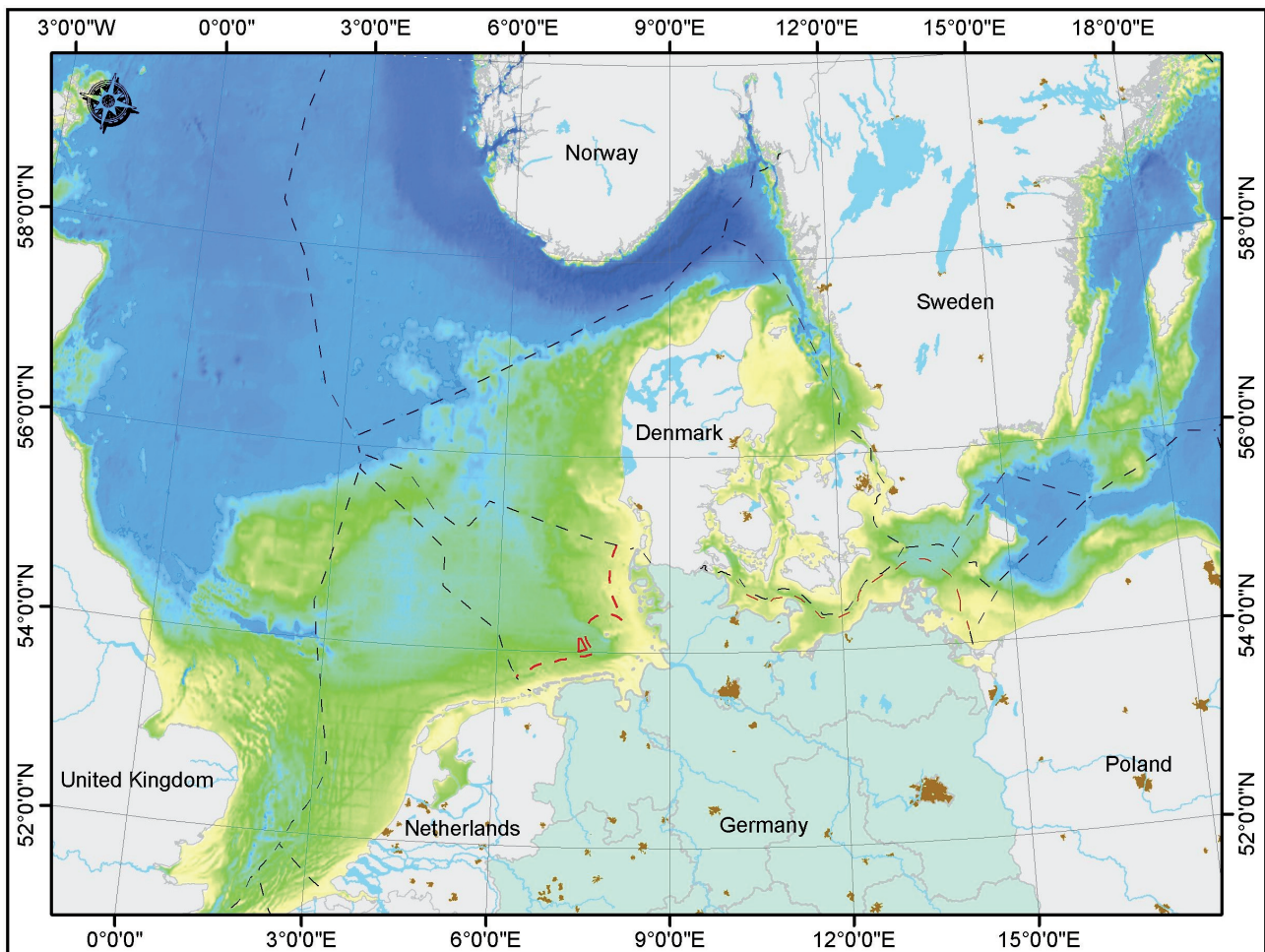# Implementation of the Marine Strategy Framework Directive

MEERESUMWELT

BUND-LÄNDER
MESSPROGRAMM

The preparation of Germany´s marine strategies

Guide to implementing the Marine Strategy Framework Directive (MSFD - 2008/56/EC) for the initial assessment, determination of good environmental status and establishment of environmental targets in the German North and Baltic Seas

ARGE BLMP - Working Group for the North Sea and Baltic Sea Monitoring Programme

At the 34th North German Environmental Ministerial Meeting held on 17 April 1997, the competent departments of the German Federal Government and of the federal states of Hamburg, Mecklenburg-Vorpommern, Lower Saxony and Schleswig-Holstein agreed to establish a joint working group co-ordinating the monitoring of the marine environment of the North and Baltic Seas (ARGE BLMP Nord- und Ostsee).

Members of ARGE BLMP are:

- Federal Ministry of Food, Agriculture and Consumer Protection
- Federal Ministry of Transport, Building and Urban Development
- Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- Federal Ministry of Education and Research
- Authority for Urban Development and Environment of the Free and Hanseatic City of Hamburg
- Mecklenburg-Vorpommern Ministry for Agriculture, the Environment and Consumer Protection
- Lower Saxony Ministry for the Environment and Climate Protection
- Schleswig-Holstein Ministry for Agriculture, the Environment and Rural Areas

Contents

1. Introduction

The world's oceans are intensively used yet poorly protected environments. In Germany's marine regions, too, protective interests are outweighed by a wide range of uses. While the use of marine waters by humans must be ensured, it must not be allowed to threaten the very survival of our marine flora and fauna. Striking a good balance between ecological, economic and social interests is a challenge for all players from politics, industry and academia, as well as each and every member of society. The Marine Strategy Framework Directive (MSFD; 2008/56/EC) aims at striking a balance between use and protection of the oceans. The implementation of the Directive aims to minimise the overall anthropogenic pressures to a level that does not impair the marine ecosystems' ability to respond to man-made changes, while at the same time allowing the ocean's commodities (such as fish, seafood) and services to be used sustainably, by both current and future generations (ecosystem approach; Article 1(3)).

According to Article 1, the objective of the MSFD is to achieve or maintain a good environmental status in the marine environment by 2020 at the latest. This entails the development and implementation of marine strategies in order to "protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected". Furthermore, the aim is to "prevent and reduce inputs in the marine environment, with a view to phasing out pollution [...] so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate uses of the sea" (Article 1(2)).

Within the context of implementing the MSFD, the Member States are collaborating with neighbouring countries to develop suitable measures in order to achieve the aforementioned objective in their marine regions. In order to prepare such measures and monitor their success, the MSFD requires the Member States to submit three reports to the EU COM (Article 17). Member States are required to report on the current state of nature and the environment (assessment in accordance with Article 8) of their marine waters, and define the desired state of their marine waters (Good Environmental Status (GES), Article 9). In the event of a deviation between the current and desired state of marine waters, or in order to maintain a good environmental status, the Member States must establish environmental targets (Article 10). These three reports are closely interrelated and build on one another (Figure 1). In simplified form, these sub-tasks of the MSFD can be summarised as follows (see Article 5):

Preparation:

- Assessment of the current state of marine waters (assessment, Article 8)
- Establishment of the desired state (determination of good environmental status, GES, Article 9) and initial gauging of the difference between this defined GES and the current state.
- Establishment of targets and associated indicators to reduce or eliminate those anthropogenic pressures that are responsible for deviations between the current and desired state (environmental targets, Article 10), with the aim of achieving or maintaining a good environmental status.
- Establishment and implementation of monitoring programmes for the ongoing assessment and regular updating of targets (monitoring, Article 11).

