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Review of Methodological Standards Related to the Marine Strategy Framework Directive Criteria on Good Environmental Status

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1. BACKGROUND

In accordance with the Marine Strategy Framework Directive (MSFD; 2008/56/EC), it is appropriate to make provision for the development of criteria and methodological standards to ensure consistency and to allow for comparison between marine regions or subregions of the extent to which good environmental status (GES) is being achieved. Provision should be made for the adoption of methodological standards for the assessment of the status of the marine environment, monitoring, environmental targets and the adoption of technical formats for the purposes of transmission and processing of data in line with Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (Inspire). Additionally in MSFD Annex V, the need to develop technical specifications and standardized methods for monitoring at Community level, so as to allow comparability of information, is identified.

Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (COM Dec; 2010/477/EU) states that for most criteria, the assessment methodologies required need to take into account and, where appropriate, be based on those applicable under existing Community legislation, in particular Directive 2000/60/EC, Directive 2008/105/EC, Directive 92/43/EEC, Directive 2009/147/EC and other relevant Union legislation (including the Common Fisheries Policy, e.g. Council Regulation (EC) No 199/2008), taking also into account reports of the Task Groups (please see Chapter 4 for detailed reference) and the approaches developed in the framework of regional sea conventions. In Part B of the COM Dec, criteria are accompanied with references to applicable methodological standards where available. It is stated that for a number of such criteria and related indicators, the need for further development and additional information is required and should be further addressed in the revision process of the COM Dec.

2. DEFINITION OF METHODOLOGICAL STANDARDS

Methodological standards *per se* are not defined in the MSFD or in the COM Dec, nor are methodological standards clearly specified for any of the descriptors in the COM Dec. The aim of the requirement for the use of methodological standards is however related to the need for comparability of approaches in determining GES and environmental goals within and among marine regions.

In this report, methodological standards are reviewed for the following points:

I. the assessment of the status of the marine environment and the determination of GES
II. environmental targets
III. monitoring.

Methodological standards are defined in general terms as all methods developed and agreed in the framework of European or international conventions.

An environmental target, within this report, is interpreted as a value set on the basis of an environment indicator or index at or beyond which good environmental status has been achieved, or which guides progress towards achieving GES.

The screening of available methodological standards is restricted to

a. WFD (2000/60/EC)
b. EQS Directive (2008/105/EC)
c. Habitats Directive (92/43/EEC)
d. Birds Directive (2009/147/EC)
e. Common Fisheries Policy (CFP)
f. Regional Sea Conventions covering European seas (OSPAR, HELCOM, UNEP MAP, Black Sea Commission).

Where relevant, reference is made to methods developed/applied by CEN, ISO, ANSI, and the European Environment Agency (EEA). The review does not cover other existing methodologies, such as those used/developed by Member States, other cooperation agreements that are geographically covered by one of the four Regional Sea Conventions, applied in research projects, etc., and is limited to methodologies within European and international conventions which are currently available. It is highlighted that the development of methodological standards is a continuous process. This document does not place requirements on Member States about how the MSFD should be implemented.

3. AVAILABILITY OF METHODOLOGICAL STANDARDS

The criteria to be used by Member States for assessing the environmental status of marine waters are specified in Part B of the COM Dec on criteria and methodological standards on good environmental status of marine waters. These relate to each of the eleven descriptors of good environmental status set out in Annex I of the MSFD and are accompanied by a number of related indicators so as to make such criteria operational and allow for assessment of ecological status. In Table 1, the outcome of the current screening for availability of methodological standards for each GES descriptor is summarized. More information on methodological standards, their availability and gaps can be found in the specific for each descriptor tables. **In these tables green indicates that standards are available, yellow that standards are available for parts of the marine region, and red that no standards are currently available.**

Table 1. The availability of methodological standards by MSFD GES Descriptor. X indicates the existence of at least one standard being this related to assessment, environmental targets or monitoring.

	WFD	EQS Directive	Habitats Directive	Birds Directive	CFP	Regional Sea Conventions	Other Sources
D1 Biological diversity	X		X		X	X	
D2 Non-indigenous species						X	
D3 Commercial fish					X		X
D4 Food webs	X					X	X
D5 Eutrophication	X					X	X
D6 Sea floor	X		X			X	X
D7 Alteration of hydrographical conditions	X						
D8 Contaminants and pollution effects	X	X				X	
D9 Contaminants in fish and other seafood							X
D10 Litter						X	X
D11 Energy/Noise							X

Descriptor 1: 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 climate conditions

Criterion 1.1 Species distribution

Indicator 1.1.1 Distributional range

The explanatory notes & guidelines on assessment, monitoring and reporting under Article 17 of the Habitats Directive (EC, 2006) provide guidance on how to estimate range of species and how to set favourable

reference range. Although they are explicitly not limited to protected areas their applicability out of the protected areas and the specific species concerned needs to be evaluated and/or developed. Furthermore, the favourable reference range may not necessarily be the same with the one required to achieve good environmental status.

Indicator 1.1.2 Distributional pattern within the latter, where appropriate

To our best knowledge there are no methods or guidelines available within the framework of European or international conventions.

Indicator 1.1.3 Area covered by the species (for sessile/benthic species)

Although the Habitats Directive does not list benthic species in its Annexes the guidelines of EC (2006) may be adapted to assess the area covered by a sessile/benthic species and to set a favourable reference area. Although they are explicitly not limited to protected areas their applicability out of the protected areas and the specific species concerned needs to be evaluated and/or developed. Furthermore, the favourable reference area may not necessarily be the same with the one required to achieve good environmental status.

Several WFD macrophyte methods that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics of species cover as a parameter indicative of abundance. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

HELCOM COMBINE programme manual Annex C-9 provides guidelines for monitoring of phytobenthic plant and animal communities in the Baltic Sea and for estimating of coverage of individual species. Similarly, Annex C-8 provides guidelines for monitoring of soft bottom macrozoobenthos and more specifically for monitoring the spatial variability in species composition, abundance and biomass.

In the framework of the Bucharest Convention (Black Sea Commission) a manual for soft-bottom macrozoobenthos (Todorova & Konsulova, 2005) sampling and analysis has been developed and used in the Black Sea, including guidelines on equipment, site selection, abundance, biomass and taxonomic identification.

Criterion 1.2 Population size

Indicator 1.2.1 Population abundance and/or biomass, as appropriate

In EC (2006) there are guidelines on how to estimate the size (abundance) of a population and the favourable reference population. Although they are explicitly not limited to protected areas their applicability out of the protected areas and the specific species concerned needs to be evaluated and/or developed. Furthermore, the favourable reference population may not necessarily be the same with the one required to achieve good environmental status.

WFD biological methods that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics to assess population abundance of phytoplankton, macrophytes and macrozoobetnhos. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. There are no such metrics for other groups of organisms, such as zooplankton. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

HELCOM COMBINE programme manual Annex C-8 provides guidelines for monitoring of soft bottom macrozoobenthos and more specifically for monitoring the spatial variability in species composition, abundance and biomass.

In the framework of the Bucharest Convention (Black Sea Commission) manuals for zooplankton (Korshenko & Alexandrov, 2006) and soft-bottom macrozoobenthos (Todorova & Konsulova, 2005) sampling and analysis

have been developed and used in the Black Sea, including guidelines on equipment, site selection, abundance, biomass and taxonomic identification.

Criterion 1.3 Population condition

Indicator 1.3.1 Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates)

Some monitoring and assessment methods exist only for some fish and cephalopod stocks and are presented further in this document for descriptor 3.

The HELCOM indicator fact sheet on coastal fish communities includes indicators of mean age, mortality and mean length (HELCOM coastal fish monitoring experts, 2008). Quantitative targets for these indicators are under development.

Indicator 1.3.2 Population genetic structure, where appropriate

To our best knowledge there are no methods or guidelines available within the framework of European or international conventions.

Criterion 1.4 Habitat distribution

Indicator 1.4.1 Distributional range

In EC (2006) there are guidelines on how to estimate the distributional range and the favourable reference range of a habitat for the Habitats Directive. Although they are explicitly not limited to protected areas their applicability out of the protected areas and the specific species concerned needs to be evaluated and/or developed. Furthermore, the favourable reference range may not necessarily be the same with the one required to achieve good environmental status.

Indicator 1.4.2 Distributional pattern

In EC (2006) there is no guidance on how to assess distributional pattern of a habitat for the Habitats Directive. However, it is stated that the distribution pattern of the habitat should allow exchange/gene flow in typical species.

Criterion 1.5 Habitat extent

Indicator 1.5.1 Habitat area

In EC (2006) there are guidelines on how to estimate the surface and the favourable reference area of a habitat for the Habitats Directive. Although they are explicitly not limited to protected areas their applicability out of the protected areas needs to be evaluated and/or developed. Furthermore, the favourable reference area may not necessarily be the same with the one required to achieve good environmental status.

Indicator 1.5.2 Habitat volume, where relevant

To our best knowledge there are no methods or guidelines available within the framework of European or international conventions.

Criterion 1.6 Habitat condition

Indicator 1.6.1 Condition of the typical species and communities

In EC (2006) there are some guidelines on how to define typical species and rough guidelines on how to monitor and assess their condition (e.g. best expert opinion, general national surveys, site-based sampling or reuse information from red data book work) for the Habitats Directive. It does not include any guidance on how to set favourable reference values for their condition.

Indicator 1.6.2 Relative abundance and/or biomass, as appropriate

WFD biological methods that are listed and described in the on-line database complied within the WISER project (Birk et al., 2010) include metrics of abundance and/or biomass only for phytoplankton, macrophytes & zoobenthos. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009)

The manual for HELCOM COMBINE programme includes guidelines for monitoring of species composition, abundance and biomass of phytoplankton (Annex C-6), mesozooplankton (Annex C-7), soft bottom macrozoobenthos (Annex C-8), phytobenthos (Annex C-9) and bacterioplankton (Annex C-12).

