OSPAR COMMISSION

MSFD Advice Manual and Background Document on Biodiversity

A living document - Version 3.2 of 5 March 2012

Approaches to determining good environmental status, setting of environmental targets and selecting indicators for Marine Strategy Framework Directive descriptors 1, 2, 4 and 6

Biodiversity Series

2012

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l'Allemagne, la Belgique, le Danemark, l’Espagne, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède, la Suisse et l’Union européenne.

Version of 5 March 2012

Prepared by the OSPAR Intersessional Correspondence Group on the Coordination of Biodiversity Assessment and Monitoring (ICG COBAM) under the responsibility of the OSPAR Biodiversity Committee (BDC)

Disclaimer

This Advice Manual is a living document and reflects the state of discussion at expert level at the time of its drafting. The manual is of a non-binding nature and aims at facilitating coordination between the EU Member States that are parties to the OSPAR Convention, with regard to determining GES and establishing targets and associated indicators for MSFD Descriptors 1, 2, 4 and 6. It does not prejudice the ongoing decision-making processes in Contracting Parties and their final conclusions on reporting under Articles 8, 9 and 10 of the MSFD in 2012. The manual will be further developed by ICG-COBAM to support ongoing implementation of the Directive.

Contents

Executive summary

Purpose and scope of the Advice Manual

This Advice Manual covers the biodiversity-related MSFD[1] Descriptors 1 (biodiversity), 2 (non-indigenous species), 4 (food webs) and 6 (sea-floor integrity). It aims at providing a common ground for coordinated and consistent determination of Good Environmental Status (GES) and related identification and establishment of indicators and targets within the OSPAR area.

This Manual provides general guidance for development of the products that are needed for the 2012 deadlines of the MSFD. It contains leading principles and methods for defining indicators, targets and baselines. As a part of the coordination process by OSPAR, an analysis of coherence in nationally identified indicators and targets and proposals for potential common indicators have been added to the previous version (31 May 2011).

Compared to the OSPAR Advice Manuals on Descriptors 5 (eutrophication) and 8 (contamination), targets and indicators for biodiversity are generally less well-developed and the set of existing common indicators is limited and insufficient to cover the requirements of the Directive. Therefore, the need for further development of biodiversity indicators beyond 2012 can be expected, together with further work within OSPAR on a coordinated assessment and monitoring framework for biodiversity.

The Manual does not directly address Descriptor 3 (commercial fish and shell-fish), but recommends there be some consistency in approach and potential integration with the biodiversity elements dealt with here.

The Manual contains two parts. Part I 'Principles' explores the concepts behind the text of the Directive, particularly as many of these concepts are new and require innovation in biodiversity assessment and monitoring. Part II 'Application of principles to biodiversity' explains how these principles can be applied to species and habitats as biodiversity components which can be important for monitoring and assessment of these MSFD Descriptors.

Part I Principles

Talking a common language

Discussions in OSPAR and EU working groups revealed different interpretations of the terminology of the Directive and related guidance documents, which was hampering progress. OSPAR's Intersessional Correspondence Group on the Coordination of Biodiversity Assessment and Monitoring (ICG-COBAM) therefore developed a proposal of definitions and interpretations, focusing on MSFD Articles 8, 9 and 10, to help Contracting Parties talk in a common language, presented as Annex 8.2. The proposal also includes criteria for selecting effective state indicators. This proposal has subsequently been used to develop common understanding at EU level [to be harmonised with the terminology in the EU Common Understanding paper][2].

Relationships to other Descriptors

Descriptors 1, 4 and 6 are often considered as 'state' Descriptors, which are influenced, often in a cumulative manner, by many of the other Descriptors that focus on pressures and impacts. To ensure consistency between assessments of these Descriptors there needs to be cooperation between those working on pressures and impacts and those working on assessing the state of marine ecosystems and its biodiversity. In addition, information on the intensity, distribution and extent of the impact on biodiversity obtained from assessments of

[1] Marine Strategy Framework Directive (Directive 2008/56/EC).

[2] Common Understanding of (Initial) Assessment, Determination of Good Environmental Status (GES) and Establishment of Environmental Targets (Art. 8, 9 & 10 MSFD) - endorsed by the Marine Directors December 2011 as a living document.

other Descriptors is needed in a form that can be directly linked to the biodiversity components and their scale of assessment (e.g. pressure maps).

GES in a dynamic ecosystem and changing climate

Dynamic ecosystems and changing climates will lead to continuous changes in species composition and their relative abundance within communities and ecosystems in any given part of a region. These changes are beyond the control of normal management measures and so setting GES in a manner which is too specific in terms of the species composition and population sizes to be achieved will not allow for such natural or climate-induced changes. It is therefore preferable to consider good status at the slightly broader level of functional groups of species and functional habitats, within which a suitable degree of fluctuation in species composition and relative abundance can be anticipated.

Making use of existing biodiversity targets and indicators

The Directive requires Member States to take into account existing assessment frameworks established in other EU Directives and Conventions. Examples include indicators and targets under the Water Framework Directive WFD) and the Birds and Habitats Directives, the OSPAR Comprehensive Procedure (COMPP)[3], the OSPAR List of Threatened and/or Declining Species and Habitats, OSPAR Ecological Quality Objectives (EcoQOs), and objectives under the UNEP Convention on Migratory Species as well as the Agreement on the conservation of small cetaceans of the Baltic, North-East Atlantic, Irish and North Seas (ASCOBANS), the Agreement on the conservation of cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS) and the Trilateral Wadden Sea Cooperation (TWSC). Targets and indicators used in the above frameworks have been tested in practice and provide a common ground for coordinated implementation of the MSFD. The Advice Manual identifies for which criteria under Descriptors 1, 4 and 6 these existing indicators are applicable. Their application in the context of overall biodiversity needs for the MSFD may, however, require further consideration to ensure compatibility with the particular requirements and aims of the Directive; for example consistency in how a species or habitat is judged as being in good status.

Approaches for setting new state-based targets and indicators

The methodological guidance for development of comparable baselines and targets for 'state' indicators describes three approaches for both baseline and target-setting (Box 1). The applicability of these methods depends on availability of past and present data and the history of human intervention with specific species and habitats. In many cases expert judgement is needed to compensate for incomplete data. As improvements in state are most likely to be achieved through reductions in human-induced impacts, the setting of targets with a focus on specific impacts (linked to pressures), as well as more generally on biodiversity state, is recommended. These approaches are used in Part II of the Manual. Target and baseline methods recommended for species differ from those recommended for habitats because at species level there is a requirement for more precise knowledge (on range and population size) than for communities (within habitat types) and such data are generally not available or only for recent decades.

[3] Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area (OSPAR Agreement 2005-3).

Box 1.

Approaches to setting **baselines** are:

Method A (reference state/negligible impacts) - Baselines can be set as a state in which the anthropogenic influences on species and habitats are considered to be negligible;

Method B (past state) - Baselines can be set as a state in the past, based on a time-series dataset for a specific species or habitat, selecting the period in the dataset which is considered to reflect least impacted conditions;

Method C (current state) - The date of introduction of an environmental directive or policy can be used as the baseline state. As this may represent an already deteriorated state of biodiversity, the associated target should typically include an expression of no further deterioration from this state.

Approaches to **target-setting** are:

Method 1. Directional or trend-based targets

i. direction and rate of change

ii. direction of change only

Method 2. Targets set as the baseline

Method 3. Target set as a deviation from a baseline

Coordinated selection of species and habitats

Biodiversity indicators can often be applied to different species. These may be chosen on the basis of their sensitivity to human pressures, or represent a functional group, or provide a habitat for other species. Coordinated selection of species will improve comparability of assessment and will facilitate cooperation in monitoring between countries sharing a (sub) region.

Approaches for setting targets for pressures

The Manual includes initial guidance on target-setting for pressures. These targets should, whenever possible, be linked to impacts on biodiversity components, taking account of the geographic scale of both pressures and ecosystem components. Moreover, the targets should form a clear basis for drawing up management measures. These measures could focus on reducing the spatial and temporal footprint and/or the intensity of the pressure. The aim of the Directive to achieve GES within a framework of sustainable use of the marine environment and the often limited understanding of quantitative interactions between pressures and ecosystem state needs to be taken into account.

Assessment scales

The choice of assessment scale is very important, because different scales may lead to markedly different outcomes for the assessment of quality status of a particular ecosystem component. The scale used should be meaningful from both a biodiversity perspective and a management perspective. It should therefore relate to the scales at which ecosystem components (populations, species, communities) occur and the scales at which management measures are effective. Use of 'nested scales' could enable assessment of local impacts, whilst enabling aggregation of assessment results to larger areas. As a start, and in accordance with the MSFD, the use of the Marine Region and its Sub-regions should form the basis for defining assessment areas for biodiversity components. Certain aspects of biodiversity should be assessed at finer scales than the sub-region; a proposal for assessment areas for habitats in the North Sea, based on hydrological and oceanographic

characteristics of the area, is provided. Assessment areas for more mobile species may be based on species or population distribution, but further consideration is needed on the practical implementation of this approach (e.g. the practicalities of using multiple scales, links to other aspects being assessed).

A priority risk-based approach is advised, first of all focusing monitoring efforts on areas where pressures caused by human activities are highest and/or ecosystem components are most vulnerable. This necessitates a cross-check of vulnerable states and spatial extent, frequency and intensity of pressures, at relevant and compatible scales. This is likely to be particularly useful for Descriptors 2 and 6 (and for seabed habitats under Descriptor 1).

Part II Application of principles to biodiversity

This part of the advice is organised around six broadly-defined biodiversity components that are of relevance for one or more of the biodiversity Descriptors, and subsequently grouped into sections on species and habitats. It looks at the application of the principles for setting targets and indicators, using the Commission Decision 2010/447/EU of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (Commission Decision on criteria and indicators). The advice can then be used to assess the individual biodiversity Descriptors (1, 2, 4 and 6).

Habitats

Although seabed habitats are very varied across the North-East Atlantic, the identification of appropriate methods for baseline and target-setting is similar. In addition to seabed habitats, water column habitats have been considered.

Assessment scale: For benthic habitats it is advised to define assessment scales smaller than, and nested within, sub-regions. This will enable identification of ecological changes within the same abiotic habitat and better accommodate links to management measures. An example of assessment areas is given for the North Sea, using the most relevant hydrological and oceanographic characteristics. Pelagic habitats could be sub-divided in a first instance into coastal, shelf and oceanic zones, noting that boundaries could be dynamic.

Baselines: For benthic habitats Method A is considered the most appropriate, given availability of reliable historical data or relatively unimpacted areas. For pelagic habitats monitoring time series in some areas will provide sufficient data to apply Method B , otherwise Method C is advised[4]. Both for benthic and pelagic habitats, complementary use of expert judgements is recommended. It is generally not considered possible to determine a state with negligible impact for pelagic habitats.

State targets: The preferred method for seabed habitats is method 3. The target level can be based on science (examples given in the text) or on policy aspirations. For pelagic habitats method 3 is also preferred, taking into account natural variation as a dynamic range around a desirable state or the current state.

Existing indicators: Taking into account the different objectives of the Habitats Directive (HD), OSPAR, TWSC and WFD existing indicators and state targets partly address the indicators identified in the MSFD Commission Decision. However, the habitat types considered may not be the most appropriate for the MSFD. Existing indicators for pelagic habitats only address their phytoplankton communities.

Potential common indicators: Indicators are available for benthic habitat distributional range and area, and for benthic habitat condition. Many of these apply to both Descriptor 1 and Descriptor 6. Because of different needs with regard to protection, indicators and targets for listed habitats (HD, OSPAR) are somewhat different from

[4] OSPAR (2011) Report of the OSPAR/MSFD workshop on approaches to determining GES for biodiversity, Utrecht November 2010. Biodiversity Series No.553

indicators for predominant habitats. Further development is needed to better define metrics/parameters. Actual monitoring may not be sufficient in a number of cases. Further consideration is needed for pelagic habitat indicators. Potential common indicators are summarized in Tables 1a and 1b below.

Species

Scale for wide-ranging and highly mobile species: Assessment areas may be at sub-regional scales, or larger scales for certain species (e.g. of cetacean), or finer than sub-region scales. In order to define a relevant assessment area for a specific species a "case by case" approach, based on specific natural population distribution is recommended. However, the defined area should be, as far as is possible, compatible (or nested) between species and habitats. Scales used in existing assessments of mobile species can provide useful guidance, for example the EcoQOs for harbour porpoise bycatch, and for commercial fish stocks.

State targets and baselines

Marine mammals - Taking into account limited data availability for cetaceans, Method 1 is advised for target-setting, while any of the approaches to set a baseline (Methods A, B and C) could be applicable, depending on data and the history of hunting. Seals are generally easier to monitor than cetaceans. Target-setting Method 1 and baseline-setting Method C are advised, building on experience with EcoQOs. Another possible approach, depending on species, could consist of modelling carrying capacity for common marine mammal species, based on assumptions or measurements of parameters of life history and setting a target as a deviation from this total carrying capacity to allow for “sustainability” (This method underpins the targets set for harbour porpoise bycatch by ASCOBANS and the OSPAR EcoQO). This advice applies to all relevant state indicators of the Commission Decision on criteria and indicators.

Birds - Based on EcoQO experience, method 3 is considered useful for target-setting, while method B is appropriate for baseline-setting.

Fish and cephalopods - Target-setting Method 1 or 2 is advised, using a mixture of approaches for baseline-setting (B and C[5]). In general, the method of choice will depend on data availability and the history of fishing. There is a close link between the biodiversity Descriptors 1, 4 and 6 which are dealt with in this Manual and Descriptor 3 on commercial fish and shellfish stocks. Fish and cephalopods cover protected species as well as commercially-exploited species. Both categories come with their own baseline and target-setting methodology. While baselines are well-defined for many of the commercially exploited fish stocks, these are lacking for non-commercial bycatch species, although they may be equally impacted by human pressures.

The complementary use of expert judgement is recommended[6] for mammals, birds, fish and cephalopods.

Pressure targets

Ideally, state and pressure targets should be used in combination. If setting state targets or monitoring progress towards them is problematic, pressure targets alone could be used to monitor achievement towards GES. An example is reduction of pressures during crucial life-cycle periods, e.g. prevention of visual/noise disturbance at seal haul-out/pupping areas during relevant times of the year. A common agreement exists about the potentiality of setting bycatch targets, not only for mammals, but for reptiles in some sub-regions. For fish and cephalopods, targets for fishing mortality and discard rates are being used for commercial species and could be developed for non-commercial species as well.

[5] OSPAR (2011) Report of the OSPAR/MSFD workshop on approaches to determining GES for biodiversity, Utrecht November 2010. Biodiversity Series No.553

[6] OSPAR (2011) Report of the OSPAR/MSFD workshop on approaches to determining GES for biodiversity, Utrecht November 2010. Biodiversity Series No.553

Potential common indicators: In most cases species distributional range and pattern and species abundance or population size can be assessed with existing indicators. However, some further development of indicators, baselines and/or targets is required. This applies to the three species groups (mammals, birds and fish). More monitoring may be required in a number of cases. There is some overlap between indicators for Descriptor 1 and Descriptor 4. There has not yet been sufficient consideration of indicators for cephalopods. A summary of potential common indicators is in Tables 1a and 1b.

With regard to mammal indicators for Descriptor 4, experts at the 2011 OSPAR workshop on MSFD Biodiversity Descriptors[7] (WKBIOD) considered these unsuitable, since the species under consideration are opportunistic feeders and will therefore not indicate structural changes at lower levels in the food web. The present version of the Advice Manual follows this advice. However, since a number of EU Member States consider mammal indicators for Descriptor 4, ICG-COBAM advises that further discussion is required on this issue.

Descriptor 2 – non-indigenous species (NIS)

Any targets or measures should be considered for relevance at the sub-regional (if not wider international) level. For many parameters, national controls may be ineffective if operated in isolation from other neighbouring countries due to the methods of introduction of NIS. Targets could be trend-based (Method 1) and should be directed towards preventing further introductions and related to management measures to reduce their impacts. Due to a lack of data on how NIS are introduced, where they occur, how abundant they are and a lack of understanding of the factors influencing their survival, establishing baseline information for trend comparisons may be very difficult. Pathway/vector management targets are likely to be the most effective means to prevent further introductions of NIS. The present Manual proposes a target-setting decision tree to ensure a coordinated approach with this Descriptor.

Potential common indicators: proposals for indicators are available for trends in abundance, occurrence and distribution of NIS, There is agreement that the concepts behind the indicators are sound; however more work is required to develop these further and build consensus. Significant development would be required for monitoring, No indicators have currently been proposed for the impact of invasive species. Potential common indicators are in Tables 1a and 1b.

Species and habitats lists

The Manual includes lists of species and habitats (Annex 8.6) which are structured according to the predominant habitat types and functional groups of species recommended for biodiversity assessment in the EU Commission Staff Working Paper[8]. These lists are intended as a common starting point for identification of more specific species and habitats which could be used for assessing GES within each sub-region. Coordination of the selection process will facilitate effective and coordinated monitoring among neighbouring Member States. The species lists started with those species that are already listed in other policy mechanisms, and hence have a strong focus on rare/threatened/declining species. According to MSFD issues, additional selection criteria (commonness, trophic keystoneness, etc.), have been added to by ICG-COBAM to also include more species, in order to represent the functional groups more accurately. However these lists are actually more illustrative than operational and further work is needed for monitoring issues.

[7] OSPAR workshop on MSFD Biodiversity Descriptors: comparison of targets and associated indicators, hosted by the Netherlands and held in Amsterdam, 2-4 November 2011.

[8] European Commission (2011) Relationship between the initial assessment of marine waters and the criteria for good environmental status. Commission Staff Working Paper, SEC(2011) 1255.

http://www.cc.cec/home/dgserv/sg/sgvista/i/sgv2/repo/repo.cfm?institution=COMM&doc_to_browse=SEC/2011/1255.

Summary of potential common parameters/metrics for biodiversity descriptors:

The current set of indicators is regarded as a menu of options to choose from, preferrably in a coordinated manner. It is a 'high level' set, with more detailed indicators (specific to different habitat types and regions) defined as needed to support more local assessments. OSPAR has set up a procedure to further develop these indicators, taking into account immediate (2012) and medium term (2014-2018) requirements of the MSFD.

Two tables present the current state of play towards identification of common parameters and metrics of the indicators for biodiversity Descriptors giving a general impression on the status of monitoring and the level of consensus in ICG-COBAM with regard to the suitability of the proposed parameter. The advice is based on an analysis of coherence in nationally identified indicators and targets carried out at WKBIOD. **Table 1a** maps out the potential common parameters against each of the Commission Decision Indicators, including highlighting gaps. The details of the parameters are not provided in this table, rather it presents a summary for each indicator of numbers of common parameters per ecosystem component. **Table 1b** presents the thirty-three potential common parameters according to ecosystem component. More detailed descriptions are available in Chapters 4, 5 and 6.

It should be noted that due to lack of knowledge and/or expertise during the workshop the following gaps in the current potential common parameters and metrics were identified:

- Cephalopods
- Reptiles
- Pelagic habitats

Further work will be required to develop parameters for indicators under Descriptor 2 (Non indigenous species) and Descriptor 4 (food webs).

Table 1a Summary of potential common parameters/metrics for each of the Commission Decision Indicators.

The numbers in parantheses (x) indicate the number of parameters/metrics available for each ecosystem component, with further details found in the relevant chapter of this Advice Manual.

