spills and amount of substances released are the most common parameters across the RSCs.

Existing RSC data flows relate to MSFD reporting requirements concerning hazardous substances levels at sources and in the marine environment (water, sediment and biota). However, the CPs in each RSC and across RSCs show inconsistency in the substances they measure with highest consistency of reporting between OSPAR and HELCOM. Furthermore not all CPs report data on a regular basis and, there are gaps both in terms of temporal and spatial coverage, most apparent in UNEP/MAP and BSC. There are also WISE SoE TCM data flows concerning hazardous substance levels in the marine environment reported via EIONET CDR.

RSC data flows concerning oil spills and shipping accidents are available; RSC data flows concerning pollution effects are limited; however relevant flows are being planned particularly for OSPAR and HELCOM.

The following gaps are identified in RSC indicator coverage of MSFD indicators for D8 and D9

- HELCOM, OSPAR and BSC
  - 9.1.2 Frequency of regulatory levels being exceeded
- OSPAR and BSC
  - 9.1.1 Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels
- BSC
  - 8.2.1 Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored

Organization of data/information flows
Most part of the available data are organized in common databases held by the ICES or the RSCs. To manage the duplicate submissions within the WISE SoE TCM data flow, an agreement was reached whereby countries were to provide only data that had not already been submitted to the RSC which are obtained from ICES directly. Data flows through ICES in fact refers to RSC data flows that are recycled as EIONET data flows, so although agreements are made with RSC or the EIONET, it is in fact possible to use the same data flow for multiple purposes.

Accessibility of data
The majority of ICES and RSCs data are public available (free on-line access). UNEP/MAP MEDPOL and BSC databases are not available on-line yet.

Marine litter
RSC data and information relevant to MSFD GES Descriptor D10- Marine litter were reviewed and analysed.

What is reported
Currently only OSPAR and UNEP/MAP have specific objectives and indicators addressing marine litter relating to D10.

HELCOM acknowledges the problem of marine litter in a series of HELCOM recommendations. In 2014 work has initiated by HELCOM MONAS forming a marine litter expert group for the development of core indicators for regional marine litter monitoring.

Currently there are OSPAR data streams providing marine litter data including the OSPAR Ecological Quality Objective (EcoQO) for litter particles in stomachs of northern fulmars and the Marine Beach Litter Monitoring data. There are also plans by several contracting parties to use their fish stock surveys for benthic litter monitoring, e.g. IBTS.

UNEP/MAP plans to include marine litter common indicators in the future Integrated Monitoring and Assessment Programme for the implementation of the Ecosystem Approach.
The analysis of data flows for Marine Litter was performed on both existing and anticipated data flows based on the developing indicators of the RSCs.

Counts of litter items are used by OSPAR and proposed by UNEP/MAP for beach litter monitoring. The use of trawl surveys is proposed by both OSPAR and UNEP/MAP for counts of number of items in seabed litter monitoring. Abundance of litter in stomach content of northern fulmars is used by OSPAR and is proposed by UNEP/MAP for seabirds and sea turtles. Currently no parameter is clearly defined for microplastics. Major gaps in current and planned data flows are in MSFD indicator coverage by HELCOM and BSC and in parameters relevant to microplastics.

OSPAR and UNEP/MAP indicators cover all the MSFD criteria and indicators for D10.

Organization of data/information flows
There are only few RSC databases holding marine litter data, particularly OSPAR data.

Underwater noise
RSC data and information relevant to MSFD GES Descriptor D11- Underwater noise were reviewed and analysed.

What is reported
Currently only OSPAR has common indicators addressing underwater noise relating to D11. UNEP/MAP has a relevant Ecological objective and has agreed on Indicators but currently these are not included in the set of common indicators. HELCOM plans development work on a relevant indicator in 2015.

OSPAR has conducted an assessment of the environmental impact of underwater noise in the OSPAR area in 2009. This assessment was based on the information available in the various JAMP assessments of human activities and the types of expected effects based on a previous OSPAR overview of underwater sound impacts.
OSPAR plans to use two common indicators for underwater noise: (i) Impulsive noise relevant to MSFD indicator 11.1.1, and (ii) ambient noise relevant to MSFD indicator 11.2.1.