The HELCOM indicator fact sheet on coastal fish communities includes species and community level indicators of biomass (HELCOM coastal fish monitoring experts 2008). Quantitative targets for these indicators are under development.

In the framework of the Bucharest Convention (Black Sea Commission) manuals for zooplankton (Korshenko & Alexandrov, 2006) and soft-bottom macrozoobenthos (Todorova & Konsulova, 2005) sampling and analysis have been developed and used in the Black Sea, including guidelines on equipment, site selection, abundance, biomass and taxonomic identification.

Indicator 1.6.3 Physical, hydrological and chemical conditions

According to the WFD and the Habitats Directive, hydromorphological, chemical and physico-chemical elements should be used in status assessments. Annex V of the WFD lists the hydromorphological elements to monitor for support to the biological elements but does not give specific guidelines. For a compilation of policy documents for hydrological conditions please see Table 8 of this report regarding Descriptor 7.

According to the eutrophication assessment guidance (EC, 2009) physico-chemical standards related to eutrophication were not fully developed in all countries and some guidelines to derive nutrient standards are provided. Pollutants fall under Descriptor 8 and available methodological standards are listed further in the present document.

The manual for HELCOM COMBINE monitoring programme contains Annex C-2 for monitoring of hydrographic and hydrochemical variables. HELCOM's indicator fact sheets on development of Sea Surface temperature, ice seasons, wave climate, water exchange between the Baltic Sea and the North Sea and oxygen conditions use established methods for those physico-chemical elements (Siegel & Gerth, 2010; Vainio et al., 2010; Pettersson et al., 2010; Feistel et al., 2010; Axe, 2010).

Criterion 1.7 Ecosystem structure

Indicator 1.7.1 Composition and relative proportions of ecosystem components (habitats and species)

Methods submitted by Members States for assessment of biological quality elements for the WFD that are listed and described in the on-line database complied within the WISER project (Birk et al., 2010) assess the taxonomic composition of phytoplankton, macrophytes & zoobenthos. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

The manual for HELCOM COMBINE programme includes guidelines for monitoring of species composition, abundance and biomass of phytoplankton (Annex C-6), mesozooplankton (Annex C-7), soft bottom macrozoobenthos (Annex C-8), phytobenthos (Annex C-9) and bacterioplankton (Annex C-12).

The HELCOM indicator fact sheet on coastal fish communities includes community level indicators of species diversity and average trophic level of catch (HELCOM coastal fish monitoring experts, 2008). Quantitative targets for these indicators are under development.

In the framework of the Bucharest Convention (Black Sea Commission) manuals for zooplankton (Korshenko & Alexandrov, 2006) and soft-bottom macrozoobenthos (Todorova & Konsulova, 2005) sampling and analysis have been developed and used in the Black Sea, including guidelines on equipment, site selection, abundance, biomass and taxonomic identification.

On-going work in HELCOM & OSPAR

According to HELCOM (2009a), a pilot indicator-based assessment Biodiversity Assessment Tool (BEAT) is developed and applied. The use of the tool has been described in HELCOM 2009b. Currently HELCOM is developing biodiversity indicators and GES determinations for targets within the HELCOM CORESET project which will deliver preliminary indicators and targets by September 2011.

According to OSPAR (2009a; 2009b; 2010), there is ongoing development, covering several of the above criteria, of

- biodiversity related ecological quality objectives;
- a biodiversity assessment framework building on lessons learnt from a new methodological approach to ecosystem assessment developed for the Quality Status Report 2010.

Table 2. Methodological standards for Descriptor 1 Biodiversity. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Available standards for species distributional range (Indicator 1.1.1.); distributional range of habitat (Indicator 1.4.1.); and habitat area (Indicator 1.5.1.)

	Source	Regional Coverage		Remarks
I, II, III	HD (EC, 2006)	NEA	BAL	Not available for all species and habitats
		MED	BS	

Available standards for area covered by the species (for sessile/benthic species) (Indicator 1.1.3.) and population abundance and/or biomass, as appropriate (Indicator 1.2.1.)

	Source	Regional Coverage		Remarks
I, II	HD (EC, 2006) WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Not available for all species
		MED	BS	Only coastal
III	HD (EC, 2006) WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Not available for all species Only coastal
	HELCOM (COMBINE manual, Annex C-8 & C-9)	MED	BS	Only in the Baltic Sea
	Black Sea Commission (Korshenko & Alexandrov, 2006; Todorova & Konsulova, 2005)			Only in the Black Sea

Available standards for population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (Indicator 1.3.1.)

	Source	Regional Coverage		Remarks
I, II	CFP (see table 4 for descriptor 3)	NEA	BAL	Only for some fish and cephalopods species
		MED	BS	
III	CFP (see table 4 for descriptor 3) HELCOM (coastal fish monitoring experts, 2008)	NEA	BAL	Only for some fish and cephalopods species Only in the Baltic Sea
		MED	BS	

Available standards for distributional pattern of habitat (Indicator 1.4.2.)

	Source	Regional Coverage		Remarks
I, III		NEA	BAL	
		MED	BS	
II	HD (EC, 2006)	NEA	BAL	Only some recommendations
		MED	BS	

Available standards for condition of the typical species and communities of the habitat (Indicator 1.6.1.)

	Source	Regional Coverage		Remarks
I, III	HD (EC, 2006)	NEA	BAL	Only some rough guidelines
		MED	BS	
II		NEA	BAL	
		MED	BS	

Available standards for relative abundance and/or biomass of the habitat, as appropriate (Indicator 1.6.2.)

	Source	Regional Coverage		Remarks
I, II	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Only coastal/ only for some species
		MED	BS	
III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Only coastal/ only for some species
	HECOM (COMBINE Annexes C-6, C-&, C-8, C-9 & C-12)	MED	BS	Only Baltic Sea
	Black Sea Commission (Korshenko & Alexandrov, 2006; Todorova & Konsulova, 2005)			Only Black Sea

Available standards for physical, hydrological and chemical conditions of the habitat (Indicator 1.6.3.)

	Source	Regional Coverage		Remarks
I, II	WFD (Eutrophication guidance EC, 2009 & table 9 in descriptor 8)	NEA	BAL	Only for coastal waters. No methods for hydrological conditions
		MED	BS	
III	WFD (Eutrophication guidance EC, 2009 & table 9 in descriptor 8)	NEA	BAL	Only for coastal waters.
	WDF Annex V			Only list of hydromorphological elements with no guidelines.
	HELCOM (COMBINE manual Annex C-2; Siegel and Gerth, 2010; Vainio et al., 2010; Pettersson et al., 2010; Feistel et al., 2010; Axe, 2010)	MED	BS	Only in the Baltic Sea

Available standards for composition and relative proportions of ecosystem components (habitats and species) (Indicator 1.7.1.)

	Source	Regional Coverage		Remarks
I, II	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Only coastal/ only for some species
		MED	BS	
III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) HELCOM (COMBINE manual Annexes C-6, C-&, C-7, C-8, C-9 & C-12; coastal fish monitoring experts, 2008) Black Sea Commission (Korshenko & Alexandrov, 2006; Todorova & Konsulova, 2005)	NEA	BAL	Only coastal/ only for some species Only Baltic
		MED	BS	Only Black Sea

Available standards for species distributional pattern within their distributional range, where appropriate (Indicator 1.1.2.); population genetic structure, where appropriate (Indicator 1.3.2.); and habitat volume, where relevant (Indicator 1.5.2.)

	Source	Regional Coverage		Remarks
I, II, III		NEA	BAL	
		MED	BS	

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Descriptor 2: Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem

Criterion 2.1 Abundance and state characterisation of non-indigenous species, in particular invasive species

Indicator 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

To our best knowledge there are no methods or guidelines available within the framework of European or international conventions.

According to Vandekerkhove & Cardoso (in prep) there are databases for marine non-indigenous species for the Baltic Sea and the Mediterranean Sea managed by HELCOM and CIESM, respectively. Additionally, there are national marine databases (for Greece, Belgium, Sweden, United Kingdom) as well as other national databases that include marine and non marine species. These databases may be used for targeting monitoring and assessment activities.

Criterion 2.2 Environmental impact of invasive non-indigenous species

Indicator 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)

The biopollution index (Olenin, 2007) uses basic information on abundance and distribution of non indigenous species. The index classifies the impact of non indigenous species on native species. It was used by HELCOM for estimating the magnitude of the alien phytoplankton species effects on local phytoplankton community, pelagic habitat and ecosystem functioning in the Baltic Sea (Olenina et al., 2009). The report claims that this assessment covers the entire Baltic Sea but all stations seem to be coastal. Its applicability needs further evaluation.

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

The biopollution index (Olenin, 2007) assesses the magnitude of bioinvasions impacts. Its applicability needs further evaluation.

Table 3. Methodological standards for Descriptor 2 Non-indigenous species. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Available standards for 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 (Indicator 2.1.1.)

	Source	Regional Coverage		Remarks
I, II, III		NEA	BAL	Some databases exist that may be used for targeting monitoring and assessment activities.
		MED	BS	

Available standards for 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) (Indicator 2.2.1.); and impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible (Indicator 2.2.2.)

	Source	Regional Coverage		Remarks
I, II, III	HELCOM (Biopollution Level (BLP) : Olenin et al., 2007; Olenina et al., 2009)	NEA	BAL	Only Baltic/ Needs further development. At the moment it is tested for coastal waters
		MED	BS	

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Descriptor 3: 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

Criterion 3.1 Level of pressure of the fishing activity

Primary indicator

The primary indicator for the level of pressure of the fishing activity is the following:

Indicator 3.1.1 Fishing mortality (F)

F values are equal to or lower than FMSY, the level capable of producing Maximum Sustainable Yield (MSY).

Fishing mortality is an outcome of an analytical stock assessment. Such assessments are performed by ICES, GFCM, STECF & ICCAT. The data for assessment originate from national and international data collection and monitoring programs such as MEDITS and others, partially funded by the European Commission under the Data Collection Framework (DCF, 199/2008).