Current Monitoring: Green = Sufficient; Orange = some, but more required; Red = none; Black = not enough information

Level of consensus: Green = high; Orange = some; Red = none; Black = not enough information

Level of development: Green = already operational; Orange = some further development required; Red = concept is sound but requires substantial development; Black = not enough information

Descriptor 1

Criterion	Indicator	Parameter/ metrics available for:	Monitoring	Level of consensus	Level of development
1.1 Species distribution	1.1.1 Species distributional range	Birds (1); Mammals (2); Fish (1)	There is some monitoring being conducted but more would be required	There is high consensus on all 4 of the proposed parameters for 1.1.1	Some further development of the proposed parameters is required
1.1 Species distribution	1.1.2 Species distributional pattern	Birds (1); Mammals (2); Fish (1)	There is some monitoring being conducted but more would be required	There is high consensus on all 4 of the proposed parameters for 1.1.2	Some further development of the proposed parameters is required
1.1 Species distribution	**1.1.3 Area covered by species (benthic)**	**NONE**			
1.2 Population size	1.2.1 Population abundance/bio mass	Birds (1); Mammals (2); Fish (2)	There is some monitoring being conducted but more would be required	There is high consensus on 4 of the 5 proposed parameters for 1.2.1	Some further development of the proposed parameters is required
1.3 Population condition	1.3.1 Population demographics	Birds (4); Mammals (3); Fish (1) Reptiles (1)	There is some monitoring being conducted but more would be required	There is high consensus on all of the proposed parameters for 1.3.1	Some further development of the proposed parameters is required
1.3 Population condition	**1.3.2 Population genetic structure**	**NONE**			
1.4 Habitat distribution	1.4.1 Habitat distributional range	Benthic habitats (1)	There is some monitoring being conducted but more would be required	There is high consensus for this proposal	No indication as to how much development would be required was provided at this stage
1.4 Habitat distribution	1.4.2 Habitat distributional pattern	Benthic habitats (1)	There is some monitoring being conducted but more would be required	There is some consensus for this proposal	No indication as to how much development would be required was provided at this stage

1.5 Habitat extent	1.5.1 Habitat area	Benthic habitats (2)	There is some monitoring being conducted but more would be required	There is high consensus for both of the proposed parameters for 1.5.1	No indication as to how much development would be required was provided at this stage
1.5 Habitat extent	**1.5.2 Habitat volume**	**NONE**			
1.6 Habitat condition	1.6.1 Condition of typical species/communities	Fish (3) Benthic habitats (5)	There is some monitoring being conducted but more would be required	There is some consensus for this proposal	Some further development of the proposed parameters is required
1.6 Habitat condition	1.6.2 Relative abundance/bio mass of spp.	Benthic habitats (1)	There is some monitoring being conducted but more would be required	There is high consensus for this proposal	No indication as to how much development would be required was provided at this stage
1.6 Habitat condition	1.6.3 Physical, hydrological & chemical conditions	Benthic habitats (1)	There is some monitoring being conducted but more would be required	There is some consensus for this proposal	No indication as to how much development would be required was provided at this stage
1.7 Ecosystem structure	1.7.1 Composition and relative proportions of ecosystem components	Birds (1)	There is some monitoring being conducted by more would be required	There is some consensus for this proposal	Some further development of the proposed parameter is required

Descriptor 2

Criterion	Indicator	Parameter/ metrics available for:	Monitoring	Level of consensus	Level of development
2.1 Abundance & state of NIS, in particular invasives	2.1.1 Trends in abundance, occurrence & distribution of NIS	Non-indigenous species (3)	No indication as to how much development would be required in terms of monitoring was provided at this stage for the three proposed parameters under 2.1.1	There is some consensus for each of the 3 proposed parameters	It is agreed that the concepts are sound but the parameters require substantial development and additional monitoring
2.2 Impact of invasives	**2.2.1 Ratio: invasive to native species**	**NONE**			
2.2 Impact of invasives	**2.2.2 Impacts of invasive species**	**NONE**			

Descriptor 4

Criterion	Indicator	Parameter/ metrics available for:	Monitoring	Level of consensus	Level of development
4.1 Productivity of key species/ groups	4.1.1 Performance of key predators (productivity)	Birds (2)	There is some monitoring being conducted but more would be required	There is high consensus on the proposed parameters for 4.1.1	Some further development of the proposed parameters is required.
4.2 Proportion of selected species at top of food webs	4.2.1 Large fish	Fish (1)	Some monitoring is in place, but more is required	There is high consensus for the proposed parameter for 4.2.1	The parameter is already operational in the North Sea, but requires further development in other regions
4.3 Abundance/ distribution of of key trophic species/ groups	4.3.1 Abundance trends of selected groups/species	Mammals (2) Birds (1)	There is some monitoring being conducted but more would be required	There is high consensus on all proposed parameters for 4.3.1	Some further development of the proposed parameters is required

Descriptor 6

Criterion	Indicator	Parameter/ metrics available for:	Monitoring	Level of consensus	Level of development
6.1 Physical damage, having regard to substrate characteris-tics	**6.1.1 Biogenic substrate**	**None** – covered by 1.5.1			
6.1 Physical damage, having regard to substrate characteris-tics	6.1.2 Extent of seabed significantly affected for the different substrate types	Benthic habitats (1)	Not enough information is currrently available about existing monitoring, so this would need to be investigated	There is high consensus for this proposal	Some further development of indicator/baseline/targets required and/or more monitoring required
6.2 Condition of benthic community	**6.2.1 Presence of sensitive species**	**NONE** – covered by 1.6.1			
6.2 Condition of benthic community	**6.2.2 Multi-metric indexes**	Benthic habitats (1)	Not enough information is currrently available about existing monitoring, so this would need to be investigated	There is a high consensus for use of this parameter	No conclusion was reached on the level of development
6.2 Condition of benthic community	6.2.3 Biomass/ number of individuals above specified length/size	Benthic habitats (1)	Not enough information is currrently available about existing monitoring, so this would need to be investigated	There is high consensus for this proposal	No indication as to how much development would be required was provided at this stage
6.2 Condition of benthic community	6.2.4 Size spectrum of benthic community	Benthic habitats (1)			

Table 1b Summary of potential common parameters/metrics organised by ecosystem component and reflecting preliminary advice on parameters and current monitoring levels. The table draws from the detailed tables presented in chapters 3, 4 and 5 of the advice manual.

Current Monitoring: Green = Sufficient; Orange = some, but more required; Red = none; Black = not enough information

Level of consensus: Green = high; Orange = some; Red = none; Black = not enough information

Level of development: Green = already operational; Orange = some further development required; Red = concept is sound but requires substantial development; Black = not enough information

The following table outlines an initial set of proposed common indicators on biodiversity (i.e. candidate common indicators).

Benthic Habitats [application of some parameters to predominant or special habitat types, to be agreed]

Numbe	Parameter	Monitoring	Level of Consensus	Level of development	Links to COM dec.
1	Listed habitats (HD, OSPAR): Distributional range of all relevant habitats	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.4.1
2	Listed habitats (HD, OSPAR): Distributional pattern of all relevant habitats	Some monitoring exist but more is required	There is some consensus for use of this parameter	No conclusion was reached on the level of development	1.4.2
3	Listed habitats (HD, OSPAR): Habitat area	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.5.1
4	Predominant habitats (not listed): Habitat area	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.5.1
5	Typical species composition (presence)	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.6.1
6	Intertidal macrophyte species composition (abundance)	Some monitoring exist but more is required	There is some consensus for use of this parameter	No conclusion was reached on the level of development	1.6.1
7	Density of biogenic structure forming species	Some monitoring exist but more is required	There is some consensus for use of this parameter	No conclusion was reached on the level of development	1.6.1; D6
8	Impact/vulnerability of habitat types to physical damage	No information provided about existing monitoring	There is some consensus for use of this parameter	No conclusion was reached on the level of development	1.6.1
9	Macrophyte depth distribution	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.6.1; D5; D6

10	Multi-metric indices to quantify relative abundance of benthic species or groups of species	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.6.1, 6.2.2; relevant for many types of (cumulative) pressures
11	Quality and abiotic conditions of all relevant habitats in Annex 1 of the Habitat Directive	Some monitoring exist but more is required	There is some consensus for use of this parameter	No conclusion was reached on the level of development	1.6.3; D5; D6; D7; D8
12	Listed habitats (HD, OSPAR): Area of habitat damage	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.5.1; 1.6; 6.2
13	Predominant habitats (not listed): Area of habitat damage	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.5.1; 1.6; 6.2
14	Size-frequency distribution of bivalve or other sensitive/indicator species in the community	Some monitoring exist but more is required	There is a high consensus for use of this parameter	No conclusion was reached on the level of development	1.6, 6.2.4

Fish

Numbe	**Parameter**	**Monitoring**	**Level of Consensus**	**Level of development**	**Link to COM dec.**
15	Distributional range of a suite of selected species	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.1.1
16	Distributional pattern within range of a suite of selected species	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.1.2; 1.2.1
17	Population abundance/ biomass of a suite of selected species	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.2.1
18	Bycatch rates of Chondrichthyes	Some monitoring exist but more is required	There is some consensus for use of this parameter	No indication of required development	1.2.1
19	Proportion of mature fish in the populations of all species sampled adequately in international and national fish surveys	There is not enough information to determine sufficiency of monitoring	There is some consensus for use of this parameter	Sound concept but substantial development needed	1.3.1
20	OSPAR EcoQO for proportion of large fish: for all species from the International Bottom Trawl Survey	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Already operational	1.6.1; 4.2.1
21	Conservation status of elasmobranch and demersal bony-fish species. (IUCN)	Some monitoring exist but more is required	There is some consensus for use of this parameter	Some further development needed	1.6.1; 4.2.1

22	Mean maximum length of demersal fish and elasmobranchs	Some monitoring exist but more is required	There is some consensus for use of this parameter	Some further development needed	1.6.1; 4.2.1

Birds

Numbe	Parameter	Monitoring	Level of Consensus	Level of development	Link to COM Dec
23	Distributional range of breeding and non-breeding marine birds	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.1.1
24	Distributional pattern of breeding and non-breeding marine birds	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.1.2
25	Species-specific trends in relative abundance of non-breeding and breeding marine bird species in all functional groups.	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.2.1; 4.3.1
26	Annual breeding success of kittiwake	Monitoring is sufficient	There is a high consensus for use of this parameter	Some further development needed	1.3.1; 4.1.1
27	Breeding success/failure of seabird species	There is not enough information to determine sufficiency of monitoring	There is a high consensus for use of this parameter	Some further development needed	1.3.1; 4.1.1
28	Mortality of seabirds from fishing (bycatch) and aquaculture	No monitoring	There is a high consensus for use of this parameter	Some further development needed	1.3.1
29	Non-native/invasive mammal presence on island seabird colonies	There is not enough information to determine sufficiency of monitoring	There is a high consensus for use of this parameter	Some further development needed	1.3.1; 2?
30	Biodiversity in terms of species numbers, species evenness or other indicators of specific assemblages.	Some monitoring exist but more is required	There is some consensus for use of this parameter	Some further development needed	1.7.1

Mammals & Reptiles

Numbe	Parameter	Monitoring	Level of Consensus	Level of development	Link to COM Dec
31	Distributional range of grey and harbour seal haul-outs & breeding colonies	Monitoring is sufficient	There is a high consensus for use of this parameter	Already operational	1.1.1
32	Distributional range at the relevant temporal scale of cetacean species regularly present	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.1.1
33	Distributional pattern of grey and harbour seal haul-outs & breeding colonies;	Monitoring is sufficient	There is a high consensus for use of this	Already operational	1.1.2

			parameter		
34	Distributional pattern at the relevant temporal scale of cetacean species regularly present.	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.1.2
35	Abundance of grey and harbour seal at haul-out sites & within breeding colonies;	Monitoring is sufficient	There is a high consensus for use of this parameter	Already operational	1.2.1; 1.3.1;
36	Abundance at the relevant temporal scale of cetacean species regularly present.	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.2.1; 1.3.1;
37	Harbour seal and Grey seal pup production	Monitoring is sufficient	There is a high consensus for use of this parameter	Already operational	1.3.1
38	Numbers of individuals within species (mammals) being bycaught in relation to population estimates	Some monitoring exist about bycatch occurrence, but the population estimate is not always monitored, so the applicability of the parameter is limited	There is a high consensus for use of this parameter	Some further development needed	1.3.1; 4.3
39	Numbers of individuals within species (reptiles) being bycaught	Some monitoring exist but more is required	There is a high consensus for use of this parameter	Some further development needed	1.3.1; 4.3

Non-indigenous species

Numbe	**Parameter**	**Monitoring**	**Level of Consensus**	**Level of development**	**Link to COM Dec**
40	Rate of new introductions of NIS (per defined period)	No information provided	There is some consensus for the use of this parameter	Sound concept but substantial development needed	2.1.1
41	Pathways management measures	No information provided	There is some consensus for the use of this parameter	Sound concept but substantial development needed	2.1.1

1 Background

1.1 Purpose and scope of the Advice Manual

The purpose of this Advice Manual is to provide those OSPAR Contracting Parties who are implementing the Marine Strategy Framework Directive (MSFD) (Directive 2008/56/EC) with practical advice on the methodologies to be applied for determining Good Environmental Status (GES), the setting of environmental targets and the selection of associated indicators for the MSFD biodiversity Descriptors. The Manual is aimed at national experts and policy-makers who will be directly involved in this work at Member State and Regional Sea levels.

The draft version of the Manual, which was distributed in OSPAR and the EU working group on Good Environmental Status in June 2011, included leading principles and methods for defining indicators, targets and baselines. Further application and implementation of the Directive by Member States enabled an analysis of the level of coherence in nationally identified indicators and targets. In order to identify candidates for a common set of indicators an OSPAR workshop was organised[9], ICG-COBAM elaborated the results of this workshop into proposals for common indicators that are included in the current version of the Advice Manual. The Manual is regarded as a living document.

Under Articles 9 and 10 of the Directive, it is the responsibility of Member States themselves to determine by 2012 the characteristics of GES and to establish the targets and associated indicators needed to guide progress towards GES. Under Article 5 of the Directive, Member States in a region or sub-region are required to cooperate to ensure that their delivery of Articles 9 and 10, *inter alia*, is coherent and coordinated across the marine region or sub-region, endeavouring to follow a common approach. In this context the Advice Manual is intended as guidance to be used by OSPAR Contracting Parties to assist them in the coordinated and consistent implementation of the Directive in the north-east Atlantic region. It is not intended to provide a legal interpretation of the requirements of the Directive.

The advice presented in this Manual is in relation to the MSFD Descriptors identified in Box 2.

Box 2: The MSFD Descriptors addressed in this manual

D1	Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.
D2	Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.
D4	All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.
D6	Sea-floor integrity is at a level that ensures that the structures and functions of the ecosystems are safeguarded and benthic ecosystems in, in particular, are not adversely affected.

Descriptor 3, concerning commercial fish and shellfish, is being considered by Contracting Parties in conjunction with expert advice being developed by the International Council for the Exploration of the Sea (ICES). This descriptor is therefore not directly addressed within this manual. However, the approaches to assessment of commercial fish and shellfish under D3 and presented here will benefit from mutual consideration, as there could

[9] OSPAR workshop on MSFD Biodiversity Descriptors: comparison of targets and associated indicators, hosted by the Netherlands and held in Amsterdam, 2-4 November 2011

be commonalities in the use of indicators and the setting of target threshold values, for example, as well as many interactions between the Descriptors.

It is anticipated that it may not be possible by 2012 to have a complete, refined picture of what constitutes GES, what it means and how progress towards GES can be measured. There is at present a need to further evolve the thinking behind the concepts, and some information is not yet available. It is therefore conceivable that, by 2012, the initial assessment, the set of GES characteristics, the environmental targets and associated indicators will be a first attempt, with the opportunity for further development and refinement in the subsequent six-year reporting period.

1.2 Policy context

1.2.1 Requirements of the Directive

The Marine Strategy Framework Directive entered into force on 15 July 2008. Its purpose is to protect the marine environment and the resource base upon which marine-related economic and social activities depend.

The Directive aims to achieve or maintain good environmental status (GES) in the marine environment by 2020. GES means that the seas are clean, healthy and productive and that use of the marine environment is at a level that is sustainable. The Directive requires an ecosystem-based approach to the management of human activities. This means that the collective pressures from human activities acting on the marine environment are kept within levels compatible with the achievement of GES, whilst enabling the sustainable use of marine goods and services by present and future generations.

In order to achieve and maintain GES, Member States must develop and implement marine strategies for their marine waters. The Directive lays down a strict implementation timetable for the different elements of marine strategies. An initial assessment of marine waters is to be undertaken by July 2012. Within the same timeframe, a set of characteristics to describe GES as well as a set of environmental targets and associated indicators are to be determined. Coordinated monitoring programmes for ongoing assessment of the status of marine waters must be in place by July 2014. Cost-effective and technically feasible programmes of measures must be developed by 2015 at the latest, and these must enter into operation by 2016 at the latest. The programmes of measures must be designed to achieve or maintain GES and should be devised on the basis of the precautionary principle, and the principles that preventative action should be taken, that environmental damage should, as a priority, be rectified at source and that the polluter should pay.

1.2.2 Requirements for determining GES and establishing environmental targets and indicators

Article 9 of the Directive requires Member States, in respect of each marine region or sub-region, to determine a set of characteristics for GES for their marine waters on the basis of the qualitative Descriptors listed in Annex I of the Directive. GES is to be determined at the level of the marine region or sub-region (Article 3(5)) and must take into account the indicative lists of characteristics as well as the pressures and impacts listed, respectively, in Table 1 and Table 2 of Annex III of the Directive.

In order to provide consistency and allow comparison between marine regions or sub-regions in determining GES, the Commission Decision on criteria and indicators sets out the criteria which are to be used by Member States for assessing the extent to which GES is being achieved in relation to each of the eleven Descriptors listed in Annex 1. In this context, the ‘GES criteria’ refer to particular aspects of a Descriptor that require their status to be assessed through the application of appropriate indicators to determine whether that aspect meets GES or not. Thus, in relation to Descriptor 1 on biological diversity, the population size of a particular species is a criterion (GES criterion 1.2) by which to judge whether the species under consideration in a particular region or sub-region meets GES or not. Similarly, habitat extent (GES criterion 1.5) is one of a number of criteria listed in the Commission Decision by which to judge whether a habitat type in a specific region or sub-region is at GES.

'Environmental target', according to Article 3, means "*a qualitative or quantitative statement on the desired condition of the different components of, and pressures and impacts on, marine waters in respect of each marine region or sub-region*". Article 10 requires that "*Member States shall, in respect of each marine region or sub-region, establish a comprehensive set of environmental targets and associated indicators for their marine waters so as to guide progress towards achieving good environmental status in the marine environment, taking into account the indicative lists of pressures and impacts set out in Table 2 of Annex III, and of characteristics set out in Annex IV*".

The GES criteria listed in the Commission Decision on criteria and indicators are accompanied by one or more related indicators. An indicator can be considered a specific characteristic of a GES criterion (such as, for example, indicator 1.5.1 habitat area which is one of two listed indicators for the criterion habitat extent) that can either be qualitatively described or quantitatively assessed to determine, alone or in combination with other indicators, whether that criterion meets GES, and if not, to ascertain how far it departs from GES.

Indicators can therefore be used within the framework of the Directive to assess:

a. environmental condition (state), and the extent to which GES is being achieved with respect to any particular GES criterion in the Commission Decision;

b. environmental impact, reflecting an undesirable state, and the extent to which the impact is being reduced in relation to the desired state (GES) and associated targets;

c. pressures from human activities, and the extent to which the pressure is being reduced in relation to associated targets.

Some indicators may serve several purposes at the same time. It is also possible to have indicators centred on human activities (drivers) and measures (response) within a DPSIR (Driver, Pressure, State, Impact, Response) management framework, but these may be more appropriate for later phases in MSFD implementation.

1.2.3 The role of OSPAR

The Directive requires Member States to cooperate to ensure the coordinated development of marine strategies for each marine region or sub-region and, where practical and appropriate, make use of existing institutional structures established in marine regions or sub-regions, in particular Regional Sea Conventions.

At the Ministerial Meeting of the OSPAR Commission, which took place in Bergen, Norway in September 2010, OSPAR undertook to facilitate the coordinated implementation of the Marine Strategy Framework Directive in the OSPAR maritime area. The North-East Atlantic Environment Strategy[10] identifies those areas where coordination is needed by OSPAR. In relation to the assessment of environmental status and the establishment of targets and indicators, OSPAR will, where practicable and appropriate, ensure that:

a. assessment methodologies are consistent across the North-East Atlantic;

b. environmental targets are mutually compatible;

c. monitoring methods are consistent so as to facilitate comparability of monitoring results;

d. relevant transboundary impacts and transboundary features are taken into account, and

e. environmental targets and indicators as well as assessments of environmental status will take due account of specific sub-regional/sub-divisonal environmental characteristics.

[10] OSPAR Agreement 2010-3 North East Atlantic Environment Strategy: Strategy of the OSPAR Commission for the Protection of the Marine Environment of the North East Atlantic 2010 - 2020

Specifically, in the context of the Biological Diversity and Ecosystems thematic strategy, the OSPAR Commission will, by 2013, agree an overall process for assessing marine biodiversity and ecosystem functioning, and develop and agree by 2014 a coordinated monitoring programme for the ongoing assessment of the environmental status with regard to biodiversity and ecosystem functioning in the OSPAR maritime area. ICG-COBAM is the main delivery group within the OSPAR framework for coordination in relation to the biodiversity aspects of the Marine Strategy Framework Directive.

1.2.4 Timetable for implementation of the Marine Strategy Framework Directive

July 2012	Finalised initial assessment, set of characteristics for GES and comprehensive set of targets and associated indicators
July 2014	Monitoring programme finalised and implemented
December 2015	Programme of measures established
December 2016	Entry into operation of programme of measures
July 2018	Review of initial assessment, set of characteristics for GES and comprehensive set of targets and indicators
July 2020	Review established monitoring programme
December 2020	Achieve or maintain good environmental status

1.3 Knowledge base for the Advice Manual

The Advice Manual builds upon

a. the results[11] of an OSPAR/MSFD workshop on approaches to determining GES for biodiversity held in Utrecht, The Netherlands, 23-24 November 2010. Experts on different aspects of the biodiversity and human pressures participated in the workshop along side policy-makers.

This workshop considered ways in which GES could be defined under the MSFD and how quantitative targets for GES (including associated pressures) could be developed for the MSFD Biodiversity Descriptors (1, 2, 4 and 6). The workshop focused initially on technical discussions concerning the definition of GES and progressed to consider (i) the appraisal of target-setting approaches that have been adopted under existing environmental Directives and Conventions (e.g. Habitats Directive, WFD, OSPAR, HELCOM) and (ii) the exploration of other national and international target-setting approaches that might be appropriate in an MSFD context.

The workshop aimed to provide a practical way forward for defining GES and setting state and pressure targets for the biodiversity descriptors. The advice on baseline and target-setting approaches was developed by a series of subgroups, which were organised according to broad habitat types and species groups. This structure is brought through in Part II of this manual. The lessons learned, and conclusions from the workshop are presented as **Annex 8.1**.

b. the results of an OSPAR workshop on MSFD biodiversity descriptors: comparison of targets and associated indicators, hosted by the Netherlands and held in Amsterdam, 2-4 November 2011.

[11] OSPAR (2011) Biodiversity Series: Report of the OSPAR/MSFD workshop on approaches to determining GES for biodiversity, 2010. http://www.ospar.org/documents/dbase/publications/p00553_GES4BIO_workshop%20report_final.pdf

The purpose of the workshop was to undertake a comparison and discussion on the state aspects of biodiversity and identify where there may be commonalities in setting targets and associated indicators for the MSFD biodiversity Descriptors 1, 2, 4 and 6. The outputs of the workshop setting out potential proposals for common biodiversity indicators have been incorporated into this Advice Manual.

1.4 How to use this document

This Advice Manual is a first step to providing pragmatic advice to Contracting Parties that can be used to address the short-term (i.e. 2012) requirements of the Directive. At the same time the document starts to explore the longer-term approaches that will be needed for biodiversity assessment to support implementation of the ecosystem-based management required by OSPAR's North-East Atlantic Environment Strategy[12] and by the Marine Strategy Framework Directive.

This is the third version of the Advice Manual, which will continue to be improved and extended in an iterative process. It is envisaged that its scope will be broadened and further developed on the basis of practical application and implementation of the Directive. While the present version is aimed at the 2012 MSFD products, its future development will deliver advice for the ongoing reporting requirements, e.g. 2014 monitoring programmes, 2015 programmes of measures, and 2018 updating of the initial assessment.

The document is structured in a way that will help the reader identify the most appropriate sections for their needs. After setting the context, the bulk of the Advice Manual is divided into two parts, and a series of Annexes.