Programme of measures:

- Establishment and practical implementation of measures to achieve the targets (measures, Article 13).

The above steps should be repeated at regular intervals to ensure that the aims of the Directive are met. To this end, an updated assessment should be performed every six years, and the GES, targets, monitoring programmes and programmes of measures adjusted where necessary (Article 17).
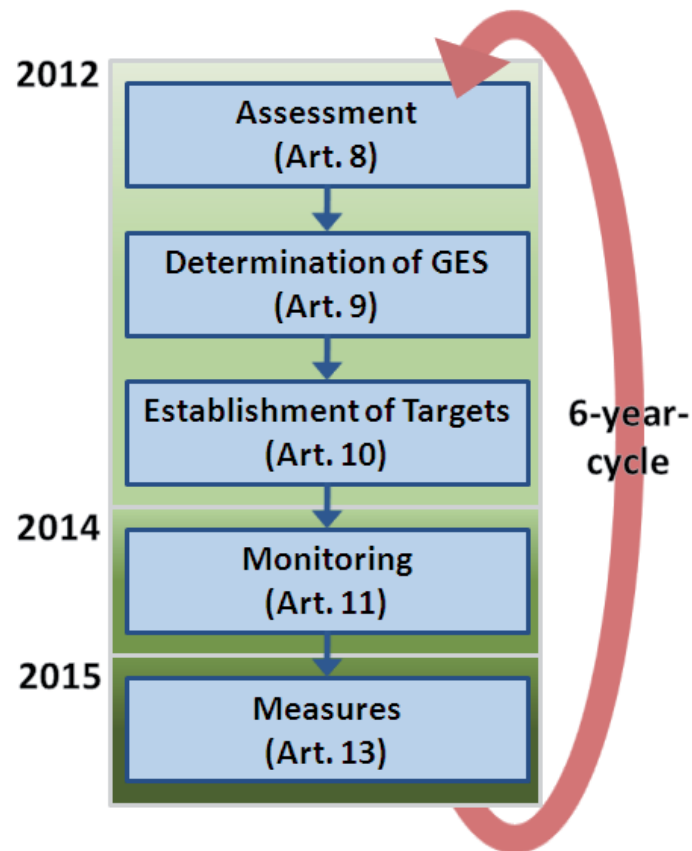
Fig. 1: Implementation stages for the MSFD, showing the task deadlines and reporting dates under the MSFD. The MSFD stipulates that progress should be reviewed every six years by repeating the aforementioned steps. The next reporting cycle will begin in 2018. The fundamental tasks remain the same; only the details will change (cf. chapters 3.2 and 4.2).

In the description of the Directive itself, the multitude of complex individual tasks within the various implementation stages of the MSFD is neither fully consistent nor self-explanatory. It is therefore up to the Member States to individually or collectively (either at EU level and/or in the respective marine regions) develop a common understanding of the given tasks and their underlying terms and structures, so that a comparable approach can be adopted.

This Guide provides a consistent interpretation of the terms and structures of the MSFD for the authorities who have been tasked with implementing the MSFD, particularly with regard to reporting obligations, and offers a pragmatic approach to the implementation of the tasks. It outlines the sequence of key tasks in a structured and transparent manner (Figure 1), and illustrates this with a range of examples (Appendix 2). The approach outlined can be applied to all marine regions.

2. Explanations of key terms in the MSFD within the context of the duties outlined in Articles 8 to 10

Below, we provide definitions of the specialist terminology used in the MSFD and in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (1 September 2010, Commission Decision 2010/477/EU) and associated concepts, and illustrate them with examples.

Descriptor

Annex I to the MSFD formulates eleven "qualitative descriptors" for determining good environmental status. When determining the characteristics of GES, descriptors relevant to the respective marine region should be used. In essence, all descriptors should be taken into account when implementing the MSFD in the North and Baltic Seas. The descriptors are defined in greater detail in the Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU of 1 September 2010), which lists a total of 29 criteria and 56 indicators.

Criterion

According to the definition in Article 3 of the MSFD, criteria are distinctive technical features that are closely linked to the qualitative descriptors.

For example, a criterion may be an aspect of biodiversity that is used to assess state and that is defined by one or more indicators. Thus within the context of Descriptor 1, the criterion "population size" may be assessed by monitoring and evaluating the indicators "abundance" and/or "biomass". Criteria may also represent a human activity or pressure, for example, the criterion "physical damage" of the sea-floor, represented by the indicator "extent of sea-floor significantly damaged by human activities". One criterion relating to pressures is the criterion "direct effects of nutrient accumulation" for Descriptor 5.

Indicator

Given the complexity of the features and characteristics of ecosystem components to be assessed under the MSFD and the numerous pressures to be taken into account when assessing state, the use of indicators in monitoring programmes and assessment tools has been found to be helpful. Indicators limit the number of parameters to be monitored by focusing on selected aspects, and facilitate a simplified view of complex ecosystems. Where necessary and feasible, indicators should directly describe and assess particular anthropogenic pressures in space or time, and in this way link them to the required associated measures for achieving or maintaining a good environmental status.

The assessment of state provided by one or more indicators should allow inferences to be drawn regarding the state of given ecosystem components in a given geographical area or over a specific period of time. State can be assessed by taking direct measurements of the particular ecosystem component (= state indicators), or indirectly, by measuring the prevailing anthropogenic pressures (= pressure indicators). When assessing the state of ecosystems, both simple indicators (such as the size of a bird population) and more complex indicators (such as the ratio of various phytoplankton taxa) can be applied. The indicators defined in the COM Decision on criteria and methodological standards, particularly those allocated to Descriptors 1 and 4, can not be used, or only with restrictions, unless specific and representative ecosystem components and specified dimensional units have been defined for each indicator. This operationalisation is the responsibility of the Member State or the shared responsibility of Member States within the context of regional seas conventions.

Within the framework of MSFD, indicators are to be applied for two different tasks:

- Firstly, to assess the differences between the actual state and desired state when performing the assessments and determinations required in accordance with Articles 8 and 9. The indicators outlined in the COM Decision should be used as a basis for this.
- Secondly, to reflect progress in achieving environmental targets in accordance with Article 10. Existing preselected indicators and, where applicable, new indicators may be used for this purpose.

As Article 10 states that environmental targets should take into account the indicative lists of anthropogenic pressures and impacts set out in Table 2 of Annex III, corresponding pressure indicators should be used for this second task in particular. Incidentally, a large portion of these will be identical to the pressure indicators listed in the COM Decision for Article 9. The development/use of additional indicators is only necessary for those pressures not covered by the COM Decision, such as by-catch of non-target species in fisheries and vectors/introduction pathways for non-native species.