Secondary indicators *(if analytical assessments yielding values for F are not available):*

Indicator 3.1.2 Ratio between catch and biomass index (hereinafter catch/biomass ratio)

The catch/biomass ratio yielding MSY can be taken as indicative reference.

The above ratio can be calculated from consistent CPUE (catch per unit of effort) series based on surveys, such as those under the DCF.

Criterion 3.2 Reproductive capacity of the stock

Primary indicator

The primary indicator for the reproductive capacity of the stock is the following:

Indicator 3.2.1 Spawning Stock Biomass (SSB)

Any observed SSB value equal to or greater than SSBMSY is considered to meet this criterion. Where simulation models do not allow the estimation of a reliable value for SSBMSY, then the reference to be used for the purpose of this criterion is SSBpa, which is the minimum SSB value for which there is a high probability that the stock is able to replenish itself under the prevailing exploitation conditions.

Spawning stock biomass is an outcome of an analytical stock assessment. Such assessments are performed by ICES, GFCM, STECF & ICCAT with data from monitoring programs.

Secondary indicators *(if analytical assessments yielding values for SSB are not available):*

Indicator 3.2.2 Biomass indices

They can be estimated from monitoring surveys, such as those under the DCF.

Criterion 3.3 Population age and size distribution.

Primary indicators

Healthy stocks are characterised by high proportion of old, large individuals. Indicators based on the relative abundance of large fish include:

Indicator 3.3.1 Proportion of fish larger than the mean size of first sexual maturation

It can be estimated from monitoring surveys, such as those under the DCF.

Indicator 3.3.2 Mean maximum length across all species found in research vessel surveys (3.3.2)

It can be calculated from monitoring surveys, such as those under the DCF.

Indicator 3.3.3 95% percentile of the fish length distribution observed in research vessel surveys (3.3.3)

It can be estimated from monitoring surveys, such as those under the DCF.

Secondary indicator:

Indicator 3.3.4 Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation

It can be estimated from monitoring surveys, such as those under the DCF.

Table 4. Methodological standards for Descriptor 3 Commercially exploited fish and shellfish. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Available standards for fishing mortality (F (Indicator 3.1.1.); and Spawning Stock Biomass (Indicator 3.2.1.)

	Source	**Regional Coverage**		**Remarks**
I	CFP (Analytical stock assessment done by ICES, GFCM, STECF, ICCAT on data collected under DCF, 199/2008)	NEA	BAL	Analytical stock assessment is not available for all stocks and considerable differences in data availability exist between (sub)regions. Data deficiencies often result in the use of agreed approximations of FMSY rather than FMSY.
		MED	BS	
II	CFP (Analytical stock assessment done by ICES, GFCM, STECF, ICCAT on data collected under DCF, 199/2008)	NEA	BAL	Data deficiencies often result in the use of agreed approximations of FMSY rather than FMSY.
		MED	BS	
III	CFP (Analytical stock assessment done by ICES, GFCM, STECF, ICCAT on data collected under DCF, 199/2008)	NEA	BAL	Analytical stock assessment is not available for all stocks and considerable differences in data availability exist between (sub)regions.
		MED	BS	

Available standards for catch/biomass ratio (Indicator 3.1.2.)

	Source	**Regional Coverage**		**Remarks**
I, II, III	CFP (data collected under DCF, 199/2008)	NEA	BAL	Stock production-based assessments not available for all stocks.
		MED	BS	

Available standards for biomass indices (Indicator 3.2.2.); proportion of fish larger than the mean size of first sexual maturation (Indicator 3.3.1.); mean maximum length across all species found in research vessel surveys (Indicator 3.3.2.); 95% percentile of the fish length distribution observed in research vessel surveys (Indicator 3.3.3.); and for size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation (Indicator 3.3.4.)

	Source	Regional Coverage		Remarks
I, II		NEA	BAL	
		MED	BS	
III	CFP (national and international data collection and monitoring programs under DCF 199/2008)	NEA	BAL	There are no reference values with enough scientific agreement for assessment. Time series of indicators not available for all stocks.
		MED	BS	

References

Most recent information on the state of stocks and fisheries with EU interest can be found in:

Scientific, Technical and Economic Committee for Fisheries (STECF), 2009. Review of scientific advice for 2010 - Consolidated Advice on Stocks of Interest to the European Community. (eds. Doerner H. & Casey J. & Vanhee W.). 2010. Office for Official Publications of the European Communities, Luxembourg, ISBN 978-92-79-14605-3, JRC56074, 358 pp.
https://webgate.ec.europa.eu/maritimeforum/sites/default/files/CONSOLIDATED%20-STOCK-REVIEW-OF%20ADVICE%20FOR%202010%20FINAL%208%20December.pdf

Descriptor 4: 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

Criterion 4.1 Productivity (production per unit biomass) of key species or trophic groups

Indicator 4.1.1 Performance of key predator species using their production per unit biomass (productivity)

OSPAR (2008) has set an Ecological Quality Objective (EcoQO) for healthy seal population:
Grey seal pup production: Taking into account natural population dynamics and trends, there should be no decline in pup production of grey seals of ≥10% as represented in a five-year running mean or point estimates.

OSPAR (2008), in cooperation with ICES (2008), has set a Draft EcoQO for sea bird breeding population size and breeding success in the North Sea:
Changes in breeding seabird abundance should be within target levels for 75% of species monitored in any of the OSPAR regions or their sub-divisions.

HELCOM has indicators for the reproductive success/health of white-tailed eagle (Helander et al., 2009), grey seal (Bäcklin et al., 2010) and ringed seal (Kunnasranta et al., 2010). The quantitative targets for these indicators are under development.

Criterion 4.2 Proportion of selected species at the top of food webs

To address the structure of food webs, size and abundance of components, there is a need to assess the proportion of selected species at the top of food webs. Indicators need to be further developed, based on the experience in some sub-regions. For large fish, data are available from fish monitoring surveys.

Indicator 4.2.1 Large fish (by weight)

OPSPAR (2008) has set an EcoQO for the North Sea:
Over 30% of fish by weight should be greater than 40cm in length based on the ICES Quarter 1 International Bottom Trawl Survey.

According to OSPAR (2010), the indicator on which the large fish EcoQO is based has been applied to other OSPAR Regions for trends in demersal fish community structure. The indicator covers several characteristics of fish community health: abundance/biomass/productivity, size composition, species richness, species evenness, and average life-history traits (such as age or length at maturity, growth rate or ultimate body length).

Criterion 4.3 Abundance/distribution of key trophic groups/species

Indicator 4.3.1 Abundance trends of functionally important selected groups/species

WFD biological methods that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics to assess abundance of phytoplankton, macrophytes and macrozoobetnhos. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

HELCOM's indicator on temporal development of coastal fish communities includes indicators on total biomass and species biomass (HELCOM coastal fish monitoring experts 2008). Quantitative targets for these indicators are under development.

The manual for HELCOM COMBINE programme includes guidelines for monitoring of species composition, abundance and biomass of phytoplankton (Annex C-6), mesozooplankton (Annex C-7), soft bottom macrozoobenthos (Annex C-8), phytobenthos (Annex C-9) and bacterioplankton (Annex C-12).

In the framework of the Bucharest Convention (Black Sea Commission) manuals for zooplankton (Korshenko & Alexandrov, 2006) and soft-bottom macrozoobenthos (Todorova & Konsulova, 2005) sampling and analysis have been developed and used in the Black Sea, including guidelines on equipment, site selection, abundance, biomass and taxonomic identification.

The Marine Trophic Index (MTI) (Pauly et al., 1998) is measuring the mean trophic level of fisheries landings and gives an estimate of relative abundance of top predators. The European Environmental Agency (EEA) gave the trends of the MTI for selected European Seas (EEA, 2010)

Table 5. Methodological standards for Descriptor 4 Food webs. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Available standards for performance of key predator species using their production per unit biomass (productivity) (Indicator 4.1.1.)

	Source	Regional Coverage		Remarks
I	OSPAR (2005) & ICES (2008)	NEA	BAL	Not available for all key predator species and for all marine areas.
		MED	BS	
II	OSPAR (2005) & ICES (2008)	NEA	BAL	Not available for all key predator species and for all marine areas.
		MED	BS	
III	OSPAR (2005) & ICES (2008) HELCOM (Helander et al., 2009; Bäcklin et al., 2010; Kunnasranta et al., 2010)	NEA	BAL	Not available for all key predator species and for all marine areas. Quantitative targets under development.
		MED	BS	

Available standards for large fish (by weight) (Indicator 4.2.1.)

	Source	Regional Coverage		Remarks
I, II, III	OSPAR (2008 & 2010)	NEA	BAL	Only for demersal fish
		MED	BS	

Available standards for abundance trends of functionally important selected groups/species (Indicator 4.3.1.)

	Source	Regional Coverage		Remarks
I, II	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Only coastal/ only for some species
		MED	BS	
III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) HELCOM (coastal fish monitoring experts 2008); COMBINE programme annexes C-6, C-7, C-8, C-9 and C-12). Black Sea Commission (Korshenko & Alexandrov; Todorova & Konsulova, 2005) European Environmental Agency (MTI: Pauly et al., 1998; EEA, 2010)	NEA	BAL	Only coastal/ only for some species Only Baltic
		MED	BS	Only Black Sea Trends are available only for selected European Seas

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Descriptor 5: Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters

The Common Procedure for the Identification of the eutrophication status of the OSPAR maritime area (OSPAR 2005) sets out a eutrophication assessment framework and associated methodologies applied to the entire North-East Atlantic, covering several of the criteria below with assessment levels. The OSPAR Commission has set an EcoQO for the North Sea corresponding to the OSPAR Strategy objective for the entire OSPAR maritime area that all parts of the OSPAR Maritime Area should have the status of non-problem areas with regard to eutrophication by 2010, as assessed under the OSPAR Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area. The North Sea EcoQO integrates 5 specific EcoQOs which are identical with selected assessment criteria and their assessment levels under the Common Procedure (OSPAR 2005). The report on the eutrophication status (OSPAR, 2009) is the assessment based on the Common Procedure (OSPAR 2005) with the specific values used by Contracting Parties following the methodology set out in the Common Procedure.