Part I: in thinking about **principles**, it explores the concepts behind the text of the Directive, particularly as many of these concepts for biodiversity are new and require innovation in assessment and monitoring.

Part II: looks at the **application** of these principles to species and habitats as biodiversity components identified for monitoring and assessment of the marine environment. Part II also contains elaborated proposals for common indicators and targets, by which OSPAR aims to improve coherence within sub-regions and at the level of the OSPAR area.

This is a living document, which will evolve over time, being informed by the experiences of implementing the MSFD. Feedback or considerations for subsequent iterations of the advice manual are welcome, please send these to secretariat@ospar.org with the subject 'COBAMAdvice'.

[12] Strategy of the OSPAR Commission for the Protection of the Marine Environment of the North East Atlantic 2010-2020 (OSPAR Agreement 2010-3)

PART I: Principles

Part I of this Advice Manual presents some of the conceptual thinking and principles concerning how to go about determining GES and what elements are needed in order to establish targets and identify indicators that will enable measurement of progress towards or maintenance of GES. Many of these concepts are new and require innovation in biodiversity assessment and monitoring. Evolution of the principles over time may be expected.

2 Introduction

2.1 What is GES?

The EU Marine Strategy Framework Directive (MSFD) (Directive 2008/56/EC) requires Members States to take the necessary measures to achieve or maintain GES by 2020.

Good environmental status is the desired state of the marine environment and its components – which according to the MSFD is to be determined at regional or sub regional scales. A definition is provided in Art. 3.5 of the Directive and further elaborated in terms of 11 Descriptors in Annex I of the MSFD. More specifically, GES is determined using a number of criteria and indicators associated to each descriptor, as given by the EU Commission's Decision on 'criteria and methodological standards'. The reader is directed to the Commission Decision 2010/477/EU[13] for more detail. Further details on application of the Commission Decision criteria, including linkages between Annex I and III of the Directive, are given in the Commission Staff Working Paper (2011)[14].

2.2 Talking a common language

The terminology of the MSFD, of the Commission Decision on criteria and indicators and of relevant guidance literature (e.g. the ICES/JRC Task Group 1 (TG1) report for Descriptor 1[15]) is not always self-explanatory. Therefore, a proposed set of definitions and interpretations has been developed through ICG-COBAM to help Contracting Parties communicate in a common language. This is presented as **Annex 8.2**. [to be harmonised with the terminology in the EU Common Understanding paper[16]].

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[13] Europeam Commission (2010). Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (2010/477/EU).
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:232:0014:0024:EN:PDF

[14] European Commission (2011) Relationship between the initial assessment of marine waters and the criteria for good environmental status. Commission Staff Working Paper, SEC(2011) 1255.
http://www.cc.cec/home/dgserv/sg/sgvista/i/sgv2/repo/repo.cfm?institution=COMM&doc_to_browse=SEC/2011/1255.

[15] S.K.J. Cochrane, D.W. Connor, P. Nilsson, I. Mitchell, J. Reker, J. Franco, V. Valavanis, S. Moncheva, J. Ekebom, K. Nygaard, R. Serrão Santos, I. Narberhaus, T. Packeiser, W. van de Bund & A.C. Cardoso (2010) Marine Strategy Framework Directive, Task Group 1 Report, Biological Diversity. Ed. H. Piha. JRC Scientific and Technical Reports, EUR 24337 EN – 2010.

[16] Common Understanding of (Initial) Assessment, Determination of Good Environmental Status (GES) and Establishment of Environmental Targets (Art. 8, 9 & 10 MSFD) - endorsed by the Marine Directors December 2011 as a living document.

2.3 Overview of the biodiversity Descriptors

The four biodiversity Descriptors covered in this Manual are presented in Box 2 above. The following overall approach to each descriptor is recommended:

Descriptor 1: Biodiversity – the guidance for this descriptor is organised around the different levels of biological organisation, as reflected in the Commission Decision on criteria and indicators and the ICES/JRC Task Group 1 report:

a. Species – individual species, such as those listed under Community Directives or identified as key species for assessment of a wider functional group;

b. Functional groups – covering the birds, mammals, reptiles, fish and cephalopods and representing the main functional groups of the more highly mobile and widely-dispersed taxa;

c. Habitat types – predominant and special (listed) types, covering both the seabed and water column habitats, and including their associated biological communities (in the sense of the term biotope as given in the Commission Decision on criteria and indicators);

d. Ecosystems – where assessment of multiple habitats and functional groups as part of larger ecosystems is envisaged.

Criteria for assessment of GES for these levels are provided in the Commission Decision on criteria and indicators; these focus on defining the state of biodiversity, with the Commission Decision indicators also focusing on state aspects.

Descriptor 2: Non-indigenous species (NIS) – this guidance addresses the state/impact aspects of the Descriptor, whilst pressures associated with the Descriptor will be considered by OSPAR's Committee on the Environmental Impact of Human Activities (EIHA) in the future. This guidance therefore focuses on this descriptor from the perspective of the impact of NIS on the native biodiversity, with a main focus on linking the assessments of NIS to the functional groups and habitat types; where appropriate it may be relevant to also consider NIS in relation to specific species and at the ecosystem level, more detailed consideration of Descriptor 2 is provided in Section 6.

Descriptor 4: Food webs – the application of this Descriptor is less well advanced than the other descriptors, with specific indicators and targets at an early stage of consideration. It is envisaged, in the first instance, that the data and indicators arising from the more specific aspects of biodiversity (Descriptor 1, Descriptor 6 and some pressure/impact descriptors), covering the range of mobile species and habitat types, can provide the starting point for establishing indicators and assessments for this descriptor. However, greater emphasis on more holistic indicators, which better reflect the functioning aspects of this descriptor, may be required in the longer term. Careful selection of species and habitat types for assessment of Descriptor 1 and Descriptor 6 should therefore facilitate the ability to address Descriptor 4 (i.e. consider the needs for Descriptor 4 when making the selections for Descriptor 1 and Descriptor 6). It may be most appropriate to focus on developing indicators for key functional groups of species under this Descriptor. This descriptor has a focus on functional aspects of the ecosystem and can be associated with the assessment of ecosystem structure required under Decriptor 1.

Descriptor 6: Sea-floor integrity – This descriptor considers non-biogenic habitats and biogenic habitats, Due to the close nature of this descriptor to the seabed habitats to be assessed under Descriptor 1, and the specific mention of biogenic substrates and different substrate types in the Commission Decision on criteria and indicators, this descriptor should be directly linked to the seabed habitat assessments under Descriptor 1. It is recommended that assessment of the predominant seabed habitats under Descriptor 1 should therefore form the basis for assessments of substrate types under Descriptor 6, i.e. that single assessments are undertaken to meet the needs of both Descriptors. For Descriptor 1 the GES criteria and indicators can be considered to have more of a structural perspective, whilst the criteria and indicators for Descriptor 6 have more of a functional

perspective, although there is a high degree of overlap in the nature of the indicators. This approach is considered most efficient in terms of future monitoring and assessment needs.

2.4 Relationships to other Descriptors

The assessment of GES for the biodiversity Descriptors 1, 4 and 6 (often considered as 'state' descriptors) has links to the other Descriptors that focus on pressures and their impacts on the environment. In assessing the state of a biodiversity component (e.g. a species or habitat type), it is necessary to assess, in relation to the desired state (GES), the total level of impact, both its intensity and extent, from all the pressures affecting the component. Some pressures and impacts are dealt with as part of other descriptors. For example, the assessment of a shallow rock habitat needs information on the level of impact from nutrient enrichment (from the assessments under Descriptor 5), contamination (from Descriptor 8), non-indigenous species (from Descriptor 2) and from physical disturbance (from Descriptor 6) and hydrographical changes (from Descriptor 7). In this way the assessments under other descriptors should support and contribute to the assessment of the biodiversity components. Figure 1 illustrates the concept of multiple impacts affecting a biodiversity component (e.g. a habitat) and where assessments of impacts from other descriptors are needed to support the biodiversity assessments.

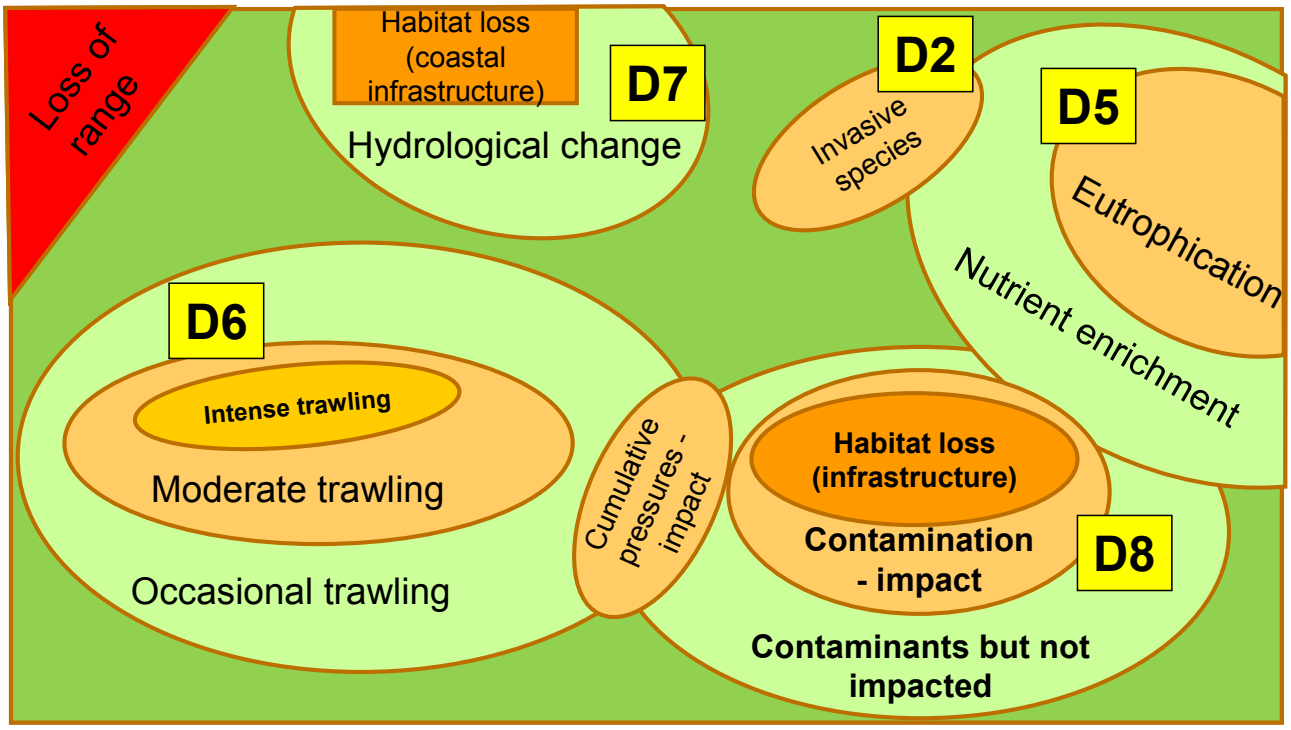


Figure 1. *Illustrative scenario to show that multiple pressures and impacts may affect a particular biodiversity component (in this example, asingle habitat type is represented by the total area of the green box). Green shades indicate acceptable condition; orange and red shades indicate unacceptable (impacted) condition, related to the intensity of the pressure and the sensitivity of the component. Yellow boxes indicate where assessments for other Descriptors (e.g. D2, D7, D8) can contribute to a biodiversity assessment.*

To facilitate such an integration across the Descriptors there needs to be:

a. Cooperation between those responsible for the biodiversity Descriptors and those dealing with associated pressures and impacts under other Descriptors;

b. Information on the intensity, distribution and extent of the impact on biodiversity obtained from assessments of other Descriptors (whether known from sampling or modelled from pressures) in a form that can be directly linked to the biodiversity components and their scale of assessment. Ideally this should be in the form of GIS (geographical information system) data that allow interface with biodiversity data and assessment of cumulative impacts;

c. Identification of those pressures (and impacts) which are not being addressed by other Descriptors, and development of similar (GIS) data on the pressures and impacts.

Given the breadth of biodiversity in the north-east Atlantic region, and the large geographical areas to be addressed, the assessment of biodiversity needs a strong focus on impacts resulting from human-induced pressures. Such an approach will significantly help focus on those aspects of biodiversity, and on particular areas, which may be most at risk of not being at GES. This can help ensure assessment and monitoring effort is most effectively targeted towards those aspects at most risk, and to focus measures in order to address the most significant impacts as a priority. For these reasons, the delivery of the Directive against the biodiversity Descriptors needs to be well coordinated and integrated with that of the pressure-based Descriptors, together with the assessment of pressures and impacts for the Initial Assessment (Table 2 of Annex III to the Directive).

2.5 Consistency between targets for all Descriptors

Because of the strong inter-relationships between the biodiversity Descriptors and other Descriptors, there is a need to review all targets as a whole to ensure there are no substantial conflicts between them (Annex IV of the Directive), and where necessary adjust certain targets to ensure compatibility between the descriptors. This is particularly relevant as the state of biodiversity and ecosystems is dynamic, such that changes in pressures on one part of the ecosystem may give rise to significant or unexpected changes in another part (thereby potentially influencing another target).

2.6 Elements for determining GES

In order to determine and then assess progress towards GES, a number of factors must be considered. These are presented briefly in this section, before going more deeply into the application of these elements in Part II.

2.6.1 Assessment areas and components

The assessment of GES and the setting of targets needs to be based on specified biodiversity components and particular geographic areas (assessment areas). This is equivalent to the approach in the Water Framework Directive and Habitats Directive which each adopt specific components (WFD quality elements, Habitats Directive Annex I and II features) and areas for assessment and reporting (WFD uses water bodies, Habitats Directive uses bio-geographical regions within a Member State territory). Specified components and areas provide essential clarity on how GES will be assessed and enable consistency to be achieved between Member States at the regional and sub-regional scale.

The MSFD provides a basis for defining both of these aspects, each of which has been further considered by ICG-COBAM, taking into account guidance from the ICES/JRC TG reports. These are further elaborated in Section 2.6 and Sections 4 and 5 with respect to different biodiversity components.

2.6.2 Determining GES and target-setting

For the Descriptors dealt with in this Advice Manual (Descriptor 1, Descriptor 2, Descriptor 4, Descriptor 6) the determination of GES means defining the desired state of the biodiversity components of the marine environment according to the GES Descriptor and its criteria and in line with the overarching definition of GES in Article 3.5. This can be in the form of qualitative descriptions at the level of the Descriptor and its criteria, but

should wherever possible be expressed quantitatively, as this will provide a clear expression against which to assess whether GES is being met or maintained. Expressing GES quantitatively includes setting threshold values per criterion (or if appropriate per indicator) which define the boundary between the desired and undesired state. It is also possible to express GES in terms of the desired limits for levels of impact on biodiversity, and for the desired limits for levels of pressure on biodiversity. These threshold values are sometimes referred to as targets (target or limit values, as appropriate)[17].

The present state of individual biodiversity components (based on the result of the initial assessment under Art. 8) should be compared against the desired state (i.e. GES and associated targets for each criterion). Assessment of the present state should have taken into account all the impacts arising from existing or past pressures on the component. It should be kept in mind that the desired state (GES or defined as 'state targets') needs to allow for ecologically sustainable use of the marine environment; it consequently may need to allow for some level of impact from these activities. This is why state targets (when expressed as an absolute value, rather than a trend) are often expressed as an acceptable deviation from a reference state (i.e. a state in which there is negligible human impact[18]).

The desired state of biodiversity can generally only realistically be achieved by a reduction or removal of pressures causing impacts to the biodiversity, thereby allowing the ecosystem to recover to a less impacted state. There may, however be some circumstances where more active management intervention is appropriate, although these can require more resources to achieve effective biodiversity outcomes. Where differences exist between the desired state (GES) and the present state, the pressure, or pressures, giving rise to this difference should be identified, and appropriate pressure-reduction targets set. For some aspects of biodiversity (especially species at the top of food webs), the link to pressures may be difficult to establish with certainty. This will likely result in less emphasis on establishing impact and pressure targets; nevertheless, for such species a focus on known pressures is a practical way to help improve their status.

The link between pressures resulting in impacts and the corresponding activities causing the pressures should be the basis for, and provide a direct link to, the determination of management measures required under Art. 13. As such, it is often also appropriate to set pressure targets which describe an appropriate level of a particular pressure even where GES is currently being achieved; this would ensure that environmental status does not deteriorate in the future and that there is a framework for the management of new/increased pressures.

Some pressure targets can be based on direct evidence (via known impacts on the state of the ecosystem). However, in many cases a clear quantitative link cannot be established, but the impacts (direct or indirect) are known in principle (e.g. based on evidence from other areas). As the Directive requires that measures be devised on the basis of the precautionary principle and that preventative action should be taken, pressure-based targets should be set with these principles in mind. Furthermore, there may be cases where pressures have no obvious link to ecosystem state but rather to pollution effects (as defined by Article. 3 (8)), such as amenity values (e.g. litter) and ecosystem goods and services. Here pressure targets can be developed even though they may not necessarily lead to a direct improvement in state.

Throughout the process indicators are used to inform progress towards the accomplishment, or maintenance, of environmenal targets as well as on the achievement of the overall goal, GES.

[17] E.g. for expressing quantitative values under Art. 10, rather than under Art. 9 (see EU Common Understanding paper).

[18] Often referred to as reference condition

The process described above is illustrated in Figure 2, using the criteria for Descriptor 1 as an example.

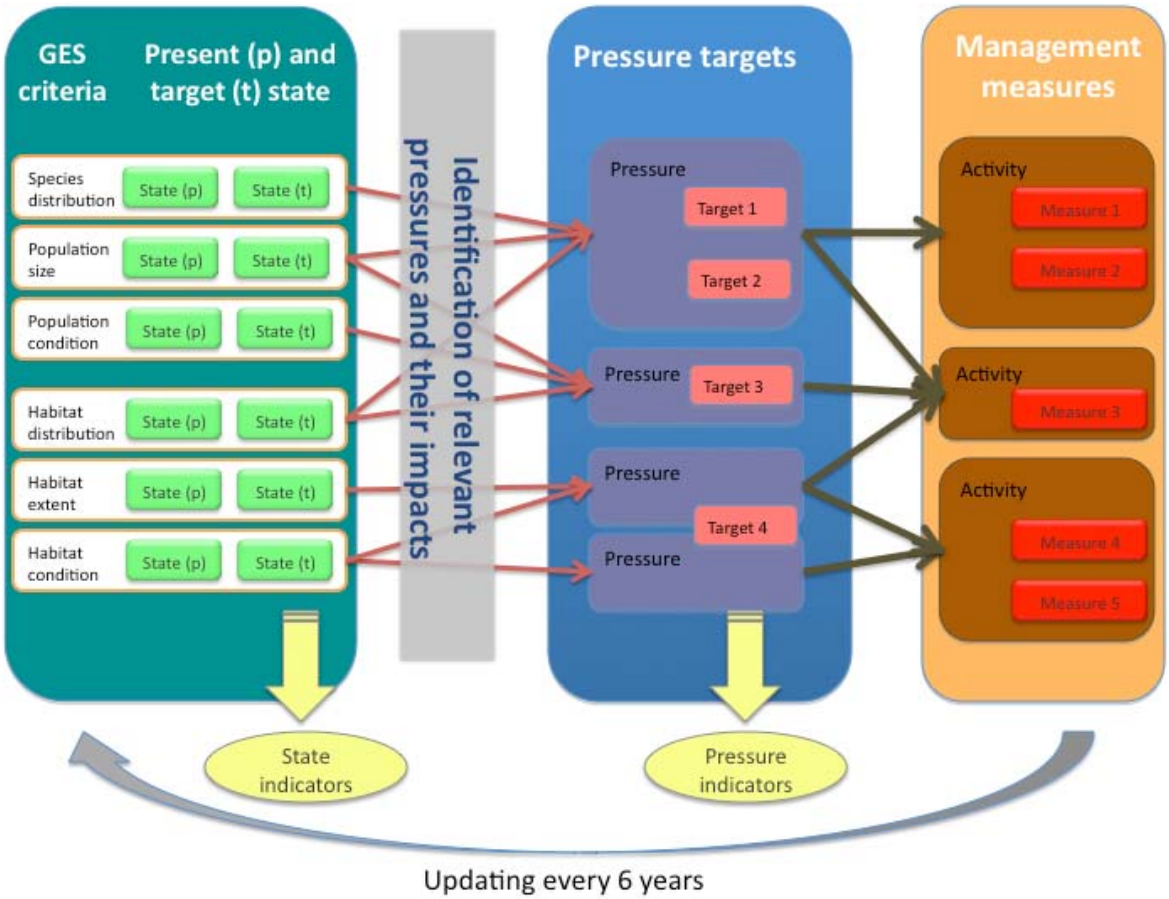


***Figure 2**: Relationships between state, impacts, pressures and activities as a basis for the development of state/impact and pressure targets, indicators and management measures, illustrated here for the criteria of Descriptor 1. See text for explanation.*

2.6.3 Characteristics of an effective indicator

Concerted efforts are needed to protect marine ecosystems. The knowledge required for effective management of human activities having an impact on the marine environment (i.e. management that provides for legitimate human use while maintaining the diversity and productivity of the seas) comes from careful observation of particular environmental properties, functions and conditions. Marine environmental indicators are important because they provide insight into the health of marine systems; they are a means for assessing progress towards environmental targets and for monitoring the efficacy of regulatory and management actions.

In general terms, an indicator can be regarded as any measurable feature or condition of the marine environment that is relevant to the stability and integrity of habitats and communities, the sustainability of ecosystem good and services (e.g. primary productivity, maintenance of food chains, nutrient cycling, biodiversity), the quality and safety of seafood and the status of amenities of socio-economic importance. Detailed characteristics of an effective indicator are specified in Table 1 of **Annex 8.2** (Terminology).