Parameter

A parameter is a single, measurable characteristic e.g. of a species or habitat (such as the number of individuals, biomass in g/dry weight, substrate particle diameter in mm), the concentration of nutrients in the water, or its levels of chlorophyll or oxygen. A parameter may in itself constitute an indicator (such as nutrient or chlorophyll concentration).

Good environmental status (GES)

Good environmental status means the desired state of the marine environment and its components. Article 3 of the Directive provides an outline definition. The description of good environmental status is based on the eleven qualitative descriptors listed in Annex I of the Directive and the 29 criteria and 56 indicators prescribed by the COM Decision (2010/477/EU).

Environmental target

An environmental target is a specific qualitative or quantitative requirement for achieving progress towards the overall aim of the MSFD (i.e. GES). For this reason, environmental targets should refer in particular to the pressures that must be reduced in order to achieve a good environmental status (Annex III, Table 2). Furthermore, the characteristics listed in Annex IV should be taken into account when specifying environmental targets. Environmental targets should therefore be derived directly from the GES definitions (Annex IV, 2a), and should include both measurable (2 b) and operational (2 c) targets. Corresponding indicators should be defined for all environmental targets.

Ecosystem components

According to the COM Decision, ecosystem components are defined as aspects of biological diversity or specific biological entities and systems such as species, species groups, populations or biotope types. When assessing state under the MSFD, it is advisable to select representative species and habitat types from the groups of characteristics listed in MSFD Annex III, Table 1; assessments should be based on the criteria and indicators outlined in the COM Decision.

Pressure

The physical, chemical or biological mechanism through which a human activity adversely impacts the ecosystem or any of its components either directly or indirectly, such as physical disturbance to the sea-floor, contamination with hazardous substances, accumulation of nutrients, or biological disturbances (such as discharge of microbial pathogens, presence of non-native species, selective extraction of species).

3. "Assessment" in accordance with Article 8 of the MSFD

The assessment that Member States are required to submit to the EU COM in accordance with Article 8 is intended to describe and analyse the present state (*current state*) of the national marine environment, i.e. in the case of Germany, of the relevant areas of the North and Baltic Seas. The assessment comprises three parts (cf. Figure 2). Part one includes the description and analysis of the physical, chemical and biological characteristics. The non-definitive, indicative list of characteristics in Annex III, Table 1 of the MSFD should be applied here. Secondly, Member States should include a qualitative and quantitative description of the prevailing pressures caused by human activities and their impacts on the ecosystems of the relevant marine waters and their components, including any detectable trends, on the basis of Annex III, Table 2 of the MSFD. The main cumulative and synergetic effects should also be covered. Thirdly, the assessment should include a social and economic analysis of the current uses of marine waters and an analysis of the cost of further degradation of the marine environment.

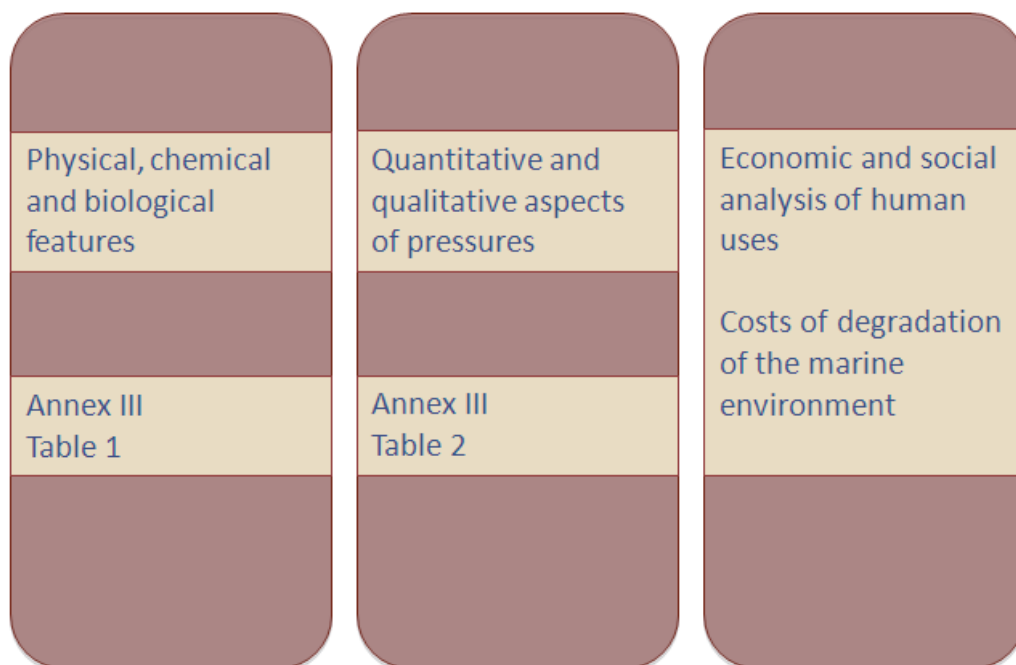| Physical, chemical and biological features	Quantitative and qualitative aspects of pressures	Economic and social analysis of human uses
		Costs of degradation of the marine environment
Annex III Table 1	Annex III Table 2	

Fig. 2: Diagrammatic representation of the three components of assessments under the MSFD. The initial assessment must be submitted to the EU COM by 15 July 2012.

3.1   Initial assessment by 2012

The three sections of the initial assessment report that Member States must submit to the EU COM by July 2012 cannot fully cover all characteristics and features relevant to the national marine waters and the associated anthropogenic pressures (Annex III, Tables 1 and 2) for all descriptors. This is mainly because the data situation is currently incomplete (the current monitoring programmes for Germany's marine regions do not yet cover all parameters), and the assessment methodologies are similarly incomplete or non-existent.

For the majority of descriptors, therefore, the initial national assessment (2012) will take the form of a synoptic view of the individual parameters already covered by and assessed within the context of other reporting obligations, often for restricted geographical regions. Data from the North and Baltic Seas collated and assessed within the context of the reporting obligations for

- The Water Framework Directive (WFD)
- The Habitats Directive (HD)
- The Birds Directive (BD)
- The ICES assessments of commercial fish stocks
- Trilateral Wadden Sea Cooperation
- OSPAR and HELCOM

provides a good initial overview for this purpose. Other important contributions to the initial assessment may be found in the latest reports for EC Directives focusing primarily on pollution of our coastal seas with substances, such as the Nitrates Directive (91/676/EEC), Priority Substances Directive (2008/105/EC), Shellfish Directive (2006/113/EC) and Bathing Water Directive (2006/7/EC). The results of individual research projects and analyses of the marine environment prepared within the context of regional planning procedures for coastal seas and the EEZ are also relevant.

With regard to assessments by OSPAR, HELCOM and the Trilateral Wadden Sea Cooperation, it should be noted that these tend to focus on larger marine regions (such as the entire North Sea) rather than specifically targeting Germany's marine regions.