The manual for HELCOM COMBINE programme provides guidelines for monitoring eutrophication in the Baltic Sea and the HELCOM Eutrophication Assessment Tool (HEAT) (HELCOM 2009; Andersen et al., 2010a) was used for assessment.

In the Mediterranean Sea the TRIX (Vollenweider, 1998) is proposed for assessment and monitoring of eutrophication in the Mediterranean Sea (UNEP, 2007).

Many WFD methods submitted for intercalibration, particularly for phytoplankton and macrophytes, include metrics that assess the eutrophication related indicators.

Criterion 5.1 Nutrients levels

Indicator 5.1.1 Nutrients concentration in the water column

The eutrophication assessment guidance (EC, 2009) provides some guideline to derive nutrient standards in line with WFD requirements.

OSPAR (2005; 2009) has set a specific EcoQO: Winter concentrations of dissolved inorganic nitrogen and phosphate should remain below a justified salinity-related and/or area-specific % deviation from background not exceeding 50%. The JAMP eutrophication monitoring guidelines on nutrients (OSPAR, 1997a) provide guidance for nutrients monitoring, including sampling strategy, equipment, storage and pre-treatment of samples and analytical procedures.

A core indicator for nutrient concentrations has been developed by HELCOM (Nausch et al., 2010). There is also a HELCOM indicator on spatial distribution of the winter nutrient pool (Axe, 2010b). Nutrients are included in the HELCOM Eutrophication Assessment Tool (HEAT) (HELCOM 2009, Andersen et al., 2010). In HEAT the acceptable deviation from the reference conditions is set at 50%. Only in exceptional cases the 50% deviation can be exceeded if scientifically justified (Andersen et al., 2010a). Andersen et al. (2010b) suggest a method for confidence rating of eutrophication status classification.

The manual for HELCOM COMBINE programme provides guidelines for nutrients monitoring (Annex C-2), including sampling strategy, equipment, techniques and procedures for analysis.

Nutrients are also included in the TRIX (Vollenweider, 1998), the method proposed for assessment and monitoring of eutrophication in the Mediterranean Sea (UNEP, 2007).

Indicator 5.1.2 Nutrient ratios (silica, nitrogen and phosphorus), where appropriate

Ratios of nitrogen and phosphorus can be calculated from any assessment method that measures nutrients.

An assessment criterion applies under the Common Procedure (OSPAR, 2005): winter N/P ratio should remain below area-specific assessment levels, which are to be based on a % deviation from background not exceeding 50% (i.e. Redfield N/P = 24).

Criterion 5.2 Direct effects of nutrient enrichment

Indicator 5.2.1 Chlorophyll concentration in the water column

ISO 10260 (1992) on spectrometric determination of the chlorophyll-a concentration provides a standard method for quantification of chlorophyll-a.

A guidance on the use of in vivo absorption techniques for the estimation of chlorophyll-a concentration in marine and fresh water samples (00230263 prEN 16161) is under approval by CEN.

WFD phytoplankton methods that are listed and described in the on-line database complied within the WISER project (Birk et al., 2010) include metrics on Chlorophyll a in the water column. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

OSPAR (2009) has set a specific EcoQO:
Maximum and mean phytoplankton chlorophyll a concentrations during the growing season should remain below a justified area-specific % deviation from background not exceeding 50%

The JAMP eutrophication monitoring guidelines on chlorophyll a (OSPAR, 1997b) provide guidance for nutrients monitoring, including sampling strategy, equipment, storage and pre-treatment of samples and analytical procedures.

Chlorophyll-a concentration is included in the HELCOM Eutrophication Assessment Tool (HEAT) (HELCOM 2009; Andersen et al., 2010a). The acceptable deviation from the reference conditions is set at 50%. Only in exceptional cases the 50% deviation can be exceeded if scientifically justified (Andersen et al., 2010a). A core indicator for chlorophyll concentrations has been developed by HELCOM (Fleming-Lehtinen et al., 2010).

The manual for HELCOM COMBINE programme provides guidelines for monitoring phytoplankton chlorophyll-a (Annex C-4), including sampling strategy, sampling, storage of samples, volume determination, filtration, extraction and measurement procedure.

Chlorophyll-a concentration is also included in the TRIX (Vollenweider, 1998) in the Mediterranean Sea (UNEP, 2007).

Indicator 5.2.2 Water transparency related to increase in suspended algae, where relevant

Transparency is one of the physicochemical quality elements that should be assessed for the ecological classification of coastal waters. Some guidelines are given in the eutrophication guidance (EC, 2009).

Turbidity is one of the supporting environmental factors that contracting parties of OSPAR are encouraged to take into account (OSPAR, 2005; 2009).

Transparency (as Secchi depth) is included in the HELCOM Eutrophication Assessment Tool (HEAT) and a deviation of 25% from the reference conditions is acceptable (Andersen et al., 2010a). A core indicator for water transparency has been developed by HELCOM (Fleming-Lehtinen et al., 2010).

The manual for HELCOM COMBINE programme provides guidelines for transparency monitoring (Annex C-2), including sampling strategy, equipment, techniques and procedures for observation.

Indicator 5.2.3 Abundance of opportunistic macroalgae

Macrophytes assessment methods for the WFD that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics on abundance of opportunistic macroalgae. Their

compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

Elevated levels of opportunistic green macroalgae are included in the harmonized assessment parameters and associated elevated levels of OSPAR (2005; 2009).

The JAMP eutrophication monitoring guidelines on benthos (OSPAR, 1997c) provide guidance for hard and soft bottom macrophytobenthos monitoring, including sampling strategy, equipment, storage and pre-treatment of samples and analytical procedures.

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

The CEN 15204:2006 guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique) describes a general procedure for the estimation of abundance and taxonomic composition of marine and freshwater phytoplankton by using inverted light microscopy and sedimentation chambers, including the preceding steps of preservation and storage.

Some phytoplankton assessment methods for the WFD that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics on taxonomic composition and frequency and intensity of algal blooms. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

OSPAR (2005; 2009) has set a specific EcoQO:
Area-specific phytoplankton species that are indicators of eutrophication should remain below respective nuisance and/or toxic elevated levels (and there should be no increase in the average duration of blooms).

The JAMP eutrophication monitoring guidelines on phytoplankton species composition (OSPAR, 1997d) provide guidance for nutrients monitoring, including sampling strategy, equipment, storage and pre-treatment of samples and analytical procedures.

HELCOM has an indicator on cyanobacterial blooms in the Baltic Sea (Hansson & Öberg, 2010) and target for that is being considered.

HELCOM COMBINE programme manual Annex C-6 provides guidelines for monitoring of phytoplankton species composition, abundance and biomass, including sampling, preservation qualitative and quantitative determinations.

Criterion 5.3 Indirect effects of nutrient enrichment

Indicator 5.3.1 Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency

Macrophytes assessment methods for the WFD that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics on abundance of seaweeds and seagrasses as well as metrics on disturbance-sensitive taxa. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

Shifts from long-lived to short-lived nuisance macrophytes species are included in the harmonized assessment parameters and associated elevated levels of OSPAR (2005; 2009).

The JAMP eutrophication monitoring guidelines on benthos (OSPAR, 1997c) provide guidance for hard and soft bottom macrophytobenthos monitoring, including sampling strategy, equipment, storage and pre-treatment of samples and analytical procedures.

Depth distribution of *Fucus vesiculosus* and *Zostera marina* is included in the HELCOM Eutrophication Assessment Tool (HEAT) and a deviation of 25% from the reference conditions is acceptable (HELCOM, 2009; Andersen et al., 2010a).

HELCOM COMBINE programme manual Annex C-9 provides guidelines for monitoring of phytobenthic plant communities in the Baltic Sea, including monitoring of important perennial species.

Indicator 5.3.2 Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned

Oxygen concentration is one of the physicochemical quality elements that should be assessed for the ecological classification of coastal waters. Some guidelines are given in eutrophication guidance (EC, 2009).

OSPAR (2005; 2009) has set a specific EcoQOs:

- Oxygen concentration, decreased as an indirect effect of nutrient enrichment, should remain above area-specific oxygen assessment levels, ranging from 4 – 6 mg oxygen per liter.
- There should be no kills in benthic animal species as a result of oxygen deficiency and/or toxic phytoplankton species.

The JAMP eutrophication monitoring guidelines on oxygen (OSPAR, 1997e) provide guidance for oxygen monitoring, including sampling strategy, equipment, storage and pre-treatment of samples and analytical procedures.

Oxygen concentration is included in the HELCOM Eutrophication Assessment Tool (HEAT) (HELCOM 2009; Andersen et al., 2010a). The assessment values for oxygen have been 2-4 mg/l and <2mg/l (HELCOM 2006) but the development of oxygen indicators is still ongoing (Andersen et al., 2010b). HELCOM has an indicator fact sheet on hydrography and oxygen in the deep basins (Axe 2010a), and work is on-going to develop it into a core eutrophication indicator. The manual for HELCOM COMBINE programme provides guidelines for oxygen monitoring (Annex C-2), including sampling strategy, equipment, techniques and procedures for analysis.

Oxygen concentration is also included in the Mediterranean TRIX (Vollenweider, 1998; UNEP, 2007).

Table 6. Methodological standards for Descriptor 5 Eutrophication. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Available standards for nutrients concentration in the water column (Indicator 5.1.1.); and nutrient ratios (silica, nitrogen and phosphorus) (Indicator 5.1.2.)