2.6.4 Setting a baseline

Setting appropriate targets should include the determination of a relevant baseline. A baseline can be defined as a specific value of state (or pressure/impact), against which subsequent values are compared: essentially a

standard (articulated in terms of both quality and/or quantity) against which various parameters can be measured. It is important to emphasise that the desired state (target) for GES is not always the same as the baseline, as the target can be set as a deviation from the baseline or as a trend towards the baseline. However, how a baseline is set has a critical effect on what state targets for biodiversity might look like, as illustrated in Figure 3. In the diagram both the quality (e.g. of a habitat or population of a species) and the quantity (e.g. habitat extent, population size) are shown to be deteriorating from left to right, such that setting the baseline as 'current state' represents a very different scenario to using 'past state' or 'reference state'. The establishment of a baseline and related state targets needs to address both quantity and quality aspects.

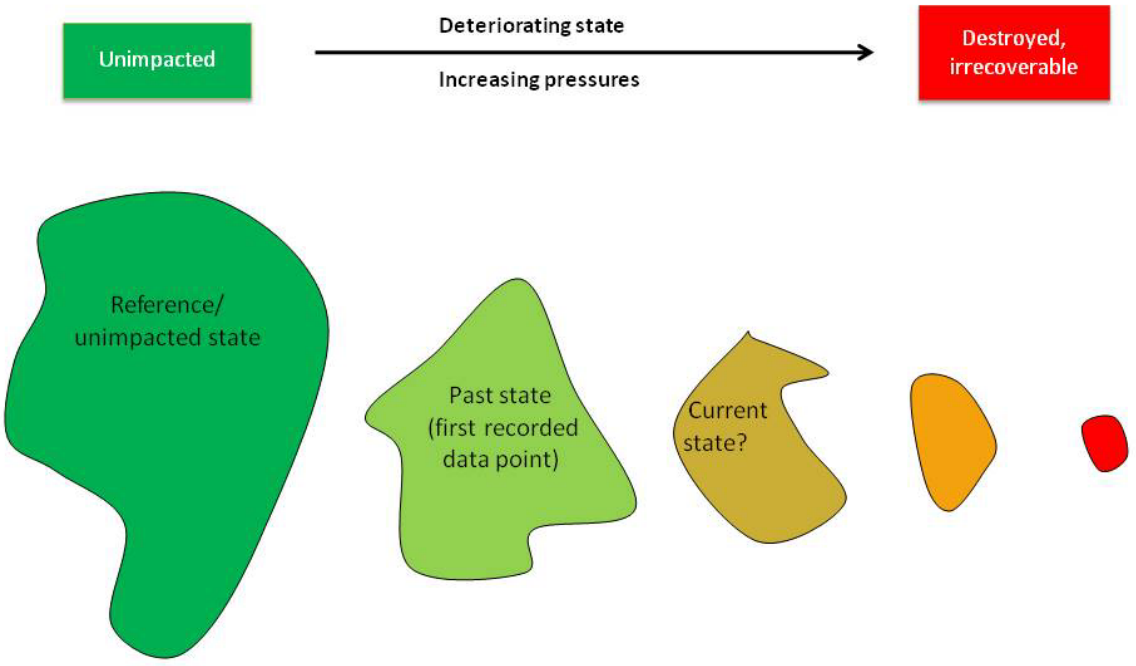


***Figure 3**. Illustration of how a deterioration in state over time, associated with increases in pressures and impacts, can include changes in both quality (e.g. of a habitat or population of a species) and quantity (e.g. habitat extent, population size) of a biodiversity component. Setting the baseline as 'current state' represents a very different scenario to using 'past state' or 'reference state'.*

The state of the marine environment in Europe has changed significantly over the last few hundred (or even thousand) years from an environment that was relatively unimpacted by human activities to one where evidence of adverse effects (impacts) from human activity is ubiquitous. These influences, together with dynamic changes in the ecosystem (e.g. fluxes in predator-prey relationships) and ongoing climatic changes, often make it difficult to determine the condition that biodiversity should be in to achieve GES, and a baseline upon which to base this assessment.

Descriptor 1 expresses the goal for biodiversity as *'the quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions'*. The ICES/JRC Task Group on Descriptor 1 advised that the phrase 'in line with prevailing physiographic, geographic and climatic conditions'' refers to what might be expected under natural environmental conditions according to current physiographic and climatic situations, which vary regionally. In this context, the setting of a baseline for biodiversity aspects of the Directive should be based on '*prevailing physiographic, geographic and climatic conditions'*, but needs to consider how biodiversity has changed in the past to help guide what might be expected under current conditions. The accommodation of sustainable uses of marine goods and services, a key element of Directive (Art. 1.3), should be reflected in target-setting rather than baseline-setting.

3 Approaches to determining GES

3.1 Understanding GES for biodiversity

The ICES/JRC Task Group 1 report provided guidance on the interpretation of Descriptor 1, whereby the aim to have biodiversity 'in line with prevailing physiographic, geographic and climatic conditions' could be interpreted as the condition of biodiversity in the absence of pressures. Whilst the Directive has a goal to phase out all pollution (Art 1.2), it is not considered feasible to remove all pressures on the marine environment. For instance it is probably not possible to irradicate invasive non-indigenous species, and certain human activities by their nature give rise to some levels of impact on the environment. To reflect these issues and to accommodate sustainable uses of the environment within the concept of GES, it was envisaged that some unavoidable levels of deterioration would need to be incorporated into the definition of GES and its associated targets for Descriptor 1. Similar considerations can be applied for Descriptors 4 and 6.

GES for the biodiversity Descriptors in relation to the GES criteria can consequently be considered to fall into two key aspects:

a. **A quality aspect** – based on increasing intensities of pressures, at what stage can aspects of biodiversity quality (e.g. population condition, habitat condition) be considered to have deteriorated to a level at which they are no longer in an acceptable condition (i.e. they are impacted by one or more pressures)? The characteristics of the impact will vary according to the type of pressure (i.e. physical pressures can have different effects to chemical pressures). GES is then represented by a range of conditions with a lower limit marking the boundary to a sub-GES condition. The boundary is preferably defined by a specific value (or range of values) for a given indicator (i.e. quantitatively) but can also be expressed descriptively (i.e. qualitatively) (Figure 4);

b. **A quantitative aspect** – Some criteria (e.g. species distribution, population size, habitat extent) are best considered in quantitative terms, setting quantitative state target values, where appropriate. Additionally, for criteria determining quality aspects (e.g. population or habitat condition), it is important to consider how much of the population of a species or of a habitat type, at the scale of assessment, is impacted and hence the proportion of the population or habitat type that should be in good condition in order for the population, species or habitat type to be considered in good status (Figure 1).

GES for biodiversity can therefore be expected to:

a. Have a quality and proportion aspect (whether expressed as GES only or as GES and state/impact targets)[19];

b. Accommodate some level of impact, such that quality is not even across an entire region or sub-region;

c. Represent a defined deviation from a reference state[20], accommodating sustainable use of the marine environment, provided that there is no further deterioration from present state (at an appropriate scale of assessment).

This approach is equivalent to assessment of Good Ecological Status for the WFD and Favourable Conservation Status (FCS) for the Habitats Directive which accommodate a defined deviation from reference state (i.e. the absence or negligible level of impact from anthropogenic pressures).

[19] It may not be possible to define proportion aspects in all cases, especially where data are limited, but for certain criteria (e.g. habitat condition), it is important to define a target value for the extent of habitat that should be in good condition.

[20] It may not always be possible to quantitatively determine 'reference state' i.e. a state at which the anthropogenic influences are negligible for the species or habitats concerned.

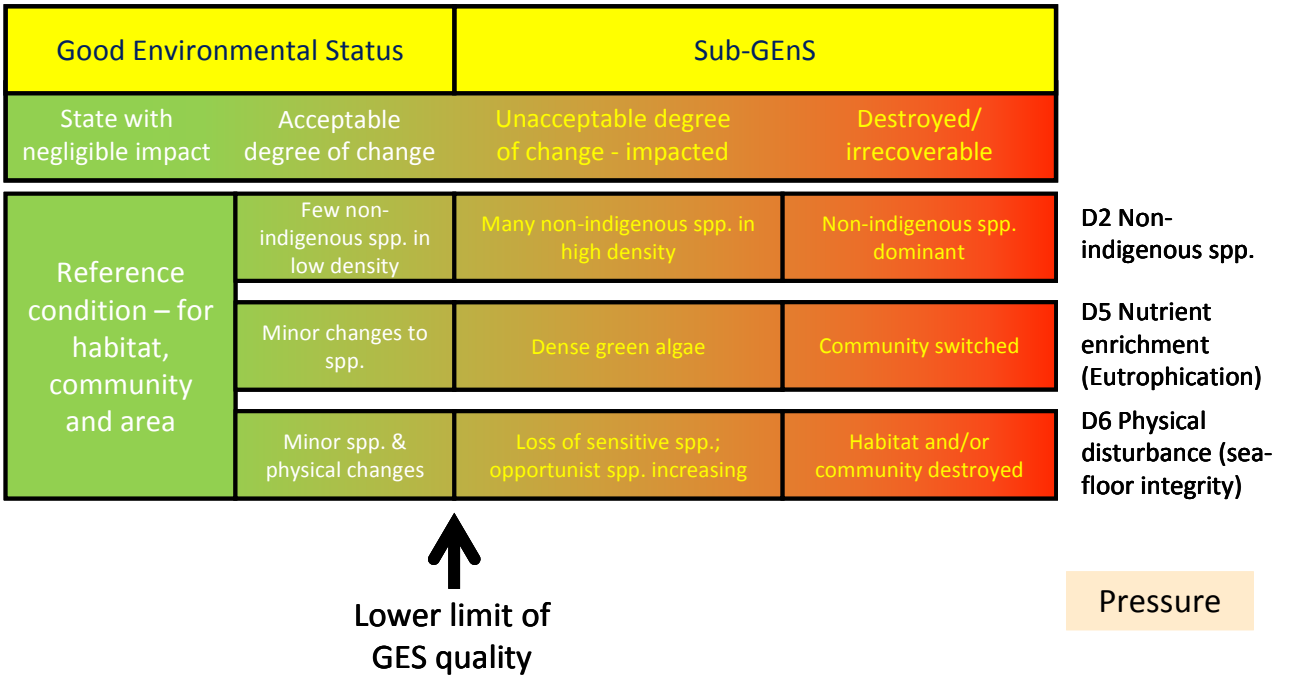


***Figure 4**. Relationship between quality of a biodiversity component and changes caused by different pressures. Types of change are illustrative for the three pressures shown. The lower limit of acceptable change in quality needs to be calibrated across relevant pressures for each biodiversity component. (adapted from Cochrane et al. 2010).*

3.1.1 GES in a dynamic ecosystem and changing climate

Whilst the state of biodiversity in the past (in the absence of pressures) can be used to inform what might be defined as the desired state of biodiversity, there are two key issues, namely ecosystem dynamics and climate changes, which could make it inappropriate to reference to a specific state in the past. In such a case, GES needs to be re-assessed on the basis of prevailing conditions.

Dynamic ecosystems and changing climates will lead to continuous changes in species composition and their relative abundance within communities and ecosystems in any given part of a region. So setting GES in a manner which is too specific in terms of the species composition and population sizes to be achieved will not allow for ecosystem changes (such as changing predator-prey relationships) or climatic variation. As these aspects are beyond the control of normal management measures, it could lead to GES/state targets being set in an unrealistic manner. It is therefore preferable to consider good status at the slightly broader level of functional groups of species and functional habitats, within which a suitable degree of fluctuation in species composition and relative abundance can be anticipated. For instance, within a benthic community, assessing condition on the basis of the balance of functional groups (e.g. filter feeders, grazers) which should be present rather than a highly specified list of typical species. Similarly, with larger more mobile species, it may be more appropriate to consider which of a range of species within a functional group might represent good overall status. In any case, the causes of change should be identified and considered whether these are within the control of management measures.

However past conditions (e.g. for species range, population size, species composition) can be used as a guide to what might be expected now (if there were no impacts) or in the future (if pressures are removed).

3.2 Making use of existing biodiversity targets and indicators

There already exist a number of policy instruments that establish environmental objectives for marine waters, which include the setting of targets and indicators for the protection of marine ecosystems. These include:

a. The Water Framework Directive: Annex V of the Directive specifies threshold quality values and indicators to be used in monitoring and assessing the ecological status of transitional and coastal waters.

b. The Birds and Habitats Directives: these Directives establish a requirement to maintain, and if necessary, restore to favourable conservation status (FCS) naturally occurring species and habitats across EU Member States, by establishing special protection requirements for those natural habitats and wild flora and fauna of Community Interest listed in Annex I and II of the Directives. Site-specific conservation objectives must be established for Natura 2000 sites. Criteria and specified threshold values are given to assess whether FCS has been achieved.

c. The OSPAR list of threatened and/or declining species and habitats is established on the basis of criteria which provide quantitative and/or qualitative values for assessing their status (i.e. whether they should be listed for protection).

d. The OSPAR Comprehensive Procedure (COMPP) identified several indicators which are primarily related to eutriphication assessments but which could additionally contribute to the setting of biodiversity targets and indicators. Its indicators/criteria include phytoplankton species, shifts in macrophyte species composition and those relating to zoobenthos (changes/kills in species).

e. The UNEP Convention on Migratory Species (CMS) includes objectives to conserve terrestrial, marine and avian migratory species throughout their range. More specifically they aim to conserve:

- Small Cetaceans of the Baltic, North-East Atlantic, Irish and North Seas
- Cetaceans of the Black Sea, Mediterranean Sea and neighbouring Atlantic Area
- Seals in the Wadden Sea
- African-Eurasian Migratory Waterbirds
- Albatrosses and Petrels

f. ASCOBANS promotes cooperation amongst Contracting Parties with a view to achieving and maintaining a favourable conservation status for small cetaceans in the North and Baltic Seas. On the other hand, ACCOBAMS promotes coordinated measures to achieve and maintain a favourable conservation status for all cetacean species. The ASCOBANS Conservation and Management Plan and the ACCOBAMS Conservation Plan requires Parties to implement a variety of different measures including reducing bycatch, marine pollution and disturbance, conducting surveys and research on species ecology and abundance, adopting protective national laws and raising public awareness. In the framework of the Trilateral Wadden Sea Cooperation, the Netherlands, Denmark and Germany have elaborated valuable basics as regards assessing the status of the whole Wadden Sea area as well as pressures and impacts affecting its ecosystem components. The focus of this cooperation is the protection and conservation of the Wadden Sea aiming at an undisturbed dynamic ecosystem and covering management, monitoring and research, as well as policy issues. The latest Joint Declaration on the Protection of the Wadden Sea was adopted at the Ministerial Conference in 2010 together with the new Trilateral Wadden Sea Plan 2010[21].

[21] http://www.waddensea-secretariat.org/index.html

g. The Bern Convention on the Conservation of European Wildlife and Natural Habitats: The broad aims of the Bern Convention are 'to conserve wild flora and fauna and their natural habitats,' with special – but not exclusive – attention for 'those species and habitats whose conservation requires the co-operation of several States,' and also 'to promote such co-operation,' with a particular emphasis on endangered and vulnerable species, including migratory ones. In order to achieve these aims, Article 2 of the Convention stipulates with respect to all wildlife that parties 'shall take requisite measures to maintain the population of wild flora and fauna at, or adapt it to, a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements and the sub-species, varieties or forms at risk locally.' Additionally, Article 3 commits parties to 'undertake' to 'have regard to the conservation of wild flora and fauna' in their 'planning and development policies' and when taking 'measures against pollution.'

3.2.1 OSPAR Ecological Quality Objectives

OSPAR has developed a set of Ecological Quality Objectives (EcoQOs) for the North Sea. The EcoQOs have been developed as tools to help OSPAR fulfil its commitment to apply the ecosystem approach.

EcoQOs provide a link between human activities and impacts on biodiversity. The system of EcoQOs for the North Sea defines the desired qualities of selected components of marine ecosystems in relation to particular pressures from human activities. The EcoQOs set objectives for specified indicators and provide a means to measure progress. Collectively, EcoQOs are intended to provide comprehensive coverage of ecosystems and the pressures acting upon them. Most EcoQOs link to specific human activities such as shipping (oil at sea), litter and fishing. Some EcoQOs, such as the EcoQOs for seal populations, indicate the health status of ecosystem components that are affected by multiple pressures. A number of EcoQOs are under development, e.g. on seabird populations, declining habitats and marine beach litter.

The EcoQOs could contribute to the identification of environmental targets and indicators under the MSFD and the experience with the EcoQO system in the North Sea can/should be seen as a starting point for Contracting Parties in other OSPAR regions. It is therefore recommended to use, where possible, comparable ecological quality elements to those used in the North Sea to provide harmonisation throughout the OSPAR maritime area.

The knowledge and experiences gained in the EcoQO process can be used in the approaches to GES-target-setting for MSFD Descriptors. Table 8.2 in **Annex 8.3** gives an overview of the relationship between GES Descriptors/criteria and the OSPAR EcoQOs. Information on practical aspects of EcoQO implementation, including target-setting, can be found in the "Handbook for the application of Ecological Quality Objectives in the North Sea. Second edition" (OSPAR Publication Number: 307/2009).

3.3 Approaches for setting targets and baselines for new indicators

3.3.1 Baseline-setting approaches

Approaches to setting baselines are described below; the most appropriate method for particular biodiversity components is addressed in Sections 4, 5 and 6. Refer also to section 2.6.4 and Figure 3 regarding distinction of quality and proportion aspects of setting baselines.

a. Method A (reference state, with negligible impacts) - Baselines can be set as a state in which the anthropogenic influences on species and habitats are considered to be negligible. This state is also known as 'reference condition'.

b. Method B (past state) - Baselines can be set as a state in the past, based on a time-series dataset for a specific species or habitat, selecting the period in the dataset which is considered to reflect least impacted conditions;

c. Method C (current state) - The date of introduction of an environmental directive or policy can be used as the baseline state. As this may represent an already deteriorated state of biodiversity, the associated target typically includes an expression of no further deterioration from this state.

In the application of these methods, it is important to take account of ecosystem dynamics and climatic variation (see Section 3.1.1) as these processes may lead to change over time in, for example, the distribution of a species or the composition of a community. Because of this, the use of baselines (and targets set as a deviation from a baseline) should aim to reflect a state of biodiversity that is consistent with 'prevailing physiographic, geographic and climatic conditions', as given in the Task Group 1 report for Descriptor 1 (Cochrane *et al*. 2010).

Method A - Baseline as a state at which the anthropogenic influences are considered to be negligible

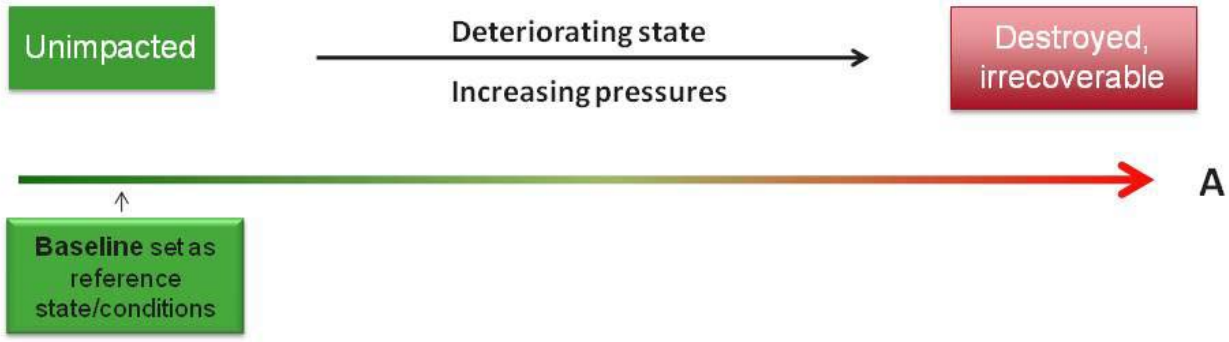


***Figure 5**. Baseline Method A – as a state at which anthrogenic influences are negligible (reference state).*

There are three options for setting baselines as a state at which anthropogenic influences are considered to be negligible (Figure 5). It is acknowledged that it is not possible to determine indisputably 'unimpacted' reference values either through modelling/historic data or through marine areas where human effects are currently minimal.

i. Existing reference state

The first approach is to use current information on species and habitats from areas where human pressure is considered negligible or non-existent (for example, in some marine protected areas). There may not be reference areas containing exactly the species or habitat for which targets need to be set, but it may be possible to use an analogous species or habitat. This approach was used to set reference conditions for the Water Framework Directive.

This approach is a scientifically robust basis for setting baselines as it demonstrates reference conditions under current physiographic, geographic and climatic conditions. It is also a relatively transparent and comprehensible approach which can provide precise data on species composition and relative abundances. However, its robustness depends on the existence of areas of negligible impact containing species and habitats that are the same or very similar to those to be assessed under the MSFD. There are likely to be few genuinely unimpacted areas in the North-East Atlantic, although as marine protected area networks are further developed, more areas may ultimately be considered to be in 'reference state (at least for habitats and low mobility species).

ii. Historical reference state

The second approach is to use historical information to ascertain what a habitat/community or species population may have been like at a time when impacts from human activities were negligible. This information

can be found in a variety of sources, such as historical accounts, old maps, fishing and whaling records, ship's logs, tax documents and archaeological information such as fish bone remains.

In the absence of present day reference state information, this method[22] offers a way to determine reference state of biodiversity but it is likely to yield mostly qualitative information on species composition and their abundance.

This approach provides a moderately scientifically robust basis for setting baselines, depending on the quality and quantity of the available data, as well as expert judgement used in the interpretation of that data. It is a comprehensible approach, but perhaps less transparent than Method Ai. The time involved in applying this approach depends on the degree to which existing research or data archiving programmes can deliver MSFD data needs. Climatic changes and ecosystem dynamics (e.g. predator-prey relationships) since the period used as a reference point needs to be built into any final definition of reference state.

iii. Modelling of reference state

A third approach to setting a baseline is one based on modelling[23] of reference states. This approach is closely linked to approach (ii), in that models depend on historic as well as current information to develop a theoretical state of unimpacted ecosystems under present climatic conditions.

As with approach (ii), the scientific robustness of this option has the potential to be moderate or even high, depending on the nature of the modelling exercise, and crucially on the quality of the data which it is fed. It offers the possibility of introducing current and future climate scenarios, and their effects on biodiversity state. However, it is perhaps the least transparent or comprehensible of the three approaches. Another limitation of this approach is that of time. Unless existing programmes are underway that can deliver MSFD needs, new modelling work is not likely to take place within the 2012 timeframes. However, it is an approach that could be considered as part of the future reporting round.