Overall, despite the preparations already carried out, we still lack knowledge of the specific characteristics and pressures of offshore marine areas in particular, and even for coastal regions, there are still gaps in our knowledge.

The assessment of current state pursuant to Article 8 must be repeated at regular intervals, and must increasingly incorporate the specific requirements of the MSFD (cf. chapter 6).

3.2   Overall assessment of the present state

According to the definitions of environmental status and good environmental status in Articles 3 (4) and (5) of the MSFD, Member States must also prepare an integral, overall ecological assessment, encompassing all relevant criteria and indicators within each of the individual descriptors, and where applicable, also between all descriptors. Based on the analysis of current state and the definition of good environmental status derived from individual indicators, Member States are required to assess the individual descriptors across all marine regions. In this regard, it should be noted that an overall assessment alone is not a sufficient basis for the required report to the EU COM on environmental targets and measures to be developed, since it is too unspecific. In addition to an aggregated overall assessment, therefore, it is always necessary to report on the individual assessments of criteria and their indicators as well. Particularly for assessments of Descriptor 1 (and, where applicable, Descriptor 4 as well), more complex modes of aggregation are likely to be necessary, given the large number of ecosystem components to be assessed within the indicators.

Figure 3 illustrates the three possible aggregation levels as an example. For each indicator, threshold values for various states must be defined using an individual, specific assessment scale.

Within the framework of the MSFD, Germany generally aspires to a 5-stage assessment system comprised of the states very good, good, moderate, poor and very poor. On this scale, a good environmental status is defined by the categories good and very good.

As well as allowing a more precise assessment of state, another advantage of multi-stage assessment systems is that change trends (cf. Article 8 (1)) are easier to identify and mediate. Where assessments are adopted from other Directives, their assessment system is retained (for example, the 3-stage system under the Habitats Directive, 2-stage system for chemical state under the WFD, and 5-stage system for ecological state under the WFD).

The integral overall assessment of environmental status (Figure 3, aggregation 2) may be achieved using a variety of methods. In order to meet the objectives of the MSFD, particularly for the state descriptors (D1, D3, D4 and D6), the one-out-all-out principle should be considered (in other words, if any of the four descriptors falls short of GES, then GES cannot be met). A moderate, poor or very poor assessment for one of these overarching and essential descriptors means that the overall state of that particular marine region can never be "good". Procedures still need to be developed and agreed for the integrated assessment of the state and pressure descriptors. This principle should not be applied below descriptor level (aggregation level 1), in view of the large number of individual assessments of individual ecosystem components.
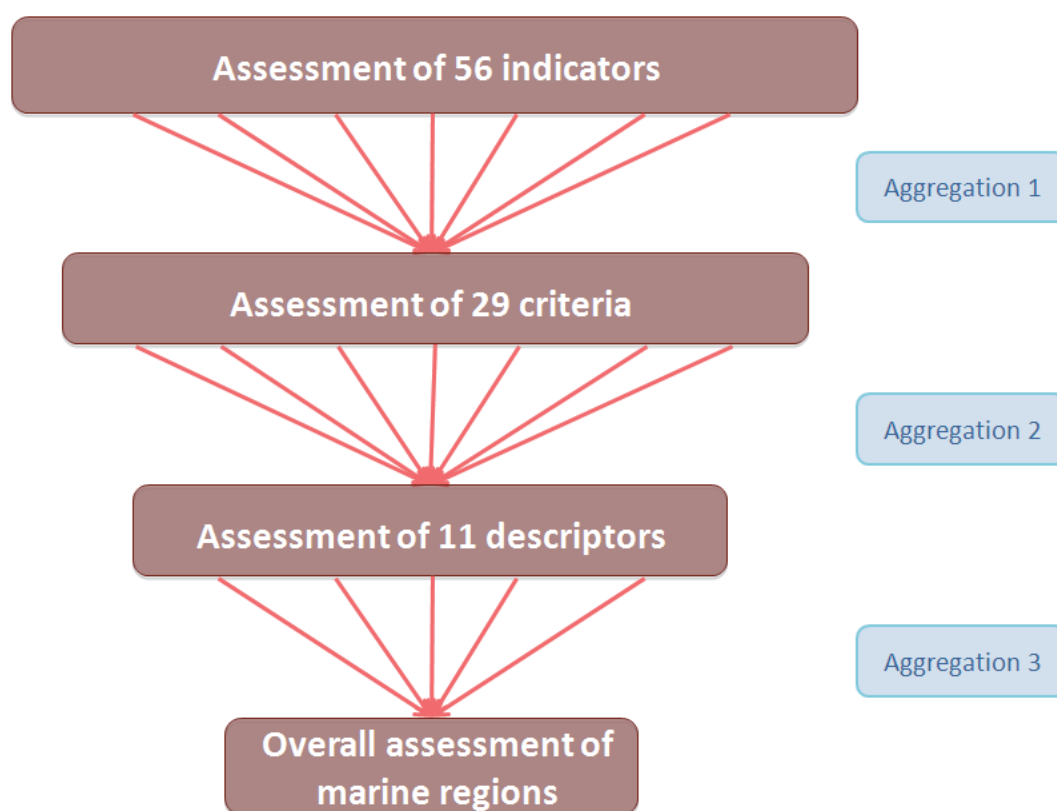

Fig. 3: Reporting obligations under the MSFD require the performance of an integrated overall ecological assessment for each marine region, comprising individual and collective descriptors. This produces three possible aggregation stages.

3.3   Coordination within the marine regions

At present, there are no binding regulations governing the coordination of procedures and results between Member States that share a marine region or subregion, such as the North or Baltic Seas. The Member States have rejected an implementation process (CIS) and intercalibration process similar to that used for the WFD within the context of the legislative procedure. At the same time, coordination and harmonisation, particularly of the assessment results, is vital. For selected criteria (such as populations of mobile species e.g. marine mammals or fish that are dispersed over a wide area), regional assessment may also be appropriate. The EU COM's Working Group on Good Environmental Status (WG GES) and the equivalent working groups of the regional seas conventions may be suitable for this purpose. There is already an Intersessional Correspondence Group for the OSPAR region (ICG-MSFD) which has offered to become an informal coordinator for the MSFD in the North-East Atlantic (its preliminary work is forwarded to the Coordination Group), as well as the ICG-COBAM (Coordination of Biodiversity Monitoring and Assessment) for the regional implementation of biodiversity aspects. A corresponding international agreement process has been initiated for the Baltic Sea, within the framework of the HELCOM CORESET and TARGREV projects (as at January 2011).

4.   Determination of good environmental status (GES) in accordance with Article 9 of the MSFD

In order to characterise good environmental status (GES), the Member States define a set of characteristics for the good environmental status of their marine waters (Article 9 (1)). Such a definition implies the determination of the desired states. The relevant characteristics should be based around the initial assessment and the 11 descriptors as qualitative descriptions of the GES, which in their entirety are indicative of environmental status. These include marine biodiversity, food webs and the sea-floor, as well as key anthropogenic pressures on the marine region, such as eutrophication, pollutants, fisheries, invasive species, litter, and the introduction of energy (including noise).