	Source	Regional Coverage		Remarks
I, II	WFD (eutrophication guidance: EC, 2009) OSPAR (2005; 2009) HELCOM (Nausch et al., 2010; Axe, 2010b; HEAT: HELCOM 2009; Andersen et al., 2010a) MEDPOL (TRIX: Vollenweider, 1998; UNEP, 2007)	NEA MED	BAL BS	Only coastal waters Ratios of nutrients can be calculated from all methods that measure nutrients.
III	WFD (eutrophication guidance: EC, 2009) OSPAR (1997a; 2005; 2009) HELCOM (COMBINE programme annex C-2) MEDPOL (TRIX: Vollenweider, 1998; UNEP, 2007)	NEA MED	BAL BS	Only coastal waters Ratios of nutrients can be calculated from all methods that measure nutrients.

Available standards for chlorophyll concentration in the water column (Indicator 5.2.1.)

	Source	Regional Coverage		Remarks
I, II	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) OSPAR (2005; 2009) HELCOM (Fleming-Lehtinen et al., 2010; HEAT: Andersen et al., 2010a). MEDPOL (TRIX: Vollenweider, 1998; UNEP, 2007)	NEA MED	BAL BS	Only coastal
III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) OSPAR (1997b; 2005; 2009) HELCOM (COMBINE programme annex C-4) MEDPOL (TRIX: Vollenweider, 1998; UNEP, 2007) ISO 10260:1992 CEN 00230 prEN 16161	NEA MED	BAL BS	Only coastal Only for quantification Under approval

Available standards for water transparency (Indicator 5.2.2.)

	Source	Regional Coverage		Remarks
I, II	WFD (EC, 2009). HELCOM (HEAT: Andersen et al., 2010a).	NEA MED	BAL BS	Only coastal
III	WFD (EC, 2009). HELCOM (COMBINE programme annex C-2) OSPAR (2005; 2009)	NEA MED	BAL BS	Only coastal

Available standards for abundance of opportunistic macroalgae (Indicator 5.2.3.)

	Source	Regional Coverage		Remarks
I, II	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) OSPAR (2005; 2009)	NEA MED	BAL BS	Only coastal
III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) OSPAR (1997c; 2005; 2009)	NEA MED	BAL BS	Only coastal

Available standards for species shift in floristic composition (Indicator 5.2.4.)

	Source	Regional Coverage		Remarks
I, II	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) OSPAR (2005; 2009)	NEA MED	BAL BS	Only coastal
III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) OSPAR (1997d; 2005; 2009) HELCOM (COMBINE programme annex C-6; Hansson & Öberg, 2010) and target for that is being considered. CEN 15204:2006	NEA MED	BAL BS	Only coastal Guidelines available from preservation and storage to light microscopy and sedimentation chambers

Available standards for abundance of perennial seaweeds and seagrasses (Indicator 5.3.1.)

	Source	Regional Coverage		Remarks
I, II	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) OSPAR (2005; 2009) HELCOM (HEAT: Andersen et al., 2010a).	NEA	BAL	Only coastal
		MED	BS	
III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009) OSPAR (1997b; 2005; 2009) HELCOM (COMBINE programme annex C-9)	NEA	BAL	Only coastal
		MED	BS	

Available standards for dissolved oxygen (Indicator 5.3.2.)

	Source	Regional Coverage		Remarks
I, II	WFD (EC, 2009) OSPAR (2005; 2009) HELCOM (Axe, 2010a; HEAT: Andersen et al., 2010a) MEDPOL (TRIX: Vollenweider, 1998; UNEP, 2007)	NEA	BAL	Only coastal
		MED	BS	
III	WFD (EC, 2009) OSPAR (1997e; 2005; 2009) HELCOM (COMBINE programme annex C-2) MEDPOL (TRIX: Vollenweider, 1998; UNEP, 2007)	NEA	BAL	Only coastal
		MED	BS	

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Descriptor 6: 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

Criterion 6.1 Physical damage, having regard to substrate characteristics

Indicator 6.1.1 Type, abundance, biomass and areal extent of relevant biogenic substrate

The explanatory notes & guidelines on assessment, monitoring and reporting under Article 17 of the Habitats Directive (EC, 2006) may be used to assess areal extend of habitats with biogenic substrate (such as reefs) and to set favourable area. Their applicability to habitats with biogenic substrate needs to be evaluated and/or developed.

Macrozoobenthos assessment methods for the WFD that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics on abundance of benthic invertebrate fauna. Most of these methods apply to soft bottom. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

The HELCOM Eutrophication assessment tool (HEAT) also assesses the biomass and abundance of benthic invertebrates (Andersen et al., 2010a).

The ISO 19493:2007 guidance on marine biological surveys of hard-substrate communities provides guidlines for marine biological surveys of supralittoral, eulittoral and sublittoral hard substrate for environmental impact assessment and monitoring in coastal areas. It comprises development of the sampling programme, survey methods, species identification and storage of data and collected material. The methods are limited to surveys and semi-quantitative and quantitative recording techniques that cause little destruction of the fauna and flora. In practice, this refers to direct recording in the field and photography. Sampling by scraping off organisms, use of a suction sampler, etc. are not covered. Additionally, ISO 16665:2005 provides guidelines on the quantitative collection and processing of subtidal soft-bottom macrofaunal samples in marine waters, including development of the sampling programme, requirements for sampling equipment, sampling and sample treatment in the field, sorting and species identification, storage of collected and processed material.

Indicator 6.1.2 Extent of the seabed significantly affected by human activities for the different substrate types

Although destruction by distinct human activities is taken into account in the assessment of the status of habitats for the Habitats Directive, to our best knowledge, there are no agreed methods available within the framework of European or international conventions.

Criterion 6.2 Condition of benthic community

Indicator 6.2.1 Presence of particularly sensitive and/or tolerant species

Assessment methods for benthic invertebrate fauna for the WFD that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics on the presence of particularly sensitive and/or tolerant species. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).

The HELCOM Eutrophication assessment tool (HEAT) assesses the presence / absence of key species / sensitive species for benthic invertebrates (Andersen et al., 2010a). Acceptable deviations from reference conditions range from -27 to -40% (Andersen et al., 2010b).

In the "OSPAR Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area" (OSPAR, 2005) it is suggested to assess zoobenthos species composition but assessment guidance is not yet available and the indicator is currently not used by OSPAR member states.

Indicator 6.2.2 Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species

Assessment methods for benthic invertebrate fauna and macrophytes for the WFD that are listed and described in the on-line database compiled within the WISER project (Birk et al., 2010) include metrics on diversity, richness and proportion of opportunistic to sensitive species. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009)

There is a HELCOM core indicator on the status of benthic invertebrate communities in the open Baltic Sea (Norkko & Villnäs, 2010). HELCOM COMBINE programme manual Annex C-9 provides guidelines for monitoring of phytobenthic plant and animal communities in the Baltic Sea and for estimating of coverage of individual species. Similarly, Annex C-8 provides guidelines for monitoring of soft bottom macrozoobenthos and more specifically for monitoring the spatial variability in species composition, abundance and biomass.

In the framework of the Bucharest Convention (Black Sea Commission) a manual for soft-bottom macrozoobenthos (Todorova & Konsulova, 2005) sampling and analysis have been developed and used in the Black Sea, including guidelines on equipment, site selection, abundance, biomass and taxonomic identification.

Indicator 6.2.3 Proportion of biomass or number of individuals in the macrobenthos above some specified length/size

To our best knowledge there are no methods available within the framework of European or international conventions.

Indicator 6.2.4 Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community

To our best knowledge there are no methods available within the framework of European or international conventions.

Table 7. Methodological standards for Descriptor 6 Sea-floor integrity. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Available standards for type, abundance, biomass and areal extent of relevant biogenic substrate (Indicator 6.1.1.)

	Source	Regional Coverage		Remarks
I, II	HD (EC, 2006)	NEA	BAL	Applicability for biogenic substrate must be evaluated
	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	MED	BS	Only coastal/ mostly for soft bottom
III	HD (EC, 2006)	NEA	BAL	Applicability for biogenic substrate must be evaluated
	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	MED	BS	Only coastal/ mostly for soft bottom
	ISO 19493:2007 & ISO 16665:2005			

Available standards for presence of particularly sensitive and/or tolerant species (Indicator 6.2.1.)

	Source	Regional Coverage		Remarks
I, II, III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Only coastal
	HELCOM (HEAT: Andersen et al., 2010a)	MED	BS	Only Baltic

Available standards for multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species (Indicator 6.2.2.)

	Source	Regional Coverage		Remarks
I, II	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Only coastal
	HELCOM (Norkko & Villnäs, 2010)	MED	BS	Only in the open Baltic Sea
III	WFD (Birk et al., 2010; Carletti & Heiskanen, 2009)	NEA	BAL	Only coastal
	HELCOM (COMBINE programme annexes C-8 & C-9)	MED	BS	Only Baltic
	Black Sea Commission ((Todorova & Konsulova, 2005)			Only Black Sea

Available standards for extent of the seabed significantly affected by human activities for the different substrate types (Indicator 6.1.2.); proportion of biomass or number of individuals in the macrobenthos above some specified length/size (Indicator 6.2.3.); and parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community (Indicator 6.2.4.)

	Source	Regional Coverage		Remarks
I, II, III		NEA	BAL	
		MED	BS	

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Descriptor 7: Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems

Criterion 7.1. Spatial characterisation of permanent alterations

Indicator 7.1.1 Extent of area affected by permanent alterations

Criterion 7.2. Impact of permanent hydrographical changes

Indicator 7.2.1 Spatial extent of habitats affected by the permanent alteration

Indicator 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

With regard to the indicators associated with Descriptor 7, methodological standards within the framework of European or international conventions are mostly lacking (see Table 8). However, as this is the only descriptor for which no Task Group report has been produced, we cite here relevant EU policy documents, guidelines and agreements related to the permanent alteration of hydrographical conditions.

In accordance with the environmental objectives of the WFD, the hydromorphological characteristics of water bodies should be preserved. In the assessment of ecological status/potential, Member States are to use biological and supporting hydromorphological and physico-chemical quality elements (see CIS Guidance Document No. 13). According to WFD Annex V, the values of the hydromorphological quality elements must be taken into account when assigning water bodies to the high ecological status class and the maximum ecological potential class. For the other status/potential classes, the hydromorphological elements are required to have conditions consistent with the achievement of the values specified for the biological quality elements.