Method B - Baseline set in the past

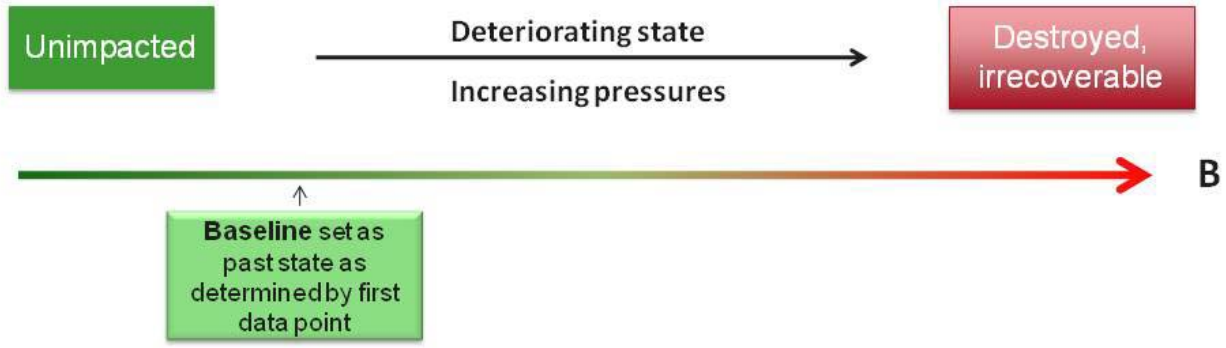


***Figure 6**. Baseline Method B – as a state set in the past (often when monitoring first started).*

[22] The History of Marine Animal Populations (HMAP), which is the historical component of the Census of Marine Life (CoML), is a research project focused on this approach. Interpretation of changes in marine populations over the past 500-2000 years is providing researchers with a baseline that extends back long before the advent of modern technology, or before significant human impact on ecosystems.

[23] This type of ecosystem reconstruction modelling work is being developed within academia, such as at British Columbia, Dalhousie and Chicago Universities.

The second method is to set a baseline as a past state (Figure 6), based on a time-series dataset for a specific species or habitat[24]. Expert judgement is needed to select the period in the dataset which is considered to reflect least impacted conditions; this may be the date of the first data point in a time series, provided this is considered the least impacted state of the time series. It is important to note that this first data point is not intended to represent an unimpacted/reference state, but simply when research or data recording on a particular species population or habitat began.

It is a robust approach in the sense that it is based on a time series of scientific data which should indicate how the state of a feature has changed over time; however, it can be limited by the quality and quantity of the data (for example, if the time series is rather short). It is straightforward and comprehensible, but resultant targets run the risk of being based on an already significantly impacted scenario. This is sometimes referred to as the 'shifting baselines syndrome'[25], where each generation at the beginning of their career redefines what it is they understand to be a 'healthy' marine environment, which may represent significant changes from the original state of the system.

Each time series needs expert evaluation to determine whether the first point/period (or some other point/period) in the time series is to be selected as the reference point, taking into account the changes in associated pressures over the time period and other relevant factors.

Method C - Current baseline

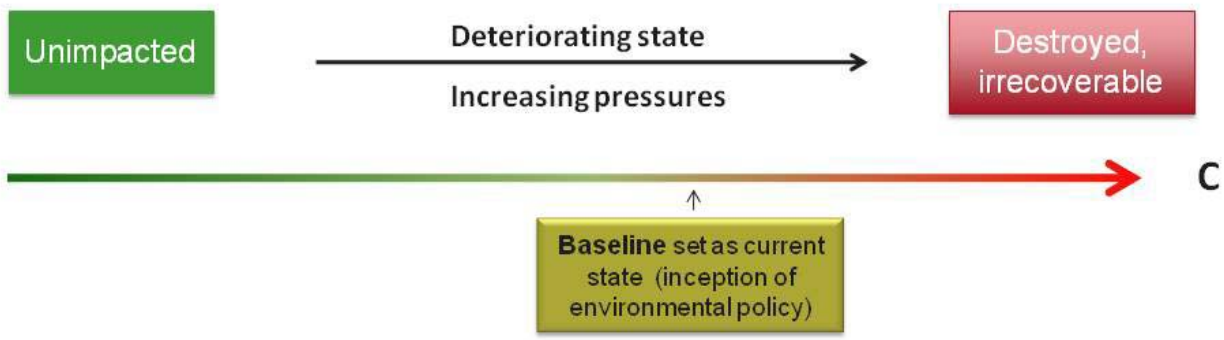


***Figure 7**. Baseline Method C – as current state e.g. at inception of a policy or first assessment.*

[24] This approach was used for some species groups for a 2010 UK marine assessment (Charting Progress 2, the second UK government report on the status of UK seas).

[25] As described by Pauly, D (1995) "Anecdotes and the shifting baseline syndrome of fisheries." Trends in Ecology and Evolution, 10(10):430.

Finally, baselines can be set as the date of inception of a particular environmental policy or the first assessment of state (Figure 7). This approach was used in the context of the Habitats Directive, where the date when the Directive came into force was used by many European countries as the baseline for favourable reference values[26]. This type of baseline is typically used with the objective of preventing any further deterioration from the current state; there can additionally be a target to improve the state from such a baseline (towards a reference state).

Although this approach is quick, practical and transparent, it is not scientifically robust as the current state may represent a wide range of conditions across European waters. This approach could be appropriate where it is determined that GES has already been achieved and hence only requires "maintenance" under the MSFD. However, it is not considered appropriate where deterioration or degradation has already occurred. In addition, there is a significant risk of succumbing to 'shifting baseline syndrome' as described above. This method is generally more appropriate for use in setting baselines for pressures.

The use of expert judgement

Expert judgement can be used to supplement information that is available from the other methods, or allow disparate information to be brought together to provide an expert interpretation, for example on the types of species that might reasonably be expected to occur in a community. The application of expert judgement, should, where possible, follow predefined rules, such as:

- expert judgement needs to be scientifically sound and comprehensible for everyone concerned;
- an appropriate number of competent experts, preferably from a majority of Contracting Parties, needs to be involved;
- the applied procedure and the outcome need to be transparent and appropriately documented.

If the implementation of such rules cannot be guaranteed, the results of this expert judgement would not be reproducible and reliable, and should therefore be avoided. On this condition, reliance on expert judgement is most appropriate when combined with the other baseline-setting methodologies (particularly, Method A), as opposed to being a distinct baseline-setting technique. Quality assessment through a panel of experts is always more preferable to using single expert judgement – confidence in the conclusions is likely to increase with the numbers of experts consulted. Expert judgement in target-setting is particularly valuable in the context of incomplete scientific evidence.

3.3.2 Target-setting approaches

Once an appropriate baseline has been established, environmental targets (for state, impacts and pressures) can then be generated in line with the methodologies outlined below. Limits[27] can also be set as alternatives to setting state targets (using the same methods), but conceptually the use of limits in defining biodiversity state goals is not considered to adequately reflect the aspirations of the MSFD. Setting limits is more appropriate in the context of pressure-levels, beyond which ecological targets are unlikely to be met.

As the Marine Stategy Framework Directive clearly seeks to encompass sustainable uses of the marine environment for present and future generations, and some of these uses, at least at a local scale, generate

[26] The favourable reference values of the Habitats Directive are, as a minimum, the ecological state when the Directive came into force. However, in the Article 17 guidance on assessment and reporting under the Habitats Directive it is acknowledged that historic data and expert judgement may also be used to help define these values.

[27] Task Group 1 defined a limit as 'the value of state that, if violated, is taken as evidence that there is an unacceptable risk of serious or irreversible harm'.

impacts on biodiversity, it is necessary to consider state targets for GES as accommodating some level of impact (in qualitative and/or spatial terms)[28]. State, impact and pressure targets can be generated using the methodologies outlined below.

Several different 'target-setting options' exist:

Method 1. Directional or trend-based targets[29]

i. direction and rate of change

ii. direction of change only

Method 2. Targets set as the baseline

Method 3. Target set as a deviation from a baseline

Method 1: Directional or trend-based targets

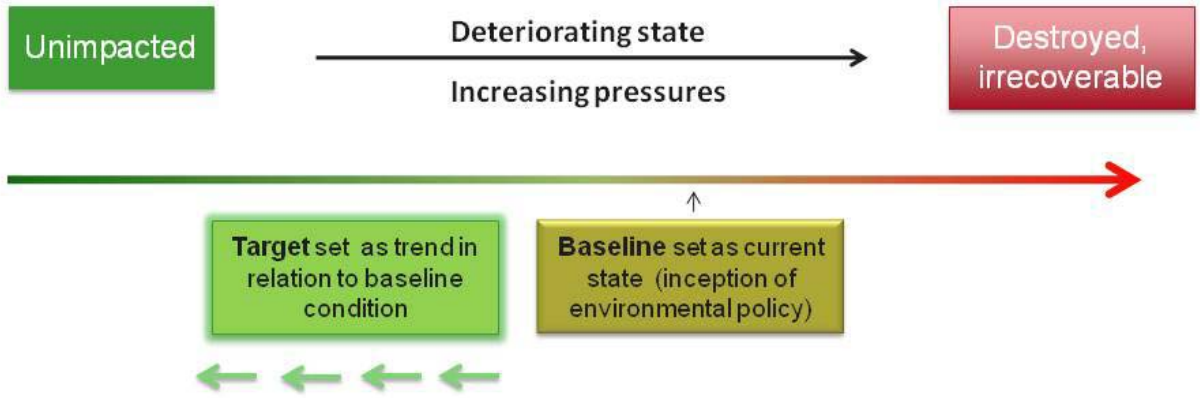


***Figure 8**. Target-setting Method 1 – directional or trend-based (here illustrated as an improvement compared with current state).*

Directional or trend-based targets represent an improvement towards a more desirable state (e.g. a larger population of a particular species, or good condition of a habitat type over an increasing area) (Figure 8). They can be articulated simply as a direction of change, or as both direction and rate of change of an environmental parameter. This approach is relatively practical and straightforward. Significantly, it does not require a great deal of historical data and is useful when complex interactions among various biodiversity components make setting of absolute targets particularly challenging, for example elements for marine food webs (under Descriptor 4). However, its weakness lies in the fact that it doesn't allow for clear assessments of status (because no end point is specified). It also does not allow for a clear assessment of whether GES has been achieved, as a slight trend might be seen as "meeting the target", but it might still be very far off from GES. This can be overcome by expressing an improving trend up to a defined limit (e.g. the carrying capacity of a species) and then an acceptable deviation from this higher limit.

[28] The Directive has an objective to phase out pollution (Art. 1.2b), which is in line with OSPAR objectives on hazardous substances and eutrophication. However, continued sustainable use of the marine environment needs to encompass certain 'non-polluting' impacts (e.g. physical loss of habitat from the placement of infrastructure of oil and gas exploration, renewable energy production and coastal facilities).

[29] [Needs further consideration of how to define a limit for any trend-based target – see HELCOM approach for species population trends]

Method 2: Target set as the baseline

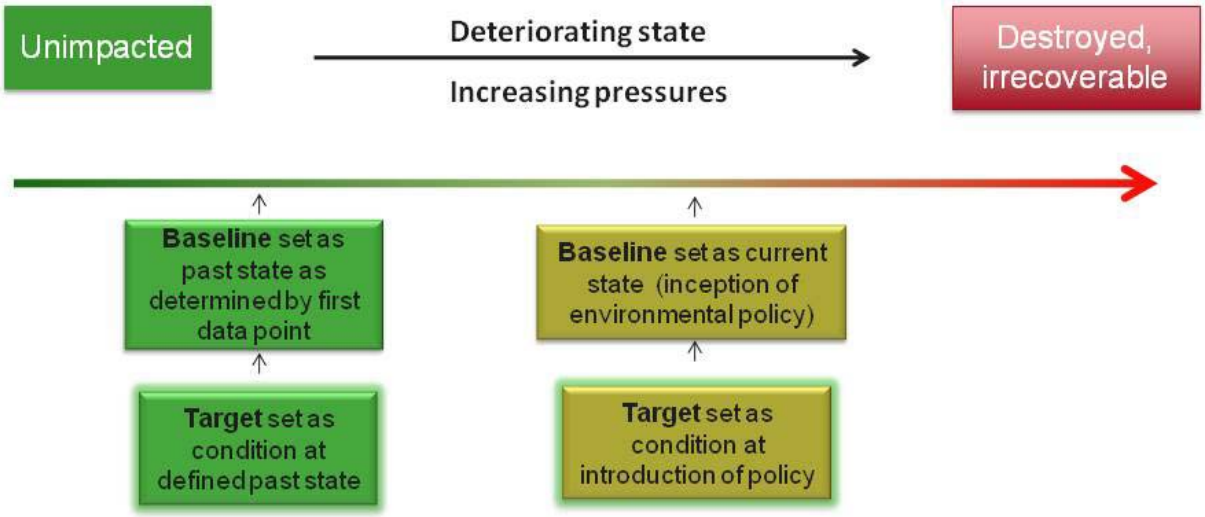


***Figure 9**. Target-setting Method 2 –target is set as the baseline (here two examples for baselines are illustrated: past and current baselines).*

The target can be set as equivalent to the baseline (whether that be current state or a past known state) (Figure 9).

Method 3: Target set as a deviation from a baseline

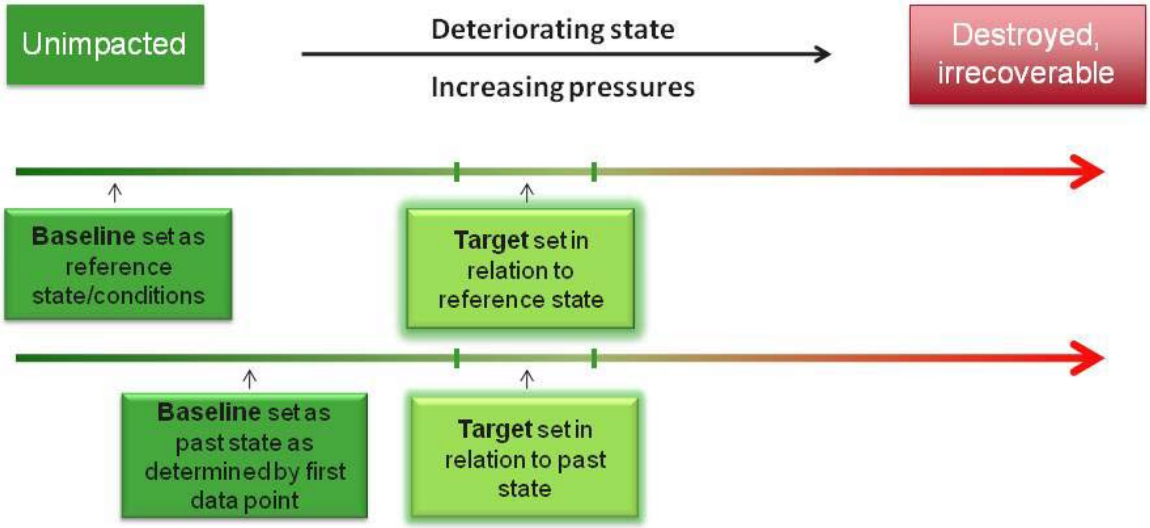


***Figure 10**. Target-setting Method 3 –target as a deviation from a baseline (here illustrated as a defined deviation from a reference or past state).*

Targets can be set that represent a specified deviation from a chosen baseline, which is typically the reference state or past state (Figure 10), but can also be in relation to a current state when the target should be for an improved state rather than a deteriorated state. For example, a target can be set as the percentage of baseline

habitat extent or species population size (or aspect of habitat or species condition, e.g. seagrass shoot density). These types of targets can be set as a percentage range or single percentage figure.

3.3.3 Coordinated selection of species and habitats

Selection of specific species or habitats as proxies to assess broader biodiversity components should be made carefully, according to well defined criteria and coordinated among Contracting Parties sharing a sub-region. Threatened and declining species/habitats can reflect some pressures very well, and benefit from historical monitoring data. However more common or widespread species and habitats should also be considered as a result of their higher representativity in terms of abundance, covered area and functional role and the fact that they are more easily monitored, i.e. in terms of occurrence, abundance and persistence. These "common" species and habitats enable greater comparability between Regions or Sub-Regions.

Biodiversity "hot-spots", for example most habitat engineering species, should also be considered both in terms of priority areas to be assessed and a relevant criterion for selecting species and habitats. Monitoring the area covered and the density/biomass of individuals of such engineering species may also be a good proxy as a first approach to assess a particular species or habitat, where the associated communities are well known.

Monitoring for declining species should be undertaken at adapted spatial and temporal scales to ensure that monitoring itself does not contribute to the decline.

3.4 Approaches to setting targets for pressures

In order to maintain or achieve GES for biodiversity aspects of the Directive (Descriptors 1, 2, 4 and 6), it will be necessary to reduce impacts on biodiversity from pressures arising from human activities. It is therefore considered necessary to set targets for pressures, preferably in close association with state/impact-based targets. The level of such reductions in pressures should be a reflection of what is considered to be GES (Art 9) and the quality and proportion of environmental targets set for the criteria used for the assessment of these Descriptors (Art. 10).

Whilst it is possible to set targets for pressures directly related to Table 2 of Annex III to the Directive and for the pressure-based criteria of the Commission Decision, such an approach will not necessarily lead to the necessary reductions in impacts needed to achieve state-based targets for the biodiversity Descriptors. To achieve the latter, the following is needed:

a. Pressure-based targets should be linked, wherever possible, to impacts on biodiversity components, such that reductions in pressures lead to the desired reductions in impacts; the level of evidence needed for this link will vary, and may be inferred from situations outside of the region/sub-region being considered;

b. As the biodiversity assessments (D1, D2, D4, D6) are focused on the assessment of specific species, functional groups and habitat types at a defined assessment scale, the associated targets for pressures should also relate directly to these components and scales.

c. The alleviation of pressures will need to be achieved through measures to manage human activities. The setting of pressure targets should therefore be set in a way which will form a clear basis for drawing up measures by 2015 (these could be 'operational targets' according to Annex IV of the Directive).

Pressure-based targets can be expected to focus on:

a. Reducing the spatial footprint of the pressure, or;

b. Reducing the temporal footprint of the pressure, or;

c. Reducing the intensity of the pressure, or;

d. Some combination of the three options above.

Setting appropriate targets: because some of the pressures associated with impacts on biodiversity fall under the responsibility of other OSPAR committees, liaison is needed between the relevant groups in order to establish pressure targets that will lead to the necessary reductions in impacts on biodiversity.

The pressures provided in Table 2 of Annex III to the Directive are likely to provide the main focus and, indeed, include the pressures which are widely considered to have most impact on biodiversity (such as physical loss and damage, removal of target and non-target species, nutrient enrichment and contamination). The list in Table 2 of Annex III of the MSFD is indicative; OSPAR (EIHA and ICG-COBAM) has developed a more comprehensive list of pressures (provided at **Annex 8.4)**, and individual assessments of particular species and habitats should consider this wider list, as some may be significant at a local level or for particular species and habitats.

To effectively assess the risks to biodiversity from pressures, it is helpful to map the distribution and intensity of these pressures at a regional/sub-regional scale and to assess the possible levels of impact from such pressures. This approach was initially considered in the 2009 OSPAR BA-6 Utrecht assessment[30] and has since been trialled by HELCOM (HOLAS assessment[31]) and is being further developed for parts of the North Sea under the HARMONY project. Whilst there remain technical and data challenges as well as challenges in terms of consistency with existing requirements in doing this work, it may nevertheless provides an effective approach to assessing the scale of risk to biodiversity, to assess where pressures may need to be reduced and to facilitate an ecosystem-based approach to the management of large sea areas. The results of such work may require further scrutiny.

The potentiality of pressure targets became evident in the OSPAR GES4BIO workshop[32], where several Contracting Parties proposed a diverse set of pressure indicators (some of them reflected in Table 2 of Annex III of the MSFD). This is an aspect of the MSFD that will need further development in subsequent iterations of the Advice Manual.

3.5 Assessment scales

In order to determine what GES is for species, habitats and ecosystems, to set appropriate targets and to assess overall status, it is necessary to clearly define the scale at which the assessments are to be undertaken. This is because, given the same criteria and state/impact-based thresholds for assessment, adoption of different scales can lead to markedly differing outcomes for the assessment. For example, assessment of intertidal mudflats at the scale of a single estuary (as is done for the Water Framework Directive) can lead to a very different judgement on their status (for that water body) when compared with a similar assessment of all mudflats in a Member State (as done for the Habitats Directive) or at the level of the North Sea (a sub-region for MSFD)[33].

Following the ecosystem-based approach required for implementation of the MSFD, the assessment of biodiversity components should be undertaken at ecologically relevant scales, taking into account the cumulative pressures and their impacts from human activities (Art 8.1b, Annex III Table 2) and based on the criteria

[30] OSPAR (2009) Report of the Utrecht Workshop - Regional assessment, Netherlands, 2009 (OSPAR Publication 2010/468)

[31] Holistic assessment of the Baltic marine environment, including a thematic assessment of hazardous substances (HELCOM HOLAS)

[32] OSPAR Workshop on approaches to determining GES for biodiversity, Utrecht, 23-24 November 2010 (OSPAR Publication 2011/553)

[33] Note in this example, the assessment criteria and target (threshold) values under WFD and the Habitats Directive are not identical to those in MSFD, thus further giving the possibility of differing outcomes for the assessment of the same habitat type.

provided for assessment in the Commission Decision on criteria and indicators (e.g. habitat/species distribution, species population size, habitat extent and habitat/population condition).