The EU COM Decision of 1 September 2010 (2010/477/EU) on "criteria and methodological standards on good environmental status of marine waters" lists a total of 29 criteria and 56 indicators designed to facilitate a more precise analysis of the 11 state and pressure descriptors (cf. Annex 1); this list is not exhaustive. The Member States are required to determine the relevant GES for these individual criteria/indicators, coordinated within the relevant marine regions; in other words, they should define corresponding thresholds or trends at which GES is achieved (Fig. 4). As the EU COM itself states in its Decision, in most cases the indicators are not defined in sufficient detail as to allow the corresponding scientific data collection techniques and assessment procedures to be automatically derived. As such, the Member States will still need to operationalise these indicators specifically for their marine regions. This also includes a fundamental analysis of the practicability and usability of the individual indicators ("viability analysis"). For the state descriptors D1, D4 and D6 in particular, it is also necessary to allocate representative ecosystem components to the respective indicators. The indicators already formulated within the context of obligations under existing EU nature and environmental protection directives and in the regional seas conventions (such as the OSPAR EcoQOs) should be used as a basis for operationalisation.

The operationalisation of indicators for GES (Article 9) also includes the quantitative definition of thresholds or trends at which a good environmental status is achieved. In essence, there are four methods already in use for defining good environmental status:

- Reference to comparable, currently unimpacted or minimally impacted marine regions (reference areas)
- Reference to areas which were unimpacted or minimally impacted in the past (historical reference values)

- Reference to the reduction of pressures in a model (modelled reference values, such as state pressure modelling, hindcasting)
- Reference to a defined baseline (agreed reference variable based on a current or past state).

If there are no reference values or modelled values available, expert judgements must be transparently considered when defining such values.

The current data situation and the limited number of existing assessment techniques or previously operationalised criteria and indicators in the COM Decision (see above) mean that the Member States are unlikely to be able to define GES for all criteria and indicators of the descriptors in time for 2012. In line with the MSFD, therefore, the first GES report pursuant to Article 9 should make reference to pre-existing definitions of state targets. For example, recourse can be made to the values and trends for a favourable conservation status as defined according to the Habitats Directive, a good ecological status as defined according to the Water Framework Directive, and other
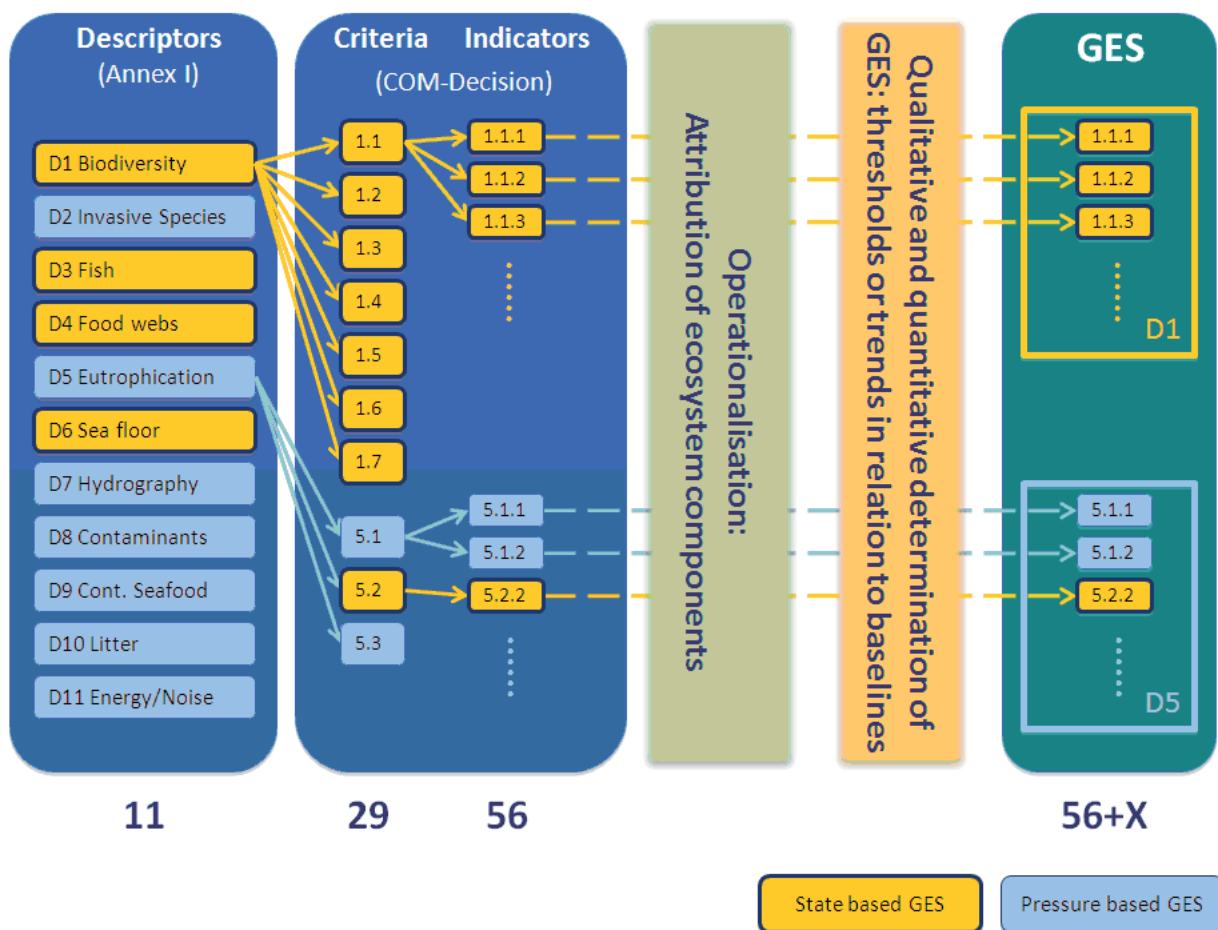

Fig. 4: Diagram showing the components required to define a good environmental status (GES) of marine waters according to Article 9 of the MSFD. Definition of GES is based on the 29 criteria and 56 indicators specified by the EU COM (2010/477/EU) for the 11 descriptors for state-based (yellow) and pressure-based (pale blue) GES components. For state descriptors in particular, several ecosystem component assessments for each indicator will generally need to be adapted from existing procedures or developed from scratch. On the other hand, not every indicator can be applied to every ecosystem component, leading to a reduction in the overall number of indicators. For this reason, the number of specified GES components and corresponding operationalised GES indicators is expected to be greater (56+X) initially than the number of indicators defined by the EU COM. The ultimate number of GES indicators cannot be finalised until a "viability analysis" has been carried out. The GES components in the right-hand box form the basis for the establishment of environmental targets (Figure 5).

existing procedures and their results; and such definitions should be adopted wherever necessary and possible. To this end, the existing data surveys and assessment techniques should initially be assigned to the criteria and indicators proposed by the EU COM (2010/477/EU). The background paper on methodological standards by the Joint Research Centre[1] offers an initial step in the right direction. This could help to identify current deficits among existing procedures and pinpoint those areas where new data needs to be collected or assessment procedures developed.