For new developments, there is a need firstly to prevent deterioration of status in a water body. Where this is not possible, mitigation measures should be applied. Where a physical modification has already taken place, actions should first be considered to restore the water body with the aim to achieve 'good ecological status'. Where restoration is not possible, mitigation measures should be investigated with the aim to meet 'good ecological potential' (WFD Art. 4(3)-4(7)). The WFD CIS activity on hydromorphology has produced a technical report providing a toolbox of prevention, mitigation and restoration measures regarding special focus on hydropower generation, navigation and flood protection (WFD and Hydromorphological Pressures Technical Report, 2006). Please also see CIS Guidance document No. 4 on the identification and designation of heavily modified and artificial water bodies and Guidance document No. 20 on exemptions to the environmental objectives.

Also the Habitats Directive sets requirements to take into account characteristics, such as hydrology, in the assessment of the status of habitats, and e.g. methodologies for the estimation of habitats and species ranges exits (European Commission 2006). In accordance with the provisions of Article 6 of the Habitats Directive, an appropriate assessment must be made of any plan or programme, such as those related to oil and gas sectors, which is likely to have a significant effect on the conservation objectives of special areas of conservation. Guidelines exist for the application of Habitats and Birds Directives for the establishment of the Natura 2000 network particularly in the marine environment and can be found at http://ec.europa.eu/environment/nature/natura2000/marine/.

In general, plans, programmes and projects likely to have significant effects on the environment are subject to environmental assessment prior to their approval or authorisation either on the basis of Directive 85/337/EEC (as amended by Directives 97/11/EC and 2003/35/EC) (Environmental Impact Assessment Directive) or Directive 2001/42/EC (Strategic Environmental Assessment Directive). Both OSPAR and HELCOM have adopted guidelines on marine sediment extraction (HELCOM Recommendation 19/1; OSPAR Agreement 03/17/1), and the Barcelona Convention has adopted a Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil.

Table 8. Methodological standards for Descriptor 7 Hydrographical conditions (Indicators 7.1.1., 7.2.1., 7.2.2.). I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

	Source	Regional Coverage		Remarks
I, II		NEA	BAL	
		MED	BS	
III	WFD	NEA	BAL	The WFD gives parameters to be monitored/taken into account but not specific monitoring guidelines.
		MED	BS	

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Descriptor 8: Concentrations of contaminants are at levels not giving rise to pollution effects

In the COM Dec it is stated that for Descriptor 8 Contaminants and pollution effects, Member States have to consider the substances or groups of substances, where relevant for the marine environment, that:

(i) exceed the relevant Environmental Quality Standards set out pursuant to Article 2(35) and Annex V to Directive 2000/60/EC in coastal or territorial waters adjacent to the marine region or sub-region, be it in water, sediment and biota; and/or

(ii) are listed as priority substances in Annex X to Directive 2000/60/EC and further regulated in Directive 2008/105/EC, which are discharged into the concerned marine region, sub-region or subdivision; and/or

(iii) are contaminants and their total releases (including losses, discharges or emissions) may entail significant risks to the marine environment from past and present pollution in the marine region, sub-region or subdivision concerned, including as a consequence of acute pollution events following incidents involving for instance hazardous and noxious substances.

An ample amount of methodologies exist for the assessment and monitoring of contaminants (Table 9). However, gaps exist and there is a need to increase the scope and harmonisation of assessment methodologies.

Criterion 8.1 Concentration of contaminants

Indicator 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

Water Framework Directive and related Directives

For the status of surface waters, WFD Annex V defines quality elements for the classification of ecological status (1.1.), normative definitions of ecological status classifications (1.2.) and the procedure for the setting of chemical quality standards by MS (1.2.6). It also sets the requirements and design for monitoring of ecological status and chemical status for surface waters, including design of surveillance, operational and investigative monitoring, frequency of monitoring, and lists standards for monitoring of quality elements. Also the classification and presentation of ecological status (1.4.) is defined.

In the WFD, chemical status is defined in terms of compliance with Environmental Quality Standards (EQS). EQS have been established in the EQS Directive (Directive 2008/105/EC) for priority substances and certain other pollutants (which are neither priority nor priority hazardous substances) in accordance with WFD requirements. EQS have been set as annual average concentrations and maximum allowable concentrations which are not to be exceeded. Where a body of water achieves compliance with all the environmental quality standards established in Annex IX, Article 16 and under other relevant Community legislation setting environmental quality standards it shall be recorded as achieving good chemical status. If not, the body shall be recorded as failing to achieve good chemical status (WFD Annex V 1.4.3.)

In addition, each River Basin Management Plan may identify River Basin Specific Pollutants and derive an EQS for those. When a specific pollutant that is not included in the EQS Directive is considered relevant at a national scale, national EQS are developed. Both RBSP and national EQS are part of physico-chemical quality elements of the ecological status classification of surface water status (WFD Annex V). The status of a water body can be classified as being in high status, good status or moderate status (WFD Annex V 1.2.4).

Minimum performance criteria for methods of analysis to be applied by Member States when monitoring water status, sediment and biota, as well as rules for demonstrating the quality of analytical results have been laid down in Commission Directive 2009/90/EC.

OSPAR

In the OSPAR CEMP assessment context, the assessment criteria used in the assessment of contaminant concentrations in sediment and biota corresponds to the achievement of, or failure to achieve, statutory

targets or policy objectives for contaminants in these matrices (Table 9). These objectives are (i) to ultimately achieve concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances, and (ii) to achieve concentrations of contaminants at levels not giving rise to pollution effects.

Assessment criteria (values) are set to allow classification of the results in a traffic light scheme:

- background assessment criteria determine the threshold from blue (background / zero) to green (above background but below the environmental assessment criteria);
- environmental assessment criteria (EACs) determine the threshold from green to red (concentrations are at levels such that there is an unacceptable risk of chronic effects occurring in marine species).

Additionally the assessment includes the identification of significant temporal trends. Assessment criteria and values used in the Quality Status Report 2010 are set out in OSPAR (2009a), supported by a background document on derivation of the criteria (OSPAR 2009b). Methodologies are described in the OSPAR CEMP assessment manual (OSPAR, 2008). The assessment and comparability of data is supported by agreed Guidelines for monitoring (sediment, biota) and reporting (see OSPAR monitoring manual at http://www.ospar.org/content/content.asp?menu=00900301400135_000000_000000).

HELCOM

HELCOM Contracting Parties are allowed to decide which environmental target levels to apply in their own coastal waters. HELCOM does not have its own target levels for contaminants in the Baltic Sea. However, recent developments such as the HELCOM HAZAS (Integrated Thematic Assessment of Hazardous Substances in the Baltic Sea) (HELCOM 2010a) and HELCOM CORESET (Development of HELCOM Core Set Indicators) (http://www.helcom.fi/projects/on_going/en_GB/coreset/) projects are aiming at establishing indicators, target levels and assessment criteria. The HELCOM EcoQO Project has developed the following initial EcoQOs for hazardous substances: (1) Concentrations of hazardous substances in the Baltic Sea near background values for naturally occurring substances and close to zero for man-made substances; (2) No illegal oil spills; (3) All fish caught in the Baltic Sea should be suitable for human consumption; (4) Toxic substances shall not cause sub-lethal, intergenerational or transgenic effects to the health of marine organisms (e.g. reproductive disturbances); (5) Attain pre-Chernobyl concentrations for Cs-137in the Baltic Sea ecosystem causing risk neither to human nor the natural systems. Indicators for these are under development and can be found from http://www.helcom.fi/BSAP/ActionPlan/otherDocs/en_GB/indicators/. In the CHASE tool used in the HELCOM thematic assessment of hazardous substances in the Baltic Sea (HELCOM 2010), Contamination Ratios (CR) – based on threshold levels of contaminants in biota, sediments and water defined in other international for a, e.g. EU directives, OSPAR etc. were used to assess the status of Baltic Sea as concerns hazardous substances.

UNEP/MAP-MEDPOL and EEA

In the framework of the Regional Seas Programme, UNEP is assisting Mediterranean participating countries in the assessment of the state of marine environment. The Reference Methods for the analysis of pollutants in water, sediment and biota, in the framework of the UNEP/MAP-MEDPOL, can be found in www.unepmap.org (Document and publications; Library Resources; Reference Methods) (Table 9). The methods and guidelines have been prepared in cooperation with the relevant specialised bodies of the United Nations system (WHO, FAO, IAEA, IOC) as well as other organisations and are tested by competent experts. The Methods and Guidelines are periodically revised taking into account the development of our understanding of the problem, of analytical instrumentation and the actual need of the users. The Marine Environment Laboratory of the International Atomic Energy Agency (IAEA) in Monaco is responsible for the technical co-ordination of the development, testing and intercalibration of Reference Methods.

The objectives of the monitoring activities implemented as part of MED POL Phase IV are:

- to present periodical assessments of the state of the environment in hot spots and coastal areas (needed to provide information for decision makers on the basic environmental status of the areas which are under anthropogenic pressures);

- to determine temporal trends of some selected contaminants in order to assess the effectiveness of actions and policy measures, and
- to enhance the control of pollution by means of compliance to national/international regulatory limits.

Trend monitoring is used for the detection of site-specific temporal trends of selected contaminants (see the Protocol on Land-Based Sources, Annex IC http://195.97.36.231/dbases/webdocs/BCP/ProtocolLBS96_eng_P.pdf) at hot spots and coastal/reference areas.

The European Environment Agency (EEA) has developed an indicator fact sheet for hazardous substances in marine organisms in which the concentrations and trends of cadmium, mercury, lead, DDT, lindane and PCB are assessed (Green et al., 2004).