ICES/JRC Task Group reports for the relevant Descriptors provide useful advice regarding assessment scale (for more detailed information for the biodiversity Descriptors see Annex 8.5). It points out that the MSFD formally operates at three different geographic levels: the Marine Region, the Sub-region and Subdivisions. The first two are defined within the Directive (Art. 4), while it is up to the Member States to apply any subdivisions, whether formally recognised or not. To facilitate aggregation of assessments for the biodiversity Descriptors and with other Descriptors, the scales for biodiversity assessment should be linked to the system of regions, sub-regions and subdivisions provided for general implementation of the Directive (Art. 4), in particular because GES is to be assessed at the level of the region or sub-region (Art 3.5) and because assessment of species and habitats for Descriptor 1 should be directly linked to assessments of food webs (Descriptor 4) and sea-floor integrity (Descriptor 6) and to the assessments of impacts, in particular from non-indigenous species (Descriptor 2), commercial fishing (Descriptor 3), nutrient enrichment (Descriptor 5), hydrographical changes (Descriptor 7), contamination (Descriptor 8) and thermal discharges (Descriptor 11).

Box 3 Defining Assessment Scale

Defining scale can be confusing because this term is relevant in different ways depending on several different aspects of the Directive. Thus scale should be considered in relation to:

i. **Assessment of state (in relation to the definition of GES and associated state targets)** of one or several biodiversity components, as GES is determined at the level of the region/sub-region (Art. 3(5)). These may be linked, by trophic relation for example in Descriptor 4 or functional relation such as between species and habitats (cf. Habitats Directive). This aspect could be expressed as an 'ecological assessment area' (or aggregated sub-areas) for reporting purposes

ii **Management measures**, which can be considered at either a local scale, to avoid missing or masking cumulative local impacts that could affect the overall quality status at larger scales, or at a broad scale to manage efficiently biodiversity components or pressures that operate over large areas of a region/sub-region (as required by MSFD);

iii **Monitoring** to assess state, expressed as the spatial and temporal resolution of data. These resolutions (number of sampling stations, accuracy of remote detection, sampling frequencies, etc.) are likely to be a compromise between "high resolution", which enable a very accurate, but expensive assessment and a more pragmatic approach, identifying a resolution in accordance with available resources which can then be used to define assessment scale and data needs.

When considering a single species, habitat or pressure, relevant scale depends on which parameters are needed for assessing state. For example, physical, hydrological, chemical and biological parameters relevant for habitat state usually need different spatial and temporal resolutions of data in order to enable a comprehensive and integrated assessment. These different resolutions must be compatible to enable an effective assessment. For example, resolutions to monitor oxygen concentration (to detect anoxic/hypoxic conditions), pelagic/benthic primary production and communities of species of a habitat should be carefully defined to enable a comprehensive and integrated assessment at a chosen scale.

For the same parameter, spatial and temporal resolutions of data needs will depend on natural or anthropogenic variability. Thus, the degree of spatial complexity (or patchiness) may directly influence the distribution and resolution of data needs for an effective assessment. For example, distributional range for seagrass beds or *Lophelia* reefs can be assessed using a grid (occurrence per defined area unit), but the area covered by these habitats should first be assessed at a finer scale as the sum of area unit where the habitat occurs might be too coarse an approximation of the real areal extent.

PART II Application of Principles to Biodiversity

To deal with the complexities of the marine environment and differences in advice or approach required the following sections have been organised around different biodiversity components that are deemed to be of greatest relevance to assessing biodiversity and subsequently grouped into species and habitats (see 1.3 for further details).

When considering the indicators for the different biodiversity components, it is essential to bear in mind that these might be applicable to one or more of the biodiversity descriptors considered here.

The structure of Part II looks at the application of the principles for setting targets and identifying indicators for the different biodiversity components described above. These can then be used by Contracting Parties to assess the individual biodiversity Descriptors (1, 2, 4 and 6) using the Commission Decision criteria and indicators.

The species part goes into more detail with regard to the Commission Decision indicators for all species groups, since it was felt that for each of these indicators an explanation was required with regard to the pros and cons of methods for baseline-setting and target-setting. Therefore, the structure of the species section is less aggregated than for the habitats section.

4 Habitats

4.1 Introduction

4.1.1 Seabed habitats

Seabed habitat types are very varied across the North-East Atlantic, ranging from broadscale predominant habitat types (such as 'Shallow sublittoral sand') to the 'special'[34] habitats (such as biogenic reef) which tend to be spatially discrete and historically more vulnerable to human pressures. However, the identification of baselines and the setting of targets for these habitat types should, in principle, be similar; hence, the advice in Chapter 3 applies equally to all those seabed habitat types listed in **Annex 8.6** to this manual.

4.1.2 Water column habitats

Pelagic systems are very dynamic and water masses may travel long distances with vertical and horizontal mixing depending on physical characteristics acting at different geographic scales. Plankton species can be used as indicators of hydroclimatic conditions or water movements since plankton have fast turn-over rates and therefore respond quickly to changes in the environment. Moreover, plankton play an important role in the functioning of marine ecosystems and in biogeochemical cycles because they are a key component of the trophodynamics of pelagic ecosystems.

In general, most of the information regarding the biological quality status of pelagic habitats is on phytoplankton in relation to eutrophication assessment (Descriptor 5). Regarding zooplankton, several indicators using long-term monitoring datasets exist but they are currently not used within existing policy frameworks.

4.1.3 Assessment scales and ecological assessment areas

The Directive indicates that hydrological, oceanographic and biogeographic features should be taken into account in defining the regions and sub-regions as set outin Art. 4 (Art. 3.2). These factors are equally important in determining the ecological characteristics (communities of species) of seabed and water column habitats, as they provide biogeographic variation across the range of abiotic habitats.

There are many different aspects of assessment scale e.g. habitats occur at a different scale to many of the pressures acting upon them, with respect to the scale required to determine GES, this would depend on the scale of the habitat within a particular assessment area. In practice this would require consideration on a case by case basis. It could help in this consideration to separate the different needs (e.g for monitoring, establishing measures) and to have a method for selecting assessment scale for cases of species of habitats using a set of criteria.

As the biological communities are strongly influenced by hydrological and oceanographic conditions, it is recommended that ecologically relevant assessment scales for habitats are determined on the basis of these water mass characteristics; this is sometimes referred to as a bioregional approach. The parameters that most influence the characteristics of water masses are sea temperature, salinity, mixing characteristics, frontal systems and turbidity/water clarity as species are tolerant (adapted) to particular conditions for each of these parameters. Also of importance are the ocean currents and general flow of water (e.g. the North Atlantic Drift, upwelling off Portugal), which influence supply of food and larval dispersal.

[34] The term 'special' in the MSFD is used for habitats listed for protection under Community legislation or international agreements.

On the basis of a review of existing relevant regional systems, an analysis of the hydrological and oceanographic characteristics of the North-East Atlantic[35], and a review of the OSPAR 2009 Utrecht Workshop on Regional biodiversity assessment held in the Netherlands, 2009 for the QSR 2010[36], it is recommended that:

a. Assessment scales for habitats are smaller than, and nested within, sub-regions to:

   i. Reflect the changes in ecological character of communities within the same abiotic habitat across a sub-region (due to changes in temperature, salinity and other factors across sub-regions);

   ii. Better accommodate links to management of human activities and their pressures, which can differ significantly across a sub-region.

   iii. Facilitate aggregation of assessments up to the level of sub-regions.

b. Ecological assessment areas are defined, as recommended by ICES/JRC Task Group 1, for each sub-region, using hydrological and oceanographic characteristics, in particular sea temperature, salinity, mixing characteristics, frontal systems and turbidity/water clarity (but also depth, currents, wave action and nutrient characteristics where appropriate) to define water masses of similar overall character within each sub-region. The water mass characteristics should consequently be reflected in similarities in community composition of both seabed and water column habitats.

c. The boundaries between such areas should wherever possible be based on marked changes in these parameters, but where changes are more gradual, more pragmatic factors such as the physiographic shape of the coastline and administrative boundaries may be used, provided that the set of areas within a sub-region overall are ecologically-based.

The identification of a set of ecological assessment areas within a sub-region provides the basis for assessment of the habitats occurring within the area (see Annex 8.6 for a list), as it provides a specific geographical area in which to determine the extent of impacts and whether GES and associated targets have been met. Assessment of ecological status for WFD (water bodies) and favourable conservation status for Habitats Directive (bioregions of Member States waters) use a defined spatial scale (area) for all assessments. As such areas may span several Member States waters, there is a need to develop practical approaches to undertaking the assessments, as are currently applied for some wide-ranging species (e.g. harbour porpoise in the North Sea), to meet the requirements for a sub-regional assessment of GES.

4.1.4 Proposal for ecological assessment areas in the Greater North Sea

Based on the approach described above, the Greater North Sea sub-region has been provisionally divided into five areas for assessment of habitats:

i. Channel/La Manche

ii. Southern North Sea[37]

iii. Northern North Sea

iv. Norwegian/Swedish coast

v. Kattegat

The characteristics of each area are given in Table 4.1.

[35] ICG-COBAM(1) 11/5/1

[36] OSPAR Publication 2010/468

[37] Features of the Wadden Sea may require separate consideration

Table 4.1. Characteristics of the provisional biodiversity assessment areas of the Greater North Sea

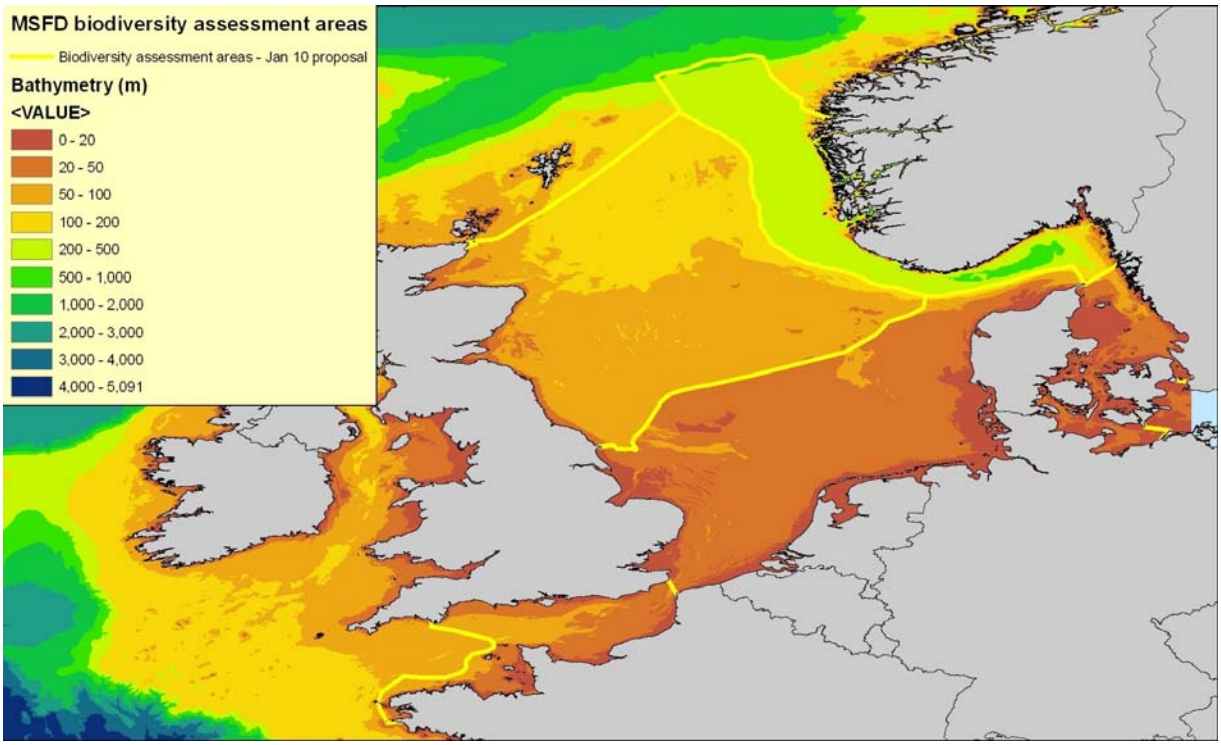
	Channel	Southern North Sea	Northern North Sea	Norwegian/ Swedish coast	Kattegat
Stratification	Stratified	Stratified/ Mixed	Mixed	Mixed	Mixed
1% light penetration	3-9m	3-9m	9-15m	3-9m	3-6m
Wave penetration	40-60m	10-50m	40-80m	30-80m	10-20m
Main depth range	30-70m	20-40m	50-130m	200-500m	<50m
Temperature (bottom) - June	13-15 ˚C	9-15 ˚C	7-8 ˚C	7 ˚C	9-12 ˚C
Salinity (winter)	34-35 ppt	24-35 ppt	33-35 ppt	24-33 ppt	16-18 ppt

The boundaries between the areas are identified, where possible, from marked changes in physical and oceanographic character; the boundaries are indicative and may need further consideration by the relevant Contracting Parties:

i. Western Channel – Ushant Front
ii. Dover Strait – Narrowest point, as per Water Framework Directive ecoregion boundary
iii. Mid North Sea – Flamborough Front and depth contour
iv. North Sea/Norwegian trench – western edge of trench
v. Northern Kattegat – Depth and salinity changes
vi. Southern Kattegat – Salinity changes and the Drogden and Darss sills in the Sound and Belt Sea[38]
vii. Northern North Sea – follows end of Norwegian Trench, and transition to cold Arctic waters at 600m
viii. Northern Scotland – changes to more stable conditions in salinity, temperature and greater wave action.

[38] Based on a proposal in Andersen *et al*. 2010. Delineation scenarios for the Kattegat, data availability and management support tools. Report by DHI for the Agency for Spatial and Environmental Planning, Denmark. Supported by mean salinity data (Figure 4) in ICG-COBAM (1) 11/5/1.

***Figure 11**: Map showing provisional biodiversity assessment areas of the Greater North Sea*



Whilst it is recognized that ecosystems show a continuum of change and hence any boundary applied in the above approach is of necessity somewhat artificial, the use of hydrological and oceanographic conditions to define water masses and their boundaries offers the most ecologically relevant way to determine suitable assessment areas, thereby facilitating the ecosystem-based approach required by the MSFD. For practical application, where such areas span several Member State waters, it should be possible to develop assessment approaches that facilitate assessments of each administrative area.

4.1.5 Further development

It is recommended that a similar approach for the other sub-regions of the North-East Atlantic region should be followed.

Whilst these areas of the Greater North Sea provide an initial method for delimiting areas to determine GES and set appropriate targets by 2012, it is recommended that:

a. They are validated using biological data to assess the appropriateness of the areas and boundaries selected;

b. Further consideration is given to the links to the management of human activities and their pressures;

c. Further consideration is given to the links to other Descriptors to develop, where possible, assessment areas that are compatible across the Descriptors (including for the species assessed as functional groups).

d. They are reviewed and, if necessary adjusted, in the light of practical application and further scientific evidence, before the second assessment in 2018.

4.2 Setting baselines

4.2.1 Setting baselines for seabed habitats

Baseline-setting Method A – This is the most appropriate method for setting baselines for seabed habitats for the criteria and indicators set out in the Commission Decision on GES criteria. For seabed habitats this means a baseline where the condition, extent and distribution of the habitat when pressures directly (e.g. physical abrasion) and indirectly (e.g. removal of typical species) affecting habitat state are removed/negligible. These conditions can be generated by a combination of methods outlined in Section 3, i.e. existing reference states (Ai), historical reference states (Aii) and modelling of reference states (Aiii).

a. Method Ai (Existing reference states) is a scientifically robust, transparent and comprehensible method, and should be the preferred approach to setting baselines where it is possible to find areas where anthropogenic influences on seabed habitats are negligible. This may be particularly challenging in the inshore/shelf environment, much of which is under active use; as such, this approach may be more easily applied to the deep sea/offshore areas. There may also be significant differences across biogeographic regions in terms of numbers of reference areas, which may limit the application of this approach[39]. This approach is likely to be most helpful in evaluating reference state for criteria pertaining to habitat condition and community condition (Criteria 1.6 and 6.2), as opposed to criteria such as extent (Criteria 1.5). As Marine Protected Areas (MPAs) begin to recover to a less impacted state (if adequately managed), the utility of method Ai should increase.

b. Method Aii (Historical reference states) should be used where possible, and in combination with Ai and Aiii (as appropriate). The efficacy of this approach depends on data quality and time period over which historical data exists. It is particularly important for the criteria habitat distribution (1.4) and habitat extent (1.5), as these may have changed substantially compared with current situations (especially for biogenic reef habitats). However, data on the historical extent and condition of benthic habitat types is often limited. A full picture of historical condition is unlikely to be available for any benthic habitat, but data on certain aspects of state may be particularly useful. Some criteria are more amenable to this baseline setting approach than others; for example, there may be more historical information on biogenic reef extent (Criteria 1.5) than reef condition (Criteria 1.6, 6.2). For sediment habitat types, few historical datasets exist particularly in offshore areas and for deep-sea benthic habitats. Longer data series are always more preferable to single data points, as the latter run the risk of missing natural variability and cycles. More specifically, it is important to consider the environmental conditions that prevailed at the time of data collection and how these may vary from current climatic and physiographic conditions. This method is best applied in combination with expert judgement (for example, taxonomic expertise). Its transparency as a methodology is lower than Ai but higher than Aiii.

c. Method Aiii (Modelling of reference states) should also be used where appropriate and feasible (e.g where applicable modelling projects are already underway). As above, this approach may be more applicable to certain criteria than others. Modelling food web dynamics of these habitats may well be challenging as the processes are highly complex. The success of modelling will be dependent on the parameters of the model and the quality / accuracy of the input data, and will require expert- and monitoring data-validation of the model and parameters used. It is also important to ensure that the scale at which the model is produced and the scale at which sampling occurs are the same. Its limitations include its lack of (perceived) transparency by stakeholders. This method may have

[39] The same habitat may vary considerably across different biogeographic region – oceanographic variables may play as significant a role in determining community composition as human pressures

relevance in predicting the state of habitats into the future under scenarios of reduced pressures and climate change.

Baseline-setting Method B - Using a baseline set as a past state is not as scientifically robust as method A, and presents a risk of 'shifting baselines syndrome'. It should therefore only be used where Method A cannot be applied, and preferably as a starting point for setting trend-based targets as opposed to absolute value targets or targets which represent deviations from baselines. Most benthic habitats were already significantly modified before sampling/research programmes began. Using a time series of data is significantly more robust than using a single data point to set a baseline. This is particularly relevant for some biogenic reef habitats which can experience high natural variability over time. Time series data on intertidal habitats is often readily available, but in deeper habitats this is not often the case. Using different past states across many biological components or indicators can become particularly complex and lacking in transparency. This approach may be the most pragmatic where short timescales for setting targets exist (i.e. by July 2012).

Baseline setting Method C - Setting a baseline as a current state is only appropriate where no past data is available, and is most applicable to trends targets (as above). To be scientifically robust, this method should take account of the pressures which prevail at the current time and describe the current state in relation to these pressures. This approach can perpetuate the 'shifting baselines syndrome' outlined in Section 3 and does not adequately address the requirements of Descriptor 1 to have biodiversity 'in line with prevailing physiographic and geographic conditions'. However it has been used for seabed habitats, for instance in the Habitats Directive, as a means to assess the need for 'no further deterioration' in status, with the expectation that further improvements in status can be aimed for (i.e. trend-based targets) where there is evidence of deterioration in any of the assessment criteria.

Expert judgement - Expert judgement is recommended as an integral part of the baseline-setting approach for seabed habitats, particularly in conjunction with Method A.

4.2.2 Setting baselines for pelagic habitats

There is knowledge on baselines for phytoplankton, related to eutrophication assessment (algal blooms and chlorophyll a), and in some areas on zooplankton. Baselines need to be developed for all pelagic organism groups based on available or new data and expert opinion. The preferred method to set a baseline is method B (baseline set in the past), whenever data are available, or Method C (current baseline), where only recent data are available. A variation to Method C (current state, Cii) may also be appropriate: to add a prediction of the modelled effects of measures implemented under current policies to the current status, and set this as a baseline. Irrespective of the method chosen, there will always be a need for expert judgement.

4.3 Setting state targets

4.3.1 Setting state targets for benthic habitats

GES state targets for benthic habitats should ideally be defined as a deviation from a baseline (Target-setting Method 3), with that baseline set as reference state (determined through Methods Ai, Aii or Aiii). This is considered to be the most scientifically robust approach, and one that aims for a target level of recovery of destroyed and/or impacted features in line with the requirements of Descriptor 1 (i.e. prevailing physiographic, geographic and climatic conditions) and Descriptor 6. If this approach is not feasible for all habitats within the 2012 time frames set out in the Directive, then alternative options may need to be pursued – for example, using Baseline-setting Methods B and C in combination with expert judgement.

The specific state targets which are set should account for the natural variability of the habitat type and its potential for recovery. The way in which the targets are set for benthic habitats, in terms of the actual deviation from reference state, can be underpinned by science (especially in defining acceptable habitat quality (condition)

or set purely on the basis of policy aspirations (e.g. for extent of habitat which should be in an acceptable condition). Percentage targets for benthic habitat extent and condition can be based on the biological needs of individual benthic species, communities and ecosystems so they are scientifically credible and robust (Rondinini *in press*).

It is important to reiterate that the way in which the baseline for benthic habitats is developed is as relevant as the chosen deviation from this baseline (i.e. how the target is ultimately set). It is also strongly recommended that an integrated approach to target-setting – combining condition, extent and range – be developed across Contracting Parties, and that targets are set as consistently and uniformly as possible across the North-East Atlantic.

4.3.2 Setting state targets for pelagic habitats

The type of target that is needed (e.g. direction, limit, value) depends on the type of indicator. Since there are few existing indicators for the pelagic habitat it is difficult to specify preferred methods.

In the case that the indicator relates to the abundance of a certain species, the target would best be defined as a range around a desirable state or around the current state (Method 3). This range has to be dynamic, taking into account seasonal fluctuations as well as other fluctuations, such as long-term inter-annual fluctuations due to the North Atlantic Oscillation (NAO), regime shifts, etc.

In the case that the indicator relates to the number/abundance/production of species at the lower end of the food web (i.e. food for other parts of the food web such as prey species – Descriptor 4, indicator 4.3.1), the target could be set as a lower limit/threshold.