The definition of the desired state pursuant to Article 9 must be reviewed at regular intervals, and adapted to the specific requirements of the MSFD (cf. chapter 6).
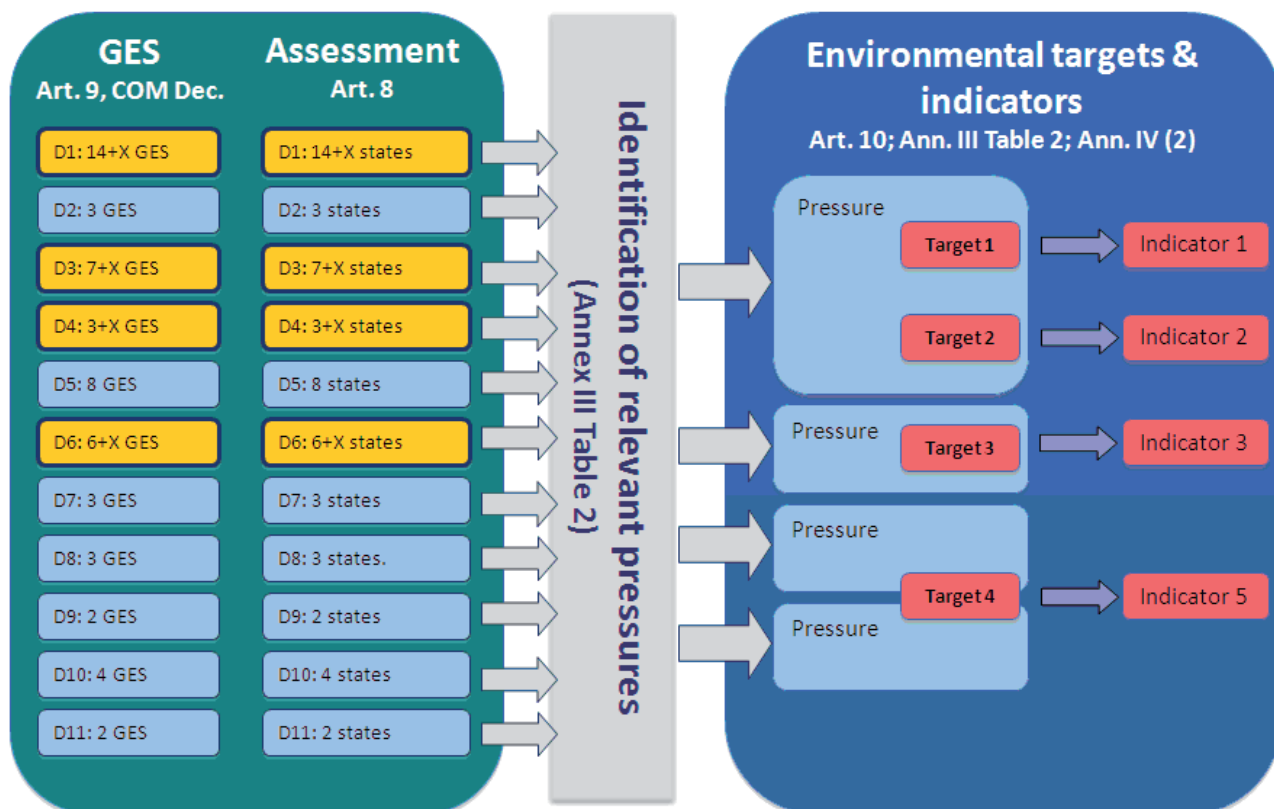

Fig. 5: Diagram showing the establishment of environmental targets in accordance with Article 10 of the MSFD. Environmental targets are the targets to be achieved with the programme of measures developed under the MSFD. These should be defined for the individual components of good environmental status (GES) that have already been established (Article 9) (cf. Figure 4 on the right), with due regard for the actual states ascertained in the initial assessment and the anthropogenic pressures identified in accordance with Annex III, Table 2 as well as considering the requirements of Annex IV. Environmental targets formulated for individual descriptors (in accordance with Annex I) can often be also relevant for other descriptors. The number of environmental targets is therefore likely to be significantly lower than the number of criteria and indicators to describe GES in accordance with Article 9. The achievement of environmental targets is reviewed using indicators. These too will be very limited in number, and will re-address many of the GES pressure indicators (see text).

[1]   Piha, H. & Zampoukas, N. (2011): Review of Methodological Standards Related to the Marine Strategy Framework Directive Criteria on Good Environmental Status. Joint Research Centre of the EU Commission.

5. Establishment of environmental targets in accordance with Article 10 of the MSFD

Environmental targets are specific qualitative and quantitative requirements toward achieving a good environmental status. They are intended to offer guidance for attaining GES. Managing human activities is the only way to improve the environmental status in marine ecosystems. For this reason, the environmental targets focus in particular on changes of anthropogenic pressures (Annex III, Table 2) through measures in order to achieve a good environmental status. Annex IV describes the principal characteristics to be taken into account when setting environmental targets. *Inter alia*, this states that it should be possible to set environmental targets based on the definition of good environmental status (Annex IV, 2a), by setting measurable targets that allow for monitoring (2b), and operational targets that relate directly to the measures (2c).

According to Article 10, environmental targets are to be established on the basis of the indicative list of pressures and impacts (Annex III, Table 2) and taking into account the criteria in Annex IV. In practice, when establishing environmental targets, the GES components described in the Article 9 report (desired state) are compared with the current state as assessed in the Article 8 report (cf. Figure 5).

Article 10 of the MSFD provides for a review of environmental target achievement on the basis of indicators. The pressure indicators for GES are generally adopted directly for the environmental targets (refer to the definition in Chapter 2). Where the GES indicators of pressure descriptors are found to be inadequate, it may be necessary to develop additional new indicators for monitoring specific pressures and activities and/or for selected aspects of a pressure. The allocation of indicators to environmental targets is a fundamental component of the definition of environmental targets.

The first report on environmental targets will predominantly contain pre-existing environmental targets. Any new environmental targets developed are only likely to be outlined in broad terms, since most of the anthropogenic pressures on marine ecosystems for which measures have yet to be developed are already known. The environmental targets, like the assessment and the definition of GES, are to be reviewed at regular intervals.

6. Regular updating of reports

The assessment (Article 8), determination of good environmental status (Article 9) and establishment of environmental targets (Article 10) are to be updated at 6-yearly intervals, as outlined above, and the results reported to the EU COM (Article 17). The first reports due for submission by July 2012 can only draw on existing data and assessments, and therefore will not yet meet all the specific requirements of the MSFD. Updated reports on Articles 8 to 10 are to be submitted to the EU COM by 15 July 2018. Any gaps and shortfalls from the first reporting cycle are to be remedied in these future reports.