Criterion 8.2 Effects of contaminants

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

OSPAR has established an EcoQO for the effects of TBT on marine gastropods (*Nucella, Littorina, Buccinum* and *Neptunea*), which is applied through corresponding assessment criteria to the entire OSPAR maritime area. Associated with this EcoQO is an assessment scale which includes background levels of effect, and levels of effect that are significant at individual and population levels (see assessment criteria, OSPAR agreement 2004-15) The same biological effects criterion has been suggested for HELCOM indicator (http://www.helcom.fi/BSAP/ActionPlan/otherDocs/en_GB/indicators/).

The HELCOM indicator fact sheet on predatory bird health compares mean annual productivity and residue concentrations of DDE and total-PCB in white-tailed sea eagle eggs (Helander et al., 2009). The HELCOM indicator fact sheet on grey seal health and ringed seal health (Bäcklin et al., 2010, Kunnasranta et al., 2010) have parameters which correlate with bioaccumulating POPs.

OSPAR, in cooperation with ICES, has established a suite of background documents for biological effects techniques (OSPAR, 2007a) which is currently being reviewed based on ICES 2010 advice. The background documents standardise reference methods for biological indicators and include assessment criteria/levels for various techniques. The most mature techniques for application include TBT effects, fish disease index, and vitellogenin (see assessments reported in OSPAR QSR 2010). The suite of biological effects techniques are part of the Pre-CEMP (voluntary component); a fully coordinated monitoring programme has not yet been implemented by Contracting Parties. Monitoring is supported by JAMP guidelines for monitoring specific and general biological effects (OSPAR agreements 2008-9 and 1997-7; see OSPAR monitoring manual: http://www.ospar.org/content/content.asp?menu=00900301400135_000000_000000). A large number of background documents have been prepared on compounds that showed potential for inclusion in the CEMP, which are available at the OSPAR website (http://www.ospar.org/v_publications/browse.asp?menu=01080304580000_000000_000000) and have been reviewed in the TG8 report, Annex 17.

In MED POL Phase IV, biological effects monitoring (monitoring with biomarkers) has been included in the monitoring programmes as a pilot activity to test the methodology to be used as an early-warning tool to detect any destructive effects of pollutants to the organisms at the initial stage of exposures.

Indicator 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

OSPAR has developed an EcoQO for assessing levels of oil pollutions; the average proportion of oiled common guillemots in all winter months (November to April) should be 10% or less of the total found dead or dying on beaches over period of at least five years (Table 9).

As part of the HELCOM HOLAS project, the Baltic Sea Pressure Index (BSPI) was developed, which presents the sum of pressures, including polluting ship accidents and oil slicks (HELCOM 2010b). The index, however, does not take into account the impacts of these pressures on the marine environment. In order to address the increasing risk of accidental pollution from shipping connected to increasing maritime transportation in the Baltic, a strategic project "Sub-regional risk of spill of oil and hazardous substances in the Baltic Sea (BRISK)" has been launched by the Baltic Sea countries under the HELCOM umbrella (http://www.brisk.helcom.fi/). The overall objective of BRISK is to substantially contribute to the development of an appropriate level of preparedness in the whole Baltic Sea area to tackle major accidental spills.

Table 9. Methodological standards for Descriptor 8 Contaminants and pollution effects. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Available standards for concentration of contaminants (Indicator 8.1.1.)

<table>
<tr><th></th><th>Source</th><th colspan="2">Regional Coverage</th><th>Remarks</th></tr>
<tr><td rowspan="2">I, II</td><td rowspan="2">WFD (EC, 2000)
EQS directive (EC, 2008)
CEMP Assessment Criteria (OSPAR, 2008; 2009a,b)
Seabird eggs EcoQO (OSPAR, 2007c)
HELCOM COMBINE Programme for monitoring of contaminants and their effects
MED POL Phase IV (UNEP, 2008)</td><td>NEA</td><td>BAL</td><td rowspan="2">WFD (for chemical status) & EQS directive apply to coastal and territorial waters.</td></tr>
<tr><td>MED</td><td>BS</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">WFD (EC, 2000)
WFD Monitoring guidance for surface water (EC 2009), and sediment and biota (EC, 2010)
EQS directive (EC, 2008)
QA/QC (COM Dir 2009)
HELCOM COMBINE Programme for monitoring of contaminants and their effects
CEMP Assessment Criteria (OSPAR, 2008; 2009a,b)
JAMP Guidelines for monitoring contaminants in biota and sediments (OSPAR, 2002; 2009c)
UNEP/MAP-MEDPOL
ICES TIMES</td><td>NEA</td><td>BAL</td><td rowspan="2"></td></tr>
<tr><td>MED</td><td>BS</td></tr>
</table>

Available standards for levels of pollution effects (Indicator 8.2.1.)

	Source	Regional Coverage		Remarks
I, II	CEMP Assessment Criteria (OSPAR, 2008; 2009a,b) HELCOM COMBINE Programme for monitoring of contaminants and their effects HELCOM Predatory bird health indicator (Helander et al., 2009) HELCOM Grey seal health and ringed seal health indicators (Bäcklin et al., 2010, Kunnasranta et al., 2010) MEDPOL Biological Effects Monitoring Programme Phase IV ICES (2008; 2009)	NEA	BAL	OSPAR region/Assessment criteria developed only for TBT. Other biological effects techniques/assessment criteria under review.
		MED	BS	
III	CEMP Assessment Criteria (OSPAR, 2008; 2009a,b) JAMP Guidelines for monitoring contaminants in biota and sediments (OSPAR, 2002; 2009c) JAMP Guidelines for general and contaminant-specific biological effects monitoring (OSPAR, 1998; 2007a) HELCOM COMBINE Programme for monitoring of contaminants and their effects HELCOM Predatory bird health indicator (Helander et al., 2009) MEDPOL Biological Effects Monitoring Programme Phase IV	NEA	BAL	
		MED	BS	

Available standards for occurrence, origin and extent of acute pollution events (Indicator 8.2.2.)

	Source	Regional Coverage		Remarks
I, II, III	EcoQO handbook (OSPAR, 2007b) HELCOM BSPI (HELCOM, 2010b)	NEA	BAL	Eco QO developed for the North Sea.
		MED	BS	

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Descriptor 9: Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards

The COM Dec states that for Descriptor 9, Member States need to monitor in edible tissues (muscle, liver, roe, flesh, soft parts as appropriate) of fish, crustaceans, molluscs and echinoderms, as well as seaweed, caught or harvested in the wild, the possible presence of substances for which maximum levels are established at European, regional, or national level for products destined to human consumption.

The current approach for monitoring fish and other seafood for compliance with levels set for public health protection are very different from monitoring of biota for environmental purposes. Existing monitoring programmes for fish and sea food for public health reasons generally focus on estimating consumer exposure rather than assessing environmental status. In order to use these programmes for assessing the environmental status of the marine environment, major adaptations would be needed regarding design of the sampling plans, sampling procedures, selected tissues analysis and traceability to the location of catching or harvesting.

Criterion 9.1 Levels, number and frequency of contaminants

Indicator 9.1.1 Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels

Maximum levels for contaminants in fish and other seafood have been established in Community legislation for lead, cadmium, mercury, inorganic tin, 3-MCPD, dioxins and dioxin-like PCBs and polycyclic aromatic hydrocarbons (benzo(a)pyrene) (Table 10). For these contaminants, also provisions regarding sampling procedures and method of analysis have been set in Regulations (EC) No 333/2007 and No 1883/2006.

Indicator 9.1.2 Frequency of regulatory levels being exceeded

To our best knowledge there are no methodological standards available for this indicator within the framework of European or international conventions.

Table 10. Methodological standards for Descriptor 9 Contaminants in fish and other seafood. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Available standards for levels of contaminants (Indicator 9.1.1.)

	Source	**Regional Coverage**		**Remarks**
I, II, III	Commission Regulation No 1881/2006	NEA	BAL	Existing monitoring programmes generally focus on estimating consumer exposure rather than assessing environmental status.
		MED	BS	

Available standards for the frequency of regulatory levels being exceeded (Indicator 9.1.2.)

	Source	**Regional Coverage**		**Remarks**
I, II, III		NEA	BAL	
		MED	BS	

References

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Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:364:0005:0024:EN:PDF

Commission Regulation (EC) No 1883/2006 of 19 December 2006 laying down methods of sampling and analysis for the official control of levels of dioxins and dioxin-like PCBs in certain foodstuffs. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:364:0032:0043:EN:PDF

Descriptor 10: Properties and quantities of marine litter do not cause harm to the coastal and marine environment

With regard to litter, it is acknowledged in the COM Dec that there is a need for further development of several indicators, particularly those relating to biological impacts and to micro-particles, as well as for the enhanced assessment of their potential toxicity. The lack of methodological standards for Descriptor 10 in all MSFD marine regions is also apparent in Table 11, in particular with regard to status assessment and environmental targets. In the TG 10 report, an overriding objective for the assessment of GES is given as a measurable and significant decrease (e.g. 10%/year) in comparison with the initial baseline in the total amount of litter in the environment by 2020.

Criterion 10.1 Characteristics of litter in the marine and coastal environment

Indicator 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

UNEP guidelines exist for comprehensive beach litter assessment and rapid beach litter assessment (Table 11). Also HELCOM has developed recommendations for sampling and reporting of beach litter surveys, which are compatible to the UNEP guidelines (Table 11).OSPAR Contracting Parties are implementing an Agreement on a Voluntary Beach Litter Monitoring Programme (Agreement 2007-7, as amended by BDC 2010) and have adopted detailed Monitoring Guidance, including photo guides for field use (see Table 11). Currently both UNEP MAP and the Black Sea Commission are considering applying the UNEP guidelines.

Indicator 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

UNEP guidelines exist for both benthic and floating litter assessment (Table 11). Standard methods are also in use for surveys of litter on sea floor performed during international bottom trawl surveys (IBTS) in the North East Atlantic and the Mediterranean (Table 11). There are currently no coordinated national or regional monitoring programmes for surface water, water column or seabed within Europe. However, OSPAR has adopted Recommendation 2010/19 on the reduction of marine litter though the implementation of fishing for litter initiatives. Reporting of monitoring data under this Recommendation will start in 2013: http://www.ospar.org/v_measures/get_page.asp?v0=10-19e_fishing%20for%20litter.pdf&v1=4. In the TG 10 report, it is strongly recommended to further harmonize monitoring protocols and methods in the European region with regard to ship surveys of surface and water column litter.