4.4 Existing European indicators and state targets

4.4.1 For benthic habitats

The existing European indicators and state targets for benthic habitats mainly relate to requirements for reporting under the Habitats Directive, Water Framework Directive and habitats on the OSPAR List. Whilst they apply to a subset of benthic habitats, as opposed to the full representative range of benthic habitats to be assessed under the MSFD, they are important to consider in terms of both how the targets are set (method) and in relation to the values in use for these policies.

a. Targets under the Habitats Directive (HD)

The following guidance is given for assessments under the Habitats Directive (HD)[40]: 'Favourable conservation status' (FCS) is the overall objective for all habitat types and species of community interest and it is defined in Article 1 of the Habitats Directive. FCS can be described as a situation where a habitat type or species is prospering (in both quality and extent/population) and with good prospects to do so in future as well. The fact that a habitat or species is not threatened (i.e. not faced by any direct extinction risk) does not mean that it is in favourable conservation status. The target of the directive is defined in positive terms, oriented towards a a favourable situation, which needs to be defined, reached and maintained. Favourable conservation status is defined by four parameters or criteria for each habitat type: range, area, structure and function and future prospects. Range and area require the setting of threshold values, which are referred to as 'favourable reference values'. Favourable reference values for range and area must be at least that when the Directive came into force but information on historic distribution may be used when defining the favourable reference value for range and

[40] Assessment and reporting under Article 17 of the Habitats Directive. Explanatory notes and guidelines for the period 2007-2012. Draft February 2011. European Commission.

area, and 'best expert judgement' may be used to define it in absence of other data. For many Member States, FCS is largely determined by the status of habitats at the time the Habitats Directive came into force nationally, and the use of historical data is minimal. As such, in the case of benthic habitats and species that were extinct or extirpated (in a region) or significantly modified before 1992 (when the Directive was adopted) targets set under the Habitiats Directive can be limited, particularly in terms of system recovery (emphasised in Article 1 of MSFD). For example, European oyster beds which disappeared in the North Sea before 1992 would not be considered in the FCS assessments for the Directive. However, despite these shortcomings, setting baselines in this way (Baseline-setting Method C) is an option where there is insufficient data to support Baseline-setting Methods A and B.

Moverover, for those deep-sea rock and biogenic reef habitats which are subject to few pressures (e.g. certain coral reefs and deep-sea sponge aggregations), the current condition and extent could be used as a baseline (determined through modelling and mapping techniques) (i.e.Baseline-setting Method C) and a limit (as opposed to target) could be set at this current condition and extent in line with the HD approach (Target-setting Method 2).

For each parameter/criteria, there are specified thresholds to assess whether the habitat is at FCS or falls below FCS (into one of two classes: Unfavourable – inadequate, and Unfavourable – bad). The thresholds for each parameter/criteria are a mixture of trend-based values, absolute values and qualitative descriptions. The same values are to be used for all habitat types. The assessments adopt the worst class from the four parameter/criteria to provide the overall assessment classification. The assessments are undertaken at the scale of the Member State, but this is split into biogeographic regions if the Member State lies in two or more defined biogeographic regions.

With the strong similarities of the criteria between HD and MSFD, and the contribution that HD habitats can make to assessments under MSFD, it is relevant to consider the approaches and values used for FCS assessment, noting:

i. The boundary between FCS and the Unfavourable-inadequate class needs to be defined for application in MSFD;

ii. The definition of reference range needs to be developed to allow for a suitable target value (deviation from reference value) to be set;

iii. Greater flexibility in a deviation from reference values for each criterion may be appropriate (i.e. the boundary between good and poor) to accommodate sustainable uses of marine waters.

b. Targets under OSPAR (Texel-Faial criteria)

Habitats are listed as ‘Threatened and/or Declining’ under the OSPAR Convention when they meet the criteria outlined in OSPAR Agreement 2003-13: Criteria for the identification of species and habitats in need of protection and their method of application (Texel-Faial Criteria) (One of these criteria relates to decline, defined as ‘a significant decline in extent or quality. The decline may be historic, recent or current. The decline can occur in the whole OSPAR maritime area or regionally’.

Where a habitat has declined by 15% or more of its former natural distribution in the OSPAR maritime area, it is defined as ‘Significantly Declined’. This 15% threshold can effectively be considered to act as a target for the distribution and extent criteria. For example to achieve 85% (of the range/extent) (Target-setting Method 3) of historical (reference) state (Baseline-setting Method A).

c. Targets under the Water Framework Directive

Certain Water Framework Directive (WFD) indicators and targets on species abundance, diversity and composition (for example, for macroalgae and angiosperms or benthic invertebrate fauna) are appropriate for application under MSFD for benthic habitats in the coastal environment. It is recommended that these be applied, as appropriate, in relation to MSFD criteria that encompass habitat condition (1.6, 6.2), as appropriate. The WFD baselines were determined through Baseline-setting Method A, and the targets through Target-setting Method 3. A specific guidance document has been produced by the Commission for setting the reference conditions (baseline-setting Method A), as well as a boundary-setting protocol and boundary harmonization among countries/methodologies[41].

When applying certain WFD indicators and targets for MSFD purposes in the coastal environment, the following considerations must be taken into account:

- The assessment in WFD is carried out at the "water body" level, which is a much smaller assessment scale than is the required by MSFD;
- Baseline-setting and target-setting under WFD is determined after a typological subdivision of water bodies. This typological subdivision can be similar for all Biololgical Quality Elements, (BQE), or BQE-specific (i.e. a typological subdivision for macroinvertebrates and different typological subdivisions for macroalgae and for phytoplankton);
- The baselines and targets set at a specific type, may not have a direct application outside this type (i.e. beyond the 1 nm limit);
- In the case of macroinvertebrates, the assessment methods have only been developed for soft bottoms (not hard substrates);
- In the case of macroalgae, the majority of assessment methods only assess the intertidal area.

d. Summary

Existing indicators and state targets under the Habitats Directive and OSPAR focus principally on aspects such as distribution and extent and do not currently adequately describe habitat condition or community composition aspirations. In the context of the MSFD, this means that there are gaps in terms of Descriptor 1 on biodiversity for criteria 1.6 on Habitat Condition, as well as criteria under Descriptor 4 on food webs and Descriptor 6 on sea-floor integrity. In contrast, targets under the WFD focus on aspects of ecological condition and quality but have not addressed issues of quantity and scale in the way that is required under the MSFD. Moreover, it should be emphasised that the habitat types and associated targets currently considered under OSPAR, Habitats Directive and WFD may not be the most appropriate to represent/apply to the predominant habitats to be assessed under the MSFD (see **Annex 8.6**).

4.4.2 For pelagic habitats

Existing indicators under OSPAR and WFD only concern phytoplankton.

The OSPAR target for e.g. chlorophyll a is a deviation from a natural background level (Method 3): "Maximum and mean phytoplankton chlorophyll a concentrations during the growing season should remain below a justified area-specific % deviation from background not exceeding 50%". This is a target that was set by policy-makers and there is no scientific basis to define the boundary between good and not good. OSPAR uses expert judgement combined with modelling to determine area-specific baselines.

[41] European Comission Common implementation strategy for the Water Framework Directive (2000/60/EC): Guidance Document nº 14 on the Intercalibration process 2008-2011. Technical Report -2011-045 (http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents/intercalibration_1/_EN_1.0_&a=d)

The WFD also uses target-setting Method 3. The target is expressed as a specific value of the Ecological Quality Ratio (EQR), which is the ratio of reference level (baseline setting Method A) and target level. For the assessment methods of phytoplankton in coastal waters it is not accepted that determination of reference conditions and the EQR boundary (or target) is made by expert judgement: a clear relationship between these levels and the pressures (nutrients, organic matter or others) has to be demonstrated with a regression model. If this is not done, the method is considered non-compliant and it is not approved by the European Commission.

4.4.3 Other advice relating to pelagic habitats

Regarding the Commission Decision, indicators 1.4.1, 1.4.2, 1.5.1 and 1.5.2, which relate to habitat distribution and extent, are most likely to be irrelevant for pelagic habitats.

It is advised to further define pelagic habitats, for instance in the current coastal, shelf and oceanic predominant habitat categories. A further refinement could take into account mixed waters, stratification, frontal systems, etc., as these features are ecologically relevant. It should be noted that boundaries between pelagic habitats are typically be dynamic, e.g. depending on season or riverine outflow. Another useful option is to define functional habitat types, for example spawning areas (as also indicated in the Commission Decision).

The assemblage of species that makes up the phytoplankton found in coastal waters in the North-East Atlantic during the spring and summer is highly variable. This means that there are no unique fixed assemblages of species that can be used to detect changes in floristic composition. Furthermore, there are no species that can be used as universal indicators of human pressure, such as nutrient enrichment. An alternative approach (that of using life-forms or functional groups of plankton species as the basis for assessing the status of pelagic habitats) could be appropriate. The grouping species into life forms or functional groups (such as those that require silicate for growth and those that do not) summarises a large amount of data on phytoplankton species and means that existing datasets can be used. The utility of this approach has been demonstrated using Continuous Plankton Recorder (CPR) data from the North Sea and the scientific rationale has been published in the peer reviewed scientific literature.

Regarding zooplankton, several indicators using long-term monitoring datasets exist but they are currently not used within existing policy frameworks. The CPR survey is the largest plankton monitoring programme in the world and has monitored the presence or abundance of more than 400 plankton species on a monthly basis over the North Atlantic since 1946. Zooplankton indicators have been derived from the Continuous Plankton Recorder (CPR) survey dataset to monitor the dynamic regime based on (i) abundance of individual taxa, (ii) functional attributes of the ecosystem, (iii) species assemblages and (iv) larval fish survival (Beaugrand *et al*. 2005). Indicators based on functional attributes may detect subtle changes in a pelagic ecosystem. For example, the regime shift in the North Sea, also evident from the greenness index (Reid *et al*. 1998, Beaugrand 2004), was detected at the beginning of the 1980's using an index of species diversity and the mean size of calanoid copepods. Furthermore, the use of species assemblage indicators is also highly recommended since they could inform on the resilience of pelagic ecosystems and therefore allow future changes to be anticipated.

4.5 Potential common indicators for habitats

The report of the OSPAR workshop on MSFD biodiversity descriptors: comparison of targets and associated indicators, hosted by the Netherlands and held in Amsterdam, 2-4 November 2011, includes the following advice on potential common indicators for benthic habitats. Sediment habitats were discussed separately from rock and biogenic reef habitats. The advice on potential common indicators has been merged because of significant overlaps.

Conclusions

General

a. the common indicators are, in the majority of cases, generic in their description, allowing for sub-regionally operationalised indicators and targets to be developed in future e.g. the choice of sensitive indicator species and metrics which are relevant to the sub-region and responsive to pressures for that particular sub-region. Many of the indicators need further development into operational metrics, taking into account monitoring requirements;

b. it is not currently known how indicators of distributional range and pattern will be measured. This is an area which needs some further thought and coordination across Contracting Parties e.g. to determine if latitude and longitude is the appropriate metric to monitor range etc;

c. differing sizes of sea areas may determine suitability of indicators. Pressure-based indicators are more realistic for large areas while measuring state indices directly is effective for small areas. Both approaches can be integrated.

Rock and biogenic reef habitats

d. gaps in knowledge have been identified such as detailed ecological understanding (for subtidal rock and biogenic habitats), food web interactions and the definition of suitable baselines.

e. it is not clear at present whether an indicator and target is required for rock and biogenic reef habitats which addresses Commission Decision criterion 1.7 on ecosystem structure. Alternatively, this target may need to be a higher level aggregation across more biodiversity components to give an ecosystem level overview.

f. all of the rock and biogenic reef habitats considered within this group fall under habitat type 1170 (reefs) of Annex I of the Habitats Directive; therefore, many of these existing indicators can be directly applied in an MSFD context. Also, the targets used under HD can form a basis for targets under MSFD. However, HD targets may not be sufficient to achieve GES as defined in the MSFD, as they do not sufficiently address restoration aspects and some Contracting Parties have not yet achieved sufficient tools / coverage outside of Natura 2000 sites.

Sediment habitats

In relation to the pressure 'sealing' there is a need to further define how far the proposed indicator could be applicable in different situations.

Advice per Commission Decision indicator

The criteria have been sometimes treated differently depending on whether they address predominant habitat types or special habitat types – a further check needs to be made to ensure both types are fully covered for each criterion

Habitat distribution and extent

- For indicator 1.4.1 (habitat distributional range) and indicator 1.5.1 (habitat extent or area) two groups of relevant habitats have been proposed by Member States: predominant habitats (e.g. defined as EUNIS level 3) and listed habitats under Annex 1 of the Habitats Directive. OSPAR biodiversity workshop (2-4 November 2011, Amsterdam) supported the idea to have (separate) targets for predominant and listed habitats. Decline in distribution was considered to relate primarily to habitats defined by [single] dominant species (e.g. biogenic reef types), because physically-defined habitats tend not to change in distribution. In this context EUNIS level 3 was considered not precise enough to detect decline in this criterion.

- Proposed targets for indicator 1.4.1 would be no decline and, where appropriate, an increase towards some historical level in the case of predominant habitats, and slight deviation from or increasing towards reference conditions or favourable reference range, in the case of listed habitats. Targets need further consideration to improve consistency. Decline has to be due to anthropogenic pressures.
- For indicator 1.4.2 (habitat distributional pattern) targets would be: not significantly different from the baseline pattern. Pattern is mainly important for habitats defined at the community level (eg. biogenic reefs), much less for physically defined habitats. There is however no information on the basis of which you can define how to measure (metric) or to define precise baseline and target..
- For indicator 1.5.1 the OSPAR Biodiversity Workshop proposed a target for predominant habitats, *i.e.* no more than 15% loss from reference conditions, and Annex 1 habitats, *i.e*. stable or increase towards reference conditions. There was concern by several Contracting Parties that 15% loss is unacceptably high. This number needs further evaluation also in respect of current state and the scale to be applied.
- The same indicator also applies to listed habitats. The target would then be stable or increasing and not smaller than baseline value, which is favourable reference area for HD habitats. For habitats on the OSPAR List it is advised to develop baselines at reference conditions.
- It was questioned whether there would be enough data to define reference conditions. For indicator 1.5.1 reference conditions can be practically assessed by determining the extent of infrastructure or other anthropogenic modifications.

Habitat condition and benthic condition

- Biological component
    - Indicator 1.6.1: typical species composition, based on the presence of species in samples, would apply to all types of habitats. The target proposed is to maintain the proportion of typical species, including sensitive species where appropriate, within each habitat type, compared to reference conditions. This needs to be further specified, potentially using a similarity index to compare current community characteristics to reference conditions. For biogenic structure forming species additional indicators may be added, although the level of consensus on these indicators is moderate.
    - Indicator 1.6.2: Use of multi-metric indices (*e.g*. the Benthic Ecosystem Quality Index (BEQI)) to quantify relative abundance of sensitive and opportunistic benthic species was supported. These currently apply to sediment habitats. Depending on the index, they need to relate to direct effects of pressures. Targets should be aligned with WFD. For sediment habitats, the sampling techniques (grabs, cores) often yield data on both species composition and their abundance – thus also fulfilling indicator 1.6.1.
    - Indicator 6.2.3: Size-frequency distribution of selected species (e.g. bivalve spp.) would be a good indicator where pressure merely affects size range while species composition is not significantly affected. Target would be near-natural size spectrum where all size classes are represented.
- Abiotic component
    - Indicator 1.6.3 (physical, hydrological and chemical conditions): indicator is considered important, but not well-defined. Multiple parameters are needed, referring to sediment structure and dynamics. Member States proposed several targets: structure, distribution and dynamics of sediment at the most slightly altered (UK) and natural water-flow and the relief at the most slightly altered, oxygen depletion rarely and short-term (DE).

- Indicator 6.1.2 (extent of damage) target: area lost or damaged below GES should not exceed 15% (predominant habitats) or 5% (listed habitats) of the total area of the habitat. The group considered a 'no deterioration' target was unacceptable for sediment habitats, in view of the current state of these habitats; a deviation from reference condition is preferred to a trend-based target because it provides a specific level to achieve and can be applied equally to all habitat types. The target was similarly proposed by HELCOM. The 15% target originates from OSPAR work. It needs further evaluation before the target can be operationalized.

Physical damage

- Indicator 1.6.1 (condition of typical species/communities): level of intensity, frequency and area of pressure. This would apply to all pressure indicators and, if metrics are harmonised, allow for quantification of cumulative pressures. Target for this indicator would be the level of impact of pressure that will meet the state-based target for habitat condition and extent.

An Alternative proposal based on the approach of the Utrecht 2010 Workshop rocky habitat group, which is consistent with Table 4.2 below):

- Indicator 1.6.1 (condition of typical species/communities): impact/vulnerability of habitat types to physical damage. Target would be the level of exposure to pressure should not result in more than "moderate impact/vulnerability" of the habitat (dependent on the sensitivity of the habitat to this pressure).
- Indicators on physical state (Descriptor 6) are rare and not well defined, but may be more effective an approach than indicators on benthic fauna because they are tightly linked to human activities/pressures. There is a need to seriously consider development of suitable physical state indicators.

Table 4.2 Common approach towards indicators and targets for GES 1 and 6: benthic habitats

The following table outlines the GES indicators and detailed advice on parameters, targets and preferred approach, *ie*. candidate common indicators. The Table 4.2 is based on responses to an inventory of nationally identified indicators returned by all Contracting Parties, except Ireland and Iceland, and subsequent discussion in the OSPAR biodiversity workshop (2-4 November 2011, Amsterdam). ICG-COBAM(3) 2011 has further condensed this work into the current Advice. Colours indicate the level of consensus in these discussions.

[1] Agreement Level: **Green = high; *Orange = some*; Red = none**; black = not enough information

[2] Current Monitoring**: Green = sufficient; *Orange = some, but more required*; Red = none**; black = not enough information

[3] Pressure – see Annex 8.4 for more detailed definitions of each theme. Notes:

- Protocols and exact metrics need to be further specified for most of the indicators.
- Focus of indicator proposals is on benthic habitats.
- The predominant habitats are sediment habitats and do not include "Listed" habitat types. All rock habitats are "Listed" habitat types.
- For biogenic reefs only reefs formed by native species have been considered.
- Indicators that were dropped: 1) Distributional range for predominant habitats

Criterion	Indicator	Link to other Ds	Parameter/Metric [1]	Target [1]	Baseline [1]	Monitoring [2]	Pressure	Advice/consideration
1.4 Habitat distribution	Distributional range (1.4.1)		Listed habitats (HD, OSPAR): Distributional range of all relevant habitats	Stable or increasing towards favourable reference range	Favourable Reference Range, not always specified and differing between CPs	Using HD monitoring; need to check whether monitoring of OSPAR habitats is sufficient		Need to further identify baselines and reconsider target.
1.4 Habitat distribution	Distributional pattern (1.4.2)		Listed habitats (HD, OSPAR): Distributional pattern of all relevant habitats	Distributional pattern is not significantly different from the baseline pattern		Using HD monitoring; need to check whether monitoring of OSPAR habitats is sufficient	Physical loss; physical damage	Verify added value of indicator compared to habitat area. No information on the basis of which you can define and monitor the metric or to define a precise target.