Organization of data/information flows
There is no current monitoring of underwater noise in any of the RSCs and thus no relevant data flows have been developed.

Overall conclusions and recommendations

This report presents an analysis of the data and information flows that are relevant for MSFD reporting. The analysis was focused on the level of data and the level of information derived from data products (parameters, indicators). In general, it is clear that there are considerable differences in the data and information flows between regional seas, and between the different topics that are covered by the descriptors of the MSFD. There are still major gaps in the coverage of MSFD indicators by RSC common indicators that are operational or in development. However, there are also many existing data and information flows that already address MSFD indicators, and can potentially be used for reporting for the MSFD. For some MSFD descriptors, in particular D5 and D8, RSCs have already developed data/information flows. For some of the MSFD descriptors, common indicators are in development and this can also result in development of more established data/information flows in the future.

At the data level, obviously the spatial and temporal coverage of current monitoring programs, and the harmonization of monitoring between contracting partners in a regional sea can be improved. In the next step of the process, the data collected through monitoring need to be stored using a standardized format also involving quality control, to enable the multiple use of once reported data (report once, use many times). This also applies to the metadata describing the data set. Reporting data to a central database can be helpful to obtain a standardized dataset with good metadata. A good example of how this could work is the use of ICES as a data centre for environmental data by OSPAR and HELCOM. Storage of environmental data by HELCOM and OSPAR at the ICES data centre required common formats for data and metadata, a form of quality control and improved accessibility of the data. A point for improvement for such data centres would be to ensure the link with the original data sources, so that it is always possible to retrace the data to its origin. A data centre where data are stored in a central database could be a solution for other data flows under the MSFD, but other solutions are possible as well. A central data portal, through which data can be accessed or ‘pulled’ from the original data sources (for example, national databases) can be an alternative solution. Again, such a solution requires a common standardized format for data and metadata. There are weaknesses in the process of reporting of data, as is illustrated by the fact that even in those cases where RSCs have a reporting mechanism, there are often gaps in available data. A data portal providing a link to the original data sources rather than a data centre that depends on uploading of data could help to improve this process as it does not depend on ‘active’ uploading of the data. For certain types of data, EMODnet could be a link between data and information on institute/national level, and RSC and/or EU (WISE Marine) level, by providing a service to find, view and download data. This does, however, not relieve member states from the important step of standardizing the data and information (technical as well as semantically). It is recommended that RSC’s follow the developments within EMODnet with regards to the availability of data and data products within their regions, and that they keep in close contact with the network to provide important feedback to the development of data availability and quality of data products for use in the MSFD assessment procedures where possible.

At the level of parameters and indicators, there are a number of issues. Although there are large differences between RSCs in the level of development, all RSCs are working on the development of common parameters and indicators. The development of a common set of parameters and indicators will be helpful in structuring the information flow. An important aspect is the transparency in the whole process of monitoring, data collection, calculation of parameters and indicators and finally assessments. It should be possible to retrace the steps in this process, which requires that the steps are well-defined. These aspects of data and information flow will be covered in task 3 and 4 of the project by defining and testing feasibility

of a common data model for reporting, and in task 5 and 6, where pilots will be performed at OSPAR and HELCOM to further develop and test data and information handling for some data streams.

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A Appendices

A.1 Overview and inventory of RSCs data streams on activities

See paperclip icon for Attachment A.1

A.2 Linkages between MSFD descriptors/criteria/indicators and RSC/ecological objectives/indicators/parameters

See paperclip icon for Attachment A.2

A.3 Overview and inventory of RSCs data streams on biodiversity

See paperclip icon for Attachment A.3

A.4 Data management aspects of RSCs data streams on eutrophication and hazardous substances

See paperclip icon for Attachment A.4

A.5 Overview and inventory of RSCs data streams on eutrophication

See paperclip icon for Attachment A.5

A.6 RSC methodologies for eutrophication indicators and assessment tools

See paperclip icon for Attachment A.6

A.7 List of hazardous substances reported to the RSCs

See paperclip icon for Attachment A.7

A.8 Overview and inventory of RSCs data streams on hazardous substances

See paperclip icon for Attachment A.8

A.9 Overview and inventory of RSCs data streams on marine litter

See paperclip icon for Attachment A.9