To this end, in the medium- to long-term, the monitoring programmes required under Article 11 should be designed and implemented in such a way that the necessary data is available for the criteria and indicators of state and pressure descriptors (cf. Figure 4) listed in the COM Decision. This data provides the basis for assessment and for gauging the difference between the current and desired environmental status of the oceans, to serve as a yardstick for the achievement and maintenance of a good environmental status. To this end, however, the indicators prescribed in the COM Decision (2010/477/EU) will need to be operationalised (cf. chapter 4). Operationalisation is also necessary when reviewing good environmental status. The environmental targets should likewise be specified in greater depth during the years ahead, and any interim targets (Annex IV (6)) for the programmes of measures (2015) should be defined in more detail.

It is impossible at present to predict how long it will take to cover all the aspects required by the MSFD, especially as the MSFD requires close collaboration with the neighbouring states of a given marine region.

Appendix 1: Overview on the criteria and indicators of the COM Decision (2010/477/EU)

Descriptor 1	1.1.	**Species distribution** – Distributional range (1.1.1) – Distributional pattern within the latter, where appropriate (1.1.2) – Area covered by the species (for sessile/benthic species) (1.1.3)
	1.2.	**Population size** – Population abundance and/or biomass, as appropriate (1.2.1)
	1.3.	**Population condition** – Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/ mortality rates) (1.3.1) – Population genetic structure, where appropriate (1.3.2).
	1.4.	**Habitat distribution** – Distributional range (1.4.1) – Distributional pattern (1.4.2)
	1.5.	**Habitat extent** – Habitat area (1.5.1) – Habitat volume, where relevant (1.5.2)
	1.6.	**Habitat condition** – Condition of the typical species and communities (1.6.1) – Relative abundance and/or biomass, as appropriate (1.6.2) – Physical, hydrological and chemical conditions (1.6.3).
	1.7.	**Ecosystem structure** – Composition and relative proportions of ecosystem components (habitats and species) (1.7.1)
Descriptor 2	2.1.	**Abundance and state characterisation of non-indigenous species, in particular invasive species** – Trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species, particularly invasive non-indigenous species, notably in risk areas, in relation to the main vectors and pathways of spreading of such species (2.1.1)
	2.2.	**Environmental impact of invasive non-indigenous species** – Ratio between invasive non-indigenous species and native species in some well studied taxonomic groups (e.g. fish, macroalgae, molluscs) that may provide a measure of change in species composition (e.g. further to the displacement of native species) (2.2.1) Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible (2.2.2).
Descriptor 3	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:* – Fishing mortality (F) (3.1.1) *Secondary indicators (if analytical assessments yielding values for F are not available):* – Ratio between catch and biomass index (hereinafter 'catch/biomass ratio') (3.1.2).
	3.2.	**Reproductive capacity of the stock** *Primary indicator. The primary indicator for the reproductive capacity of the stock is the following:* – Spawning Stock Biomass (SSB) (3.2.1) *Secondary indicators (if analytical assessments yielding values for SSB are not available):* - Biomass indices (3.2.2).
	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:* – Proportion of fish larger than the mean size of first sexual maturation (3.3.1) – Mean maximum length across all species found in research vessel surveys (3.3.2) – 95 % percentile of the fish length distribution observed in research vessel surveys (3.3.3). *Secondary indicator:* – Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation (3.3.4).

Descriptor 4	4.1.	**Productivity (production per unit biomass) of key species or trophic groups** – Performance of key predator species using their production per unit biomass (productivity) (4.1.1)
	4.2.	**Proportion of selected species at the top of food webs** – Large fish (by weight) (4.2.1)
	4.3.	**Abundance/distribution of key trophic groups/species** – Abundance trends of functionally important selected groups/species (4.3.1)
Descriptor 5	5.1.	**Nutrients levels** – Nutrients concentration in the water column (5.1.1) – Nutrient ratios (silica, nitrogen and phosphorus), where appropriate (5.1.2)
	5.2.	**Direct effects of nutrient enrichment** – Chlorophyll concentration in the water column (5.2.1) – Water transparency related to increase in suspended algae, where relevant (5.2.2) – Abundance of opportunistic macroalgae (5.2.3) – 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 (5.2.4)
	5.3.	**Indirect effects of nutrient enrichment** – Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency (5.3.1) – Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned (5.3.2)
Descriptor 6	6.1.	**Physical damage, having regard to substrate characteristics** – Type, abundance, biomass and areal extent of relevant biogenic substrate (6.1.1) – Extent of the seabed significantly affected by human activities for the different substrate types (6.1.2).
	6.2.	**Condition of benthic community** – Presence of particularly sensitive and/or tolerant species (6.2.1) – Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species (6.2.2) – Proportion of biomass or number of individuals in the macrobenthos above some specified length/size (6.2.3) – Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community (6.2.4)
Descriptor 7	7.1.	**Spatial characterisation of permanent alterations** Extent of area affected by permanent alterations (7.1.1)
	7.2.	**Impact of permanent hydrographical changes** Spatial extent of habitats affected by the permanent alteration (7.2.1) Changes in habitats, in particular the functions provided (e.g. spawning, breeding and feeding areas and migration routes of fish, birds and mammals), due to altered hydrographical conditions (7.2.2)
Descriptor 8	8.1.	**Concentration of contaminants** Concentration of the contaminants mentioned above, measured in the relevant matrix (such as biota, sediment and water) in a way that ensures comparability with the assessments under Directive 2000/60/EC (8.1.1)
	8.2.	**Effects of contaminants** 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 (8.2.1) Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil and oil products) and their impact on biota physically affected by this pollution (8.2.2)
Descr. 9	9.1.	**Levels, number and frequency of contaminants** Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels (9.1.1) Frequency of regulatory levels being exceeded (9.1.2)

Descriptor 10	10.1. Characteristics of litter in the marine and coastal environment – Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1) – Trends in the amount of litter in the water column (including floating at the surface) and deposited on the sea- floor, including analysis of its composition, spatial distribution and, where possible, source (10.1.2) – Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro- plastics) (10.1.3) 10.2 Impacts of litter on marine life – Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis) (10.2.1)
Descriptor 11	11.1. Distribution in time and place of loud, low and mid frequency impulsive sounds – 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 (11.1.1) 11.2. Continuous low frequency sound – Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1μPa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate (11.2.1)

Appendix 2: Selected examples of report contents and the programme of measures required by the MSFD

Below, we illustrate the content of the three MSFD reports using the examples of harbour porpoises in the Baltic Sea, spiny dogfish in the North Sea, and eutrophication in the North and Baltic Seas. The aim here is not to establish targets, but to highlight examples which illustrate how existing assessments may be used. The charts (Figures 6 and 7) explain how existing assessments can be built upon, and illustrate the interconnections between the tasks in accordance with Articles 8-10.

Example 1: Harbour porpoises (Baltic Sea) as an ecosystem component to be assessed under Descriptor 1 (biodiversity)

The COM Decision on criteria and methodological standards distinguishes for Descriptor 1 between three different levels: species, habitat/biotope, and ecosystem. Many species and habitats/biotopes are already assessed under other Directives and agreements, particularly the Habitats Directive. This information should be used for assessments under the MSFD (see COM Decision, Part B).