Indicator 10.1.3 Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro-plastics)

There are currently no monitoring programs for microparticles within Europe (Table 11). However, microplastic particles can and have been monitored in the water column using the continuous plankton recorder (Warner & Hays 1994), and this method could be used to analyse trends in larger microplastic. Sampling protocols of microparticles needs harmonisation.

Criterion 10.2 Impacts of litter on marine life

Indicator 10.2.1 Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis)

The COM Dec states that this indicator needs to be developed further, based on the experience in some sub-regions (e.g. North Sea), to be adapted in other regions. The OSPAR Fulmar Plastic EcoQO has a fully established methodology (Table 11). OSPAR has provisionally defined its objective for acceptable Ecological Quality concerning litter in the North Sea as "There should be less than 10% of Northern Fulmars having more than 0.1 gram plastic particles in the stomach in samples of 50-100 beach-washed fulmars found from each of 4 to 5 areas of the North Sea over a period of at least 5 years". The applicability of this EcoQO to other regions

of the NE Atlantic and to other marine regions by applying other species with adjusted targets needs further development.

Table 11. Methodological standards for Descriptor 10 Litter. I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

Trends in the amount of litter washed ashore and/or deposited on coastlines (Indicator 10.1.1.)

	Source	Regional Coverage		Remarks
I, II		NEA	BAL	
		MED	BS	
III	HELCOM Recommendation 29/2 OSPAR Guideline for marine litter monitoring on beaches (2009a) OSPAR Photo guides for marine litter monitoring on beaches (OSPAR, 2009b,c,d) UNEP Guidelines on Survey and Monitoring of Marine Litter (Cheshire et al., 2009)	NEA	BAL	
		MED	BS	

Trends in the amount of litter in the water column and deposited on the sea-floor (Indicator 10.1.2.)

	Source	Regional Coverage		Remarks
I, II		NEA	BAL	
		MED	BS	
III	UNEP Guidelines on Survey and Monitoring of Marine Litter (Cheshire et al., 2009) ICES guidelines (IBTS North Sea, IBTS Western and Southern areas, Baltic International Trawl Survey) MEDITS program	NEA	BAL	No coordinated national or regional monitoring programmes for surface water, water column or seabed within EU. Surface water monitoring is not done on a regular basis by observers or net based surveys.
		MED	BS	

Trends in the amount, distribution and, composition of micro-particles (Indicator 10.1.3.)

	Source	Regional Coverage		Remarks
I, II, III		NEA	BAL	
		MED	BS	

Trends in the amount and composition of litter ingested by marine animals (Indicator 10.2.1.)

	Source	Regional Coverage		Remarks
I, II, III	OSPAR Fulmar EcoQO (OSPAR, 2008)	NEA	BAL	The OSPAR Fulmar EcoQO has been developed for the North Sea. For southern parts of the OSPAR region and the MEDPOL region, pilot studies using other seabird species are being conducted. For other regions suitable species need to be identified and tested.
		MED	BS	

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HELCOM Recommendation 29/2: Guidelines on sampling and reporting of marine litter found on beach. http://www.helcom.fi/Recommendations/en_GB/rec29_2/

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Descriptor 11: Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment

As stated in the COM Dec, additional scientific and technical progress is still required to support the further development of criteria related to this descriptor, including in relation to impacts of introduction of energy on marine life, relevant noise and frequency levels (which may need to be adapted, where appropriate, subject to the requirement of regional cooperation). At the current stage, the main orientations for the measurement of underwater noise have been identified as a first priority in relation to assessment and monitoring, subject to further development, including in relation to mapping.

To our best knowledge there are no methodological standards available within the framework of European or international conventions to the indicators of Descriptor 11. Please refer to this report for reasoning of and background to the selected criteria and indicators.

There are, however, currently plans in the Baltic Sea region to establish a project aimed at developing a common methodology for measuring acoustic data. In the HELCOM Initial Holistic Assessment (HELCOM 2010) the impact of noise was assessed using a 4-level indicator: level 1 indicating that the noise is audible to biota; level 2 indicating that masking of communication occurs; level 3 indicating an avoidance reaction; and level 4 indicating physiological impacts from construction work. Impact levels were based on studies on harbor porpoises, seals and cod and data sources used were shipping during six days in November 2008, construction of wind farms and cables and operational wind farms.

Also an EC technical subgroup "Underwater Noise and Inputs of Other Forms of Energy" has been established. Background on underwater sound, including the nature of sound and basic concepts, measurement of sounds, physical and biological units, source level measurements, and background noise, have been overviewed by OSPAR (2009).

The Acoustical Society of America has published American National Standards on standardised methods of measurement for impulse noise see (ANSI 1986), standard on quantities and procedures for description and measurement of underwater sound from ships (ANSI 2009). There is also an ISO standard for basic quantities and assessment procedures of environmental noise (ISO 1996-1:2003).

Criterion 11.1 Distribution in time and place of loud, low and mid frequency impulsive sounds

Indicator 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

The monitoring needs identified for this indicator are essentially administrative monitoring of documents, such as environmental impact assessments (EIAs) and licence reports (see TG 11 report).

Criterion 11.2 Continuous low frequency sound

Indicator 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.

As identified in the TG 11 report, the monitoring needs for this indicator require the establishment of a set of underwater noise observatories for each regional sea with the expectation that existing observatories, such as ESONET (European Seas Observatory NETwork; http://www.oceanlab.abdn.ac.uk/research/esonet.php) and LIDO (Listening to the Deep Ocean environment; http://listentothedeep.com/) or fixed oceanographic moorings could be used.

Table 12. Methodological standards for Descriptor 11 Energy/Noise (Indicators 11.1.1. and 11.2.1). I assessment of the status of the marine environment, II environmental targets, III monitoring. NEA (North East Atlantic), MED (Mediterranean Sea), BAL (Baltic Sea), BS (Black Sea).

	Source	Regional Coverage		Remarks
I, II, III		NEA	BAL	
		MED	BS	

References

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4. MSFD Task Group Reports

Further details on the assessment methods can be found in the MSFD Task Group reports relating to the descriptors of GES listed in Annex I of the Directive:

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S. Olenin, F. Alemany, A. C. Cardoso, S. Gollasch, P. Goulletquer, M. Lehtiniemi, T. McCollin, D. Minchin, L. Miossec, A. Occhipinti Ambrogi, H. Ojaveer, K. Rose Jensen, M. Stankiewicz, I. Wallentinus & B. Aleksandrov, 2010. Marine Strategy Framework Directive Task Group 2 Report Non-indigenous species. EUR 24342 EN – 2010. http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/13628/1/tg2%20report_final_vii.pdf

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J. Rice, C. Arvanitidis, A. Borja, C. Frid , J. Hiddink , J. Krause, P. Lorance, S. Á. Ragnarsson, M. Sköld & B. Trabucco, 2010. Marine Strategy Framework Directive Task Group 6 Report Seafloor integrity. EUR 24334 EN – 2010.
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R. Law, G. Hanke, M. Angelidis, J. Batty, A. Bignert, J. Dachs, I. Davies, Y. Denga, A. Duffek, B. Herut, K. Hylland, P. Lepom, P. Leonards, J. Mehtonen, H. Piha, P. Roose, J. Tronczynski, V. Velikova & D. Vethaak. 2010. Marine Strategy Framework Directive – Task Group 8 Report Contaminants and pollution effects. EUR 24335 EN.
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F. Swartenbroux, B. Albajedo, M. Angelidis, M. Aulne, V. Bartkevics, V. Besada, A. Bignert, A. Bitterhof, A. Hallikainen, R. Hoogenboom, L. Jorhem, M. Jud, R. Law, D. Licht Cederberg, E. McGovern, R. Miniero, R. Schneider, V. Velikova, F. Verstraete, L. Vinas & S. Vlad. 2010. Marine Strategy Framework Directive – Task Group 9 Report Contaminants in fish and other seafood. EUR 24339 EN – 2010.
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5. INTEGRATED ASSESSMENT

Both OSPAR and HELCOM have conducted integrated environmental status assessments. HELCOM has conducted a Holistic Assessment of the Ecosystem Health of the Baltic Sea (HELCOM 2010), in which an integrated assessment of the ecosystem health of the Baltic Sea is presented as well as thematic assessments of eutrophication status, biodiversity status and hazardous substances status. In the Quality Status Report 2010, the OSPAR Commission presents an overview of current knowledge on trends in pressures and impacts and the quality status of the North-East Atlantic and its Regions (http://qsr2010.ospar.org/en/index.html). It is supported by a series of thematic assessment reports (http://qsr2010.ospar.org/en/qsr_assessments.html) prepared under the OSPAR Joint Assessment and Monitoring Programme. The HELCOM and OSPAR assessments can be seen as important regional contributions to the initial assessment of the MSFD; at the moment of this publication (March 2011), further work is being specifically developed within various groups and projects of these Conventions.

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Abstract
In accordance with the Marine Strategy Framework Directive (MSFD; 2008/56/EC), it is appropriate to make provision for the development of criteria and methodological standards to ensure consistency and to allow for comparison between marine regions or subregions of the extent to which good environmental status (GES) is being achieved. In this report, methodological standards are reviewed for (1) the assessment of the status of the marine environment and the determination of GES; (2) environmental targets; and (3) monitoring. Methodological standards are defined in general terms as all methods developed and agreed in the framework of European or international conventions. The screening of available methodological standards is restricted to the WFD (2000/60/EC), EQS Directive (2008/105/EC), Habitats Directive (92/43/EEC), Birds Directive (2009/147/EC), Common Fisheries Policy and Regional Sea Conventions covering European seas (OSPAR, HELCOM, UNEP MAP, Black Sea Commission).

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