Initial assessment 2012 (Article 8 report)

Description of regional distribution and seasonal variations; population densities and trends (monitoring under the Habitats Directive); description of known specific regional pressures, for example using bycatch rates, strandings and pathology analyses (e.g. impacts from noise and hazardous substances).

GES (Article 9 report)

Determination of a favourable conservation status (Habitats Directive); determination of population trends (GES indicator).

Environmental targets (Article 10 report)

Maximum bycatch rates (percentage of the population); maximum concentrations of hazardous substances; maximum noise levels; guaranteed food resources.

Measures (Article 13)

Under consideration of the regional and seasonal variations in habitats and population numbers of harbour porpoises, creation of protected areas in which bycatch-intensive fishing gear is prohibited; specification of upper limits for noise and hazardous substances; regulation of total allowable catch (TAC) limits and catch quotas for feed fish.

Indicators (COM Dec)	GES-Definition		Assess	Environmental targets	Measures
Distributional range (1.1.1)	✓	HD: favourable Range	GES	(Secure that range is maintained)	
Distributional pattern, where appropriate (1.1.2)	✗	(may be omitted)			
Area covered by the species (for sessile/benthic species) (1.1.3)	✗	(may be omitted)			
Population abundance and/or biomass, as appropriate (1.2.1)	✓	HD: positive population trend	Below GES	Reduce bycatch Reduce noise and contaminants in water column Secure food ressource	• Exclude bycatch intensive gears from critical areas (esp in Baltic proper), e.g. in MPAs • Set upper limits for underwater noise • Regulation of fisheries effort on feed fish (e.g. sand eel) • ….
Population demographic characteristics (1.3.1)	✗	(may be omitted)			
Population genetic structure, where appropriate (1.3.2)	✓	Increased subpopulation of Baltic proper	Below GES		

Fig. 6: Implementation of Articles 8, 9, 10 and 13 as illustrated by the example of harbour porpoises in the Baltic Sea: Indicators in accordance with the COM Decision; use of existing definitions for GES (including some adopted from the Habitats Directive: "Favourable conservation status"); existing assessments (conservation status as per the Habitats Directive, research projects); consequent setting of environmental targets to reduce pressures; measures based on this. The report should quantify environmental targets and measures wherever possible.

19

Example 2: Spiny dogfish (North Sea) as an ecosystem component to be assessed under Descriptor 1 (biodiversity)

Initial assessment 2012 (Article 8 report)

Description of regional distribution and seasonal variations; population densities and trends; description of known specific regional pressures, for example from bycatch statistics; gender ratio imbalances due to catch selection on larger females; impacts from noise and hazardous substances.

GES (Article 9 report)

Determination of population trends (GES indicator); bycatch limits (GES indicator); balanced sex ratios.

Environmental targets (Article 10 report)

Size of seasonally limited minimal disturbance regions to be set up (if necessary); bycatch limits (percentage of the population); maximum concentrations of hazardous substances (organic mercury compounds); maximum noise levels.

Measures (Article 13)

Under consideration of the regional and seasonal variations in habitats and population numbers of spiny dogfish, creation of protected areas (if necessary); immediate mandatory return to the sea of any bycaught individuals; maximum catch sizes to protect females; specification of upper limits for noise and hazardous substances.

Initial assessment 2012 (Article 8 report)

Description of the eutrophication status for the German Baltic and North Sea regions (including the Wadden Sea) based on the results of corresponding studies by HELCOM, OSPAR and TWSC, and incorporation of the relevant results from the assessment of coastal waters in accordance with the WFD.

GES (Article 9 report)

Description of good environmental status with regard to eutrophication, based on the quantitative, regional-specific values that were derived for the assessment of eutrophication under the afore-mentioned legal regimes (such as nutrient loads of rivers, discharges of atmospheric nitrogen and deposition, nutrient concentrations and ratios in the ocean, chlorophyll levels, visibility depths, abundance of phytoplankton indicator species, abundance of opportunistic macroalgae, species shifts in the flora composition (such as ratio of diatoms to flagellates, impairment to the abundance of perennial algae (such as brown algae) and seagrass, oxygen levels).

Environmental targets (Article 10 report)

North Sea and Baltic Sea without anthropogenic eutrophication in accordance with the OSPAR strategy, HELCOM BSAP, MSFD, TWSC (ecological quality objectives for the Wadden Sea) and WFD (for coastal waters).

Reduction targets for nutrient discharges via the relevant discharge pathways (water (rivers and direct discharges), atmosphere and currents from surrounding or more remote marine regions (transboundary transport)) from the perspective of the relevant "eutrophication problem areas".

Measures (Article 13)

In order to achieve the reduction targets formulated under Article 10 for German North and Baltic Sea regions without anthropogenic eutrophication, appropriate measures must be derived and implemented in a variety of legal regimes.

It can be assumed that the management plans under the WFD will cover a considerable portion of the required measures. Two further relevant legal regimes that may contribute to the achievement of MSFD targets are the EC Nitrate Directive (91/676/EEC) and the EC Urban Waste-Water Treatment Directive (91/271/EEC). The same is also true for the industry/plant-specific IPPC Directive (2008/1/EC: Integrated Pollution Prevention and Control). Since agriculture is responsible for the bulk of nutrient discharges, the environmental pillar within the framework of the EU's Common Agricultural Policy could also be significantly strengthened.

With regard to atmospheric discharges, forthcoming revisions of the EC NEC Directive and UN ECE CLRTAP will need to incorporate the requirements for a good environmental status from a marine ecology viewpoint. HELCOM has already taken the first steps in this respect. The IMO will need to be approached vis-à-vis nitrogen discharges from marine shipping. The creation of special areas for nitrogen (NECA: NO_x Emission Controlled Areas) in the North and Baltic Seas, imposing more stringent requirements on N emissions from ships, is an important step in this connection. HELCOM is working on an appropriate submission to the IMO. A corresponding study with the same objective has been initiated for the North Sea.

Indicators	GES-Definition	Assessment	Env. Targets	Measures
Nutrient levels				
• Nutrients concentration in the water column (5.1.1) • Nutrient ratios (silica, nitrogen and phosphorus), where appropriate (5.1.2)	Values according to WFD, OSPAR, HELCOM, TMAP	GES Below GES	Maintenance	Secure maintenance
Direct effects of nutrient enrichment				
• Chlorophyll concentration in the water column (5.2.1) • Water transparency related to increase in suspended algae, where relevant (5.2.2) • Abundance of opportunistic macroalgae (5.2.3) • 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 (5.2.4)	Definitions according to WFD, OSPAR, HELCOM, TMAP	GES Below GES	Definition of nutrient reduction targets for every problem area	Implementation of respective measures in the respective drainage area
Indirect effects of nutrient enrichment				
• Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency (5.3.1) • Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned (5.3.2)	Definitions according to WFD, OSPAR, HELCOM, TMAP	GES Below GES		

Fig. 7: Implementation of Articles 8, 9, 10 and 13 as illustrated by the example of eutrophication: For explanatory comments, refer to text