Criterion	Indicator	Link to other Ds	Parameter/Metric [1]	Target [1]	Baseline [1]	Monitoring [2]	Pressure	Advice/consideration
1.5 Habitat extent	Habitat area (1.5.1)		Listed habitats (HD, OSPAR): Habitat area	Stable or increasing and not smaller than baseline value	reference area, not always specified	Using HD monitoring; need to check whether monitoring of OSPAR habitats is sufficient	Physical loss; physical damage	
1.5 Habitat extent	Habitat area (1.5.1)		Predominant habitats: Habitat area	No more than 15% loss from reference conditions, for each substrate type	reference area, not always specified	Probably little monitoring in place.	Physical loss; physical damage	There was concern by several CPs that 15% loss is unacceptably high. This number needs further evaluation also in respect of current state and the scale to be applied. Note comments for 6.1.2 regarding damage and the need for further testing.
1.5 Habitat extent	Habitat volume, where relevant (1.5.2)		-					
1.6 Habitat condition	Habitat: Condition of the typical species and communities (1.6.1)	All pressure descriptors	Typical species composition (presence)	Maintain proportion of typical species (incl. sensitive/long-lived species)	Reference conditions	Using HD monitoring need to check whether monitoring of OSPAR habitats is sufficient	All types of pressures affecting habitats	Needs to be further specified. A similarity index could be used comparing the community to reference/baseline conditions.
1.6 Habitat condition	Habitat: Condition of the typical species and communities (1.6.1)		Intertidal macrophyte species composition (abundance)	Macrophyte species composition is maintained		Using WFD monitoring; need to check whether monitoring of OSPAR habitats is sufficient	All types of pressure affecting habitats	

Criterion	Indicator	Link to other Ds	Parameter/Metric [1]	Target [1]	Baseline [1]	Monitoring [2]	Pressure	Advice/consideration
1.6 Habitat condition	Habitat: Condition of the typical species and communities (1.6.1)		Density of biogenic structure forming species	Maintain current density of habitat forming species at known locations with biogenic structures			All types of pressure affecting habitats	
1.6 Habitat condition	Habitat: Condition of the typical species and communities (1.6.1)		Impact/vulnerability of habitat types to physical damage	Level of exposure to pressure should not result in more than "moderate impact/ vulnerability" of the habitat (dependent on the sensitivity of the habitat to this pressure)			Physical damage	This is a preliminary idea for an impact indicator based on spatial overlapping of habitat and pressure data. Needs more development and validation.
1.6 Habitat condition	Habitat: Condition of the typical species and communities (1.6.1)	D5, D6	Macrophyte depth distribution	WFD target		Using WFD monitoring; need to check whether monitoring of OSPAR habitats is sufficient	Pollution and other chemical changes (i.e. nutrient enrichment)	Already implemented WFD target and indicator. Needs to be adapted and tested in a wider biogeoraphic and ecological context.
1.6 Habitat condition	Habitat: Relative abundance and/or biomass, as appropriate (1.6.2)	D6	Multi-metric indices (e.g. BEQI) to quantify relative abundance of sensitive and opportunistic benthic species (see COM DEC 6.2.2)	Depending on the index, need to relate to direct effects of pressures. Targets should be aligned with those set under WFD.			All types of pressures affecting habitats	Pros: applies to all sediment habitats (special and predominant). Can also give data for typical species indicator. Cons: information on separate species (e.g trends, shifts between species) is lost. Needs further testing and calibration against sensitivity to pressures especially in offshore areas. Possibly to be included in monitoring and preliminarily

Criterion	Indicator	Link to other Ds	Parameter/Metric [1]	Target [1]	Baseline [1]	Monitoring [2]	Pressure	Advice/consideration
								without setting a target.
1.6 Habitat condition	Habitat: Physical, hydrological and chemical conditions (1.6.3)	D5, D6, D7, D8	Quality and abiotic conditions of all relevant habitats in Annex 1 of the Habitat Directive	Only slight alteration from natural conditions.	Reference conditions	Using HD monitoring		Indicator needs further specification, e.g. in terms of abiotic characteristics.
1.7 Ecosystem structure	Ecosystem: Composition and relative proportions of ecosystem components (habitats and species) (1.7.1)							
6.1 Physical damage, having regard to substrate characteristics	6.1.2 Extent of seabed significantly affected for the different substrate types	1.5.1; 1.6; 6.2	Listed habitats (HD, OSPAR): Area of habitat damage	Area of habitat below GES (i.e. unacceptable impact / unsustainable use), as defined by condition indicators, must not exceed 5% of the baseline value	Favourable Reference Area for HD habitats	Using HD monitoring and spatial pressure data; need to check whether monitoring of OSPAR habitats is sufficient (see proposal for 1.5.1)	Physical damage	Need to further identify baselines for reference areas.
6.1 Physical damage, having regard to substrate characteristics	6.1.2 Extent of seabed significantly affected for the different substrate types	1.5.1; 1.6; 6.2	Predominant habitats: Area of habitat damage	Area of habitat below GES (i.e. unacceptable impact / unsustainable use), as defined by condition indicators, must not exceed 15% of the baseline value	Reference area		Physical damage	The target was similarly proposed by HELCOM. The 15% target originates from OSPAR work (pro). Combination of extent and condition within target is important: Includes loss+damage (pro). The target needs further evaluation before the target can

Criterion	**Indicator**	**Link to other Ds**	**Parameter/Metric** [1]	**Target** [1]	**Baseline** [1]	**Monitoring** [2]	**Pressure**	**Advice/consideration**
								be operationalized.
6.2 Condition of benthic community	6.2.3 Biomass/number of individuals above specified length/size	1.6	Size-frequency distribution of bivalve or other sensitive/indicator species in the community	Near-natural size spectrum where all size classes are represented	Reference conditions		All types of pressure affecting habitats	

5 Species

5.1 Assessment scales and species

For mobile species, that are very wide-ranging, assessment areas may need to be as large, or larger than sub-regions, spanning a whole region if necessary, to adequately reflect the population characteristics of some species (e.g. certain cetaceans). However, if assessment areas are too large, there is a risk that assessment of GES could be biased towards those areas that are in the best condition or least impacted. Large assessment areas may fail to take into account significant but localised impacts that could result in a shrinking of the population's range or fragmentation of it. This may have negative effects on the rest of the population in the longer term. Careful setting of targets under Descriptor 1 criterion 1.1 population distribution may help to reduce the risk of detrimental range shrinkage or fragmentation. A "case by case" approach is recommended, depending on species, to define a relevant assessment area. However, the defined area should be, as far as is possible, compatible (or nested) within the sub-regions and linked to those used for habitats to facilitate assessments at ecosystem level (criterion 1.7, Descriptor 4).

Seabirds are not always highly mobile – they form aggregations and can be assessed at this particular location. A recent analysis of seabird breeding numbers at colonies around the UK, showed that temporal trends were similar at adjacent colonies and that sub-regional groupings of colonies existed, presumably because of common drivers in population state related to the geographical location of each colony. Such an analysis could be used in terms of selecting the most ecologically coherent assessment areas.

Assessment scales must be appropriate for the subject and purpose of the assessment. From the experience in the UK, where its marine waters are sub-divided into 'regional seas' (based on biogeographical criteria) it has been demonstrated that such an approach is an appropriate scale for determining GES for seabirds because they depend on the marine resources within the regional seas. However, in supporting such an approach, it is recommended that this should not ignore, but rather make use of the results of smaller scale, more detailed assessments that Member States may undertake. Under the EU Birds Directive, Member States are required to assess and determine the status of each Specially Protected Area (SPA), as well as to monitor the bird populations at the Member State scale, to ensure that the ecological requirements of each species are being met within their jurisdiction. Consequently, this reporting under the Birds Directive will provide data for the GES assessments, also highlighting if and where smaller scale issues are occurring that may have knock on effects for the assessment of GES of seabirds. A similar situation also applies to the two seal species occurring in UK waters. The majority of cetacean species, however, range over much larger areas, although reporting under the Habitats Directive will provide data for GES assessments.

In order to achieve an ecosystem-based approach to management, ICES/JRC Task Group 1 recommended the assessment areas should be defined according to the criteria provided in Art. 3.2 (hydrological, oceanographic and biogeographic). This approach was used to sub-divide the UK's territorial waters into assessment areas for two successive state of the seas assessments (2005, 2010)[42]. For cetaceans, in particular it was not possible to carry out assessments in these spatial units because a) the data on state were not extensive enough to provide accurate indicators at such small spatial scales; and b) the species move across the sub-divisional boundaries and therefore, measures required to improve population state (e.g. bycatch reduction) would need to be implemented at a much larger scale. Indeed, the Utrecht workshop recommended that assessments of cetaceans under relevant criteria in D1 and D4, should be at a biological population level, which may correspond to a region/sub-region (e.g. North Sea). Existing assessments on mobile species can provide useful guidance,

[42] For the North Sea, these are the UK parts of the five areas proposed for habitat assessment (see Section 4.2.1).

for example the Ecological Quality Objects for the harbour porpoise bycatch, grey and harbour seal populations and for commercial fish stocks.

5.1.1 Further development

More work is needed on determining appropriate assessment scales for species. An important issue which is currently not covered in this advice manual is temporal assessment scales (notably relating to life cycles) which will have relevance to monitoring guidances and frequency of monitoring to detect trends.

5.2 Marine mammals and reptiles

5.2.1 Cetaceans

Criteria from Commission Decision:

Species distribution (1.1) and Population size (1.2)

There are two appropriate means of setting 'state' targets on species distribution and population size for cetaceans:

Adopting directional/trends-based targets (specifying direction of change) (Target-setting method 1) using a mixture of approaches to set a baseline) (Baseline-setting Methods A, B[43] and C);

> In practice, this means using an approach similar to that of Habitats Directive Favourable Conservation Status reporting, but with assessment units based on biological populations (rather than Member State political boundaries) and ensuring that, where historic data indicate population size, distribution and condition were greater in the past, GES targets should seek a clear improvement in these criteria (rather than simply maintaining them at current state). Specifying an 'end point' state target may be scientifically flawed given the limitations of current information, but population sizes should not be expected to always increase and so directional targets should be periodically reviewed in the light of ecosystem balances and ongoing pressures. It may also be possible to model carrying capacity for common marine mammal species, based on assumptions or measurements of parameters of life history and use this as a baseline. A target can then be set as a deviation from this baseline of total carrying capacity (for example, 80%). (This method underpins the targets for harbour porpoise bycatch set by ASCOBANS and used in the OSPAR EcoQO).
>
> For species distribution, it may be more appropriate to use historic distribution patterns as a baseline and a specified deviation target, as trends-based targets are less appropriate for this criterion.

In the absence of any reliable information from which to derive baseline and target states, an alternative approach may be to set targets on the pressures that are known to impact on cetaceans – see below.

Population condition (1.3)

Indicators could possibly be developed for body size or age class structure, sex ratio, fecundity rates, survival/mortality rates of cetaceans, where the availability of reliable information allows. Targets for these indicators could be set using methods outlined above for population size and distribution, or by using pressure targets (for example, for certain pollutants such as PCBs) as a proxy for species population condition. Lack of suitable information will greatly limit the scope (e.g. number of constituent species) of any indicators for population condition.

[43] Note there may not be enough historical information on genuinely 'unimpacted' cetacean populations, historical information is still very useful in indicating the levels of cetacean populations at various (impacted) points in the past. This information should inform baseline-setting, along with current and recent scientific monitoring data.

Abundance/distribution of key trophic groups/species (4.3)

Marine mammals are not necessarily useful indicators in the context of food webs. This is because most marine mammals are opportunistic feeders and can alter feeding strategies according to the relative abundance of prey species. This means the state of marine mammal populations are not always a direct and immediate reflection of the state of other trophic levels.

Pressure targets

Reducing known pressures on cetaceans is an alternative way of achieving GES for cetaceans when there are problems with setting state targets or monitoring progress towards them. Ideally, state and pressure targets should be used in combination where possible. Obviously some degree of understanding of the impact of pressures on cetaceans is required if realistic targets are to be set. This may be particularly difficult for baleen whales, for which current impacts are poorly understood.

Pressure targets could be set using the following approaches:

a. setting pressure targets in line with impact levels, i.e. agreed deviations from modelled carrying capacity. For instance, the Harbour porpoise EcoQO requires annual bycatch levels to be reduced to below 1.7% of the best population estimate, so that a target population of at least 80% of carrying capacity is maintained;

b. reducing pressures on cetaceans at crucial points during their life-cycle;

c. reducing or eliminating the impacts of pressures on endangered/threatened species.

The EIA/SEA process may well be used to regulate licensed activities that may introduce (new) pressures (e.g. underwater noise) that will impact on cetaceans, unless mitigation measures are introduced.

5.2.2 Seals

Criteria from Commission Decision:

Species distribution (1.1), Population condition (1.3)

Population size (1.2) and Abundance/distribution of key Trophic groups/species (4.3)

There are two existing EcoQOs, on harbour seal population size and on grey seal pup production (a proxy for breeding population size), that are potentially useful as targets of GES under Descriptors 1 and 4. Both EcoQOs use a current baseline of a five-year running mean (Baseline-setting Method C) and a directional / trend based target (rate of change) (Target-setting Method 1): taking into account natural population dynamics and trends, there should be no decline of ≥10% within any of eleven sub-units (re. harbour seal) or nine sub-units (re. grey seal) of the North Sea.

The EcoQOs were designed to trigger concern that there is a problem with an important part of the North Sea's mammal fauna. If the EcoQO is not met, then it is unlikely that immediate management action would be taken, instead it is intended that this event should trigger research into the causes of this change. Therefore, the EcoQO may not necessarily indicate whether GES has been achieved or not and so there are problems with using these EcoQOs in the context of MSFD. Firstly, the use of a current baseline may not be appropriate in the context of GES because it does not indicate what the aspirations for seal populations should be. Secondly, the 10% target may also not be appropriate for GES, given that it was not developed to be a statutory threshold: 10% was the level at which change could be reliably detected and at which 'social concern' is usually raised.

The EcoQOs on seals in their current form would not be an appropriate target for GES, but could be useful for indicating areas where seal populations might not be moving towards GES. Member States could commit to

taking necessary measures for seals if this research indicated a need to do so. The use of smaller assessment units is also useful for indicating the impact of localised pressures (e.g. bycatch).

Another possible approach might be to model carrying capacity (as with harbour porpoise – see above) and set a target as an appropriate deviation from that (e.g. 80%).

Pressure targets

Given that there are problems with setting state targets for seals or monitoring progress towards them, there could be reliance on pressure targets alone to monitor achievement towards GES. Ideally, state and pressure targets should be used in combination where possible. Pressure targets could be set as outlined for cetaceans above; for example, visual/noise disturbance should be prevented at seal haul-out/pupping areas during relevant times of the year. ICES has previously considered using the number of undisturbed haul out/pupping sites as a basis for an EcoQO, but rejected the idea due to the lack of information on the location of suitable areas for undisturbed haul out/pupping sites. However there may be merit in exploring this concept in the context of GES. The location of pupping areas can change from year to year (OSPAR 2005[44]) and they are not necessarily protected through Natura 2000. As a result, any target-setting should be independent of where the pupping areas are located in a given year.

A synthesis of the information presented here is provided as **Annex 8.7** (Table 8.3).

5.2.3 Reptiles[45]

Given that marine turtles do not breed in the North-East Atlantic and occur in very low densities over very large areas, it is probably unrealistic to attempt to collect abundance data that could be used to provide indicators of population distribution/size or condition under Descriptors 1 and 4. Likewise, carrying capacity models (as suggested above for cetceans and seals) would be extremely difficult to construct given the paucity of necessary information. An alternative approach to achieving GES for turtles in the north-east Atlantic region, may be to set a pressure-target to reduce or eliminate the impact of predominant pressures, for example, from fisheries bycatch.

Setting baselines and targets

Data on historical populations of oceanic stage turtles in the North-East Atlantic are considered insufficient to set a negligible impact reference state and a robust modelled reference state for historical populations is not available. Therefore the options of setting a baseline as a past state (Method B) or set the current state as the baseline (Method C) are more achievable and should, at least, prevent any further deterioration of the population. However, it is highlighted that they provide less scope for recovery of the populations as deterioration of population levels has already occurred.

State targets

Given that marine turtles occurring in the North-East Atlantic breed outside the area, the use of indicators based on nest production (an appropriate state target used in nesting regions) can only be achieved if collaboration is established with western and southern Atlantic countries and territories where nesting beaches are known to occur.

On the other hand, establishing state targets based on estimates of the oceanic stage turtles found in the North-East Atlantic itself would require logistically-intense international monitoring efforts at a regional scale encompassing the waters off Portugal, Spain, France, Ireland and the UK.

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[44] OSPAR. 2005. Background Document on the Ecological Quality Objective for Seal Population Trends in the North Sea. Publication No. 245. 13pp.

[45] Adapted from: International Working Group for the Conservation of the North-west Atlantic Loggerhead Nesting Population. 2010. *White Paper for the Loggerhead Sea Turtle in the Marine Environment*. 4 pp.

Retrieving information from various observers programmes (for fisheries, marine mammals and seabirds) and commercial fisheries bycatch records would be most appropriate since the North-East Atlantic turtle populations occur in very low densities over a very large area. The fisheries observers programme ongoing at the University of the Azores (POPA) was identified as a potential source of information but a basin-wide integration of information is not likely to occur within the 2012 timeframe.

Once population size is estimated, the impacts of pressures occurring in the North-East Atlantic can be properly assessed and carrying capacity models developed that provide pressure mitigation targets.

Pressure targets

Given the paucity of data available for the previous approaches and the inadequacy of relying on nest production indicators for obtaining a timely indicator of the state of pelagic stages of the dominant species (*Caretta caretta*), using pressure indicators and setting pressure targets are probably most appropriate for a more immediate mitigation of the main pressures.

Fisheries bycatch

As inferred from the recommendations of the International working group for the conservation of the North-west Atlantic Longgerheads, summarized above, pressure targets for fisheries bycatch could be based upon one or several of the following indices:

a. turtles by-caught per number of hooks based on pelagic fisheries observers programmes;
b. changes in pelagic fisheries operation (e.g., focus on reduction in the number of hooks in the water per daylight hour);
c. percentage of turtle-bycatch minimizing techniques per total number of hooks set (e.g., focus on use of modified hooks and leader lines, baiting practices, elimination of lightsticks);
d. number of training and awareness activities on safe handling and de-hooking protocols provided to fishermen and longline fisheries observers.

Marine litter

Marine pollution is also of major concern for marine turtle conservation. Cables and plastic rings are known to entangle or strangle the turtle's limbs and neck, causing lethal and sub-lethal effects. Furthermore, plastic debris in general may be confused for natural preys such as gelatinous pelagic organisms and ingested, ending up accumulating in the turtles' guts and producing lethal clogs or sublethal constipation. Finally, contamination by spilled hydrocarbon products also cause a range of lethal and sublethal physical, physiological and toxic effects on these marine reptiles.

An appropriate pressure target contributing to Descriptor 10 would be the acquisition of rescue/necropsy statistics on:

a. frequency of rescued/stranded turtles containing plastic debris in the gut;
b. the weight of plastics in the gut as a function of body size (weight, carapace length);
c. the frequency of live and/or dead turtles affected by limb entanglement and stranglement;
d. the number of turtle deaths attributable to marine litter;
e. frequency of stranded turtles affected by oil contamination.

5.2.4 Potential common indicators for marine mammals and reptiles

The report of the OSPAR biodiversity workshop (2-4 November 2011, Amsterdam) includes the following advice on potential common indicators for mammals. A bycatch indicator for reptiles, ie. turtles, has been proposed by

both Spain and Portugal, but this was not submitted in time for discussion by the subgroup (due to an administrative error). Following the workshop these proposals were added to Table5.1 below.

Conclusions

a. It is considered essential to develop coordinated international monitoring programmes to support any common regional indicators; e.g. use SCANS[46]/CODA[47] surveys and the Joint Cetacean Protocol[48] to facilitate the development of robust and accurate transboundary reporting.

b. A number of countries had proposed using marine mammal abundance and other parameters as indicators of food web status. The group concluded that marine mammal indicators are not necessarily particularly useful in this context because most marine mammals are opportunistic feeders, and because the feeding strategy of the same species will not be the same in different areas. So although the indicators and targets proposed fit the Commission Decision criteria, they were not representative indicators of the food web.

Advice per Commission Decision indicator

Bycatch

a. A significant number of Contracting Parties are proposing bycatch indicators and targets (for short-beaked common dolphin, harbour porpoise, grey and harbour seals). There is strong potential to develop common bycatch targets/indicators at a regional level. It was acknowledged that the specific species to be used in the indicator would vary from sub-region to sub-region.

b. Differences in target thresholds for bycatch need to be resolved. For porpoises there was general agreement about the approach, but debate about whether to use 1.7% or 1% of best population estimate (OSPAR uses 1.7%, ASCOBANS uses 1.7% as an interim level with the ultimate aim of reducing to 1). An alternative approach is to reduce the rate of bycatch by 30%. Similar issues occur in relation to common dolphins.

c. Monitoring methodologies for bycatch appear to differ across Contracting Parties, with UK assessment of bycatch based on observers on commercial vessels, Netherlands and Belgium based on monitoring of strandings, and Sweden based on information reported by fishing vessels. The potential to use CCTV information on vessels in the future was noted (The Common Fisheries Policy may end up requiring this).

d. Bycatch indicators are also relevant to Commission Decision indicator 4.3.1 – however bycatch is not considered a particularly good indicator of food web status.

Distribution (range and pattern) and abundance of seals and cetaceans

e. Distribution and abundance of grey and harbour seals and a range of cetaceans (including harbour porpoise and short-beaked common dolphin) are proposed by a significant number of Contracting Parties. It should be possible to develop common regional targets/indicators for seals and cetaceans.

f. Monitoring methodologies and surveys need to be clarified to ensure commonality (e.g. especially for seal monitoring). Monitoring of cetaceans and seals differs, as seals are counted on land and cetaceans at sea. For seals extensive knowledge is available for numbers on land, however a knowledge gap is behaviour and pattern of seals at sea. Some information is gathered with tagged animals. For cetaceans there is a good basis for common monitoring with international SCANS and CODA surveys.

[46] SCANS - Small Cetacean Abundance in the North Sea and adjacent waters

[47] CODA – Cetatean Offshore Distribution and Abundance in the European Atlantic

[48] Joint Cetacean Protocol http://jncc.defra.gov.uk/page-5657

g. Distributional range will be impacted by anthropogenic activity. Considerably more work is needed on development of the actual target and baseline (historical baseline thought to be most appropriate). There is a need for a better definition for the term 'distributional range' and current data availability - pattern within range is more important for most countries than range per se.

Seal and cetacean population condition

h. A number of potentially common indicators for seal and cetacean condition have been identified (e.g. seal pub survival, PCB contamination, condition based on post-mortem analysis of strandings/bycatch) –all of these require further work.

i. A possible indicator of population condition could also be the pup production ratio of seals (if a population is healthy the ratio pup/adult is higher than when a population is under stress), however caution is needed in areas with recovering populations. For example, in the Wadden Sea (NL, DE, DK) the population is increasing and as a consequence pup/adult ratios are high. When the population becomes more stable, pup/adult ratio will fall. However, this will not indicate declining status, but rather a maturing population.

Table 5.1 contains proposed common parameters including one parameter proposed for reptiles. See also Table 7.1 for common parameters relating to Descriptor 4 on food webs.

Table 5.1 Common approach towards indicators and targets for GES 1 and 4: mammals and reptiles

The following table outlines the GES indicators and detailed advice on parameters, targets and preferred approach, *ie*. candidate common indicators. The Table uses Descriptor 1 as a starting point and includes references to related indicators in Descriptor 4. The Table is based on responses to an inventory of nationally identified indicators returned by all CPs, except Ireland and Iceland, and subsequent discussion in the OSPAR biodiversity workshop (2-4 November 2011, Amsterdam). ICG-COBAM(3) 2011 has further condensed this work into the current advice. Colours indicate the level of consensus in these discussions.

[1] Agreement Level: **Green = high; *Orange = some*;** Red = none; black = not enough information

[2] Current Monitoring**: Green = sufficient; *Orange = some, but more required*;** Red = none; black = not enough information

[3] Pressure – see Annex 8.4 for more detailed definitions of each theme. 'No single pressure' = no identified links between the parameter/metric and a specifc type of pressure.

[4] Feasibility: *** Already operational; ** some further development of indicator/baseline/targets required; and/or more monitoring required; *concept is sound but requires substantial development and additional monitoring.

Criterion	Indicator	Link to other Descriptors	Parameter/Metric [1]	Target[1]	Baseline[1]	Monitoring[2]	Pressure[3]	Advice/ consideration	Feasibility[4]
1.1 Species distribution	Species: Distributional range (1.1.1)	**None**	**Distributional range of grey and harbour seal haul-outs & breeding colonies.**	**No decrease with regard to baseline due to anthro-pogenic activities**	**Baseline mostly derived from SCANS I (1994) or SCANS II (2005); or if available, from historical data (i.e. at a time with little human influence).**	**All seal monitoring data is based on hauled out and some tagged animals at sea.**	No single pressure, but potential, substantial impact of biological pressure on small cetatceans through bycatch	Progress expert discussions to define and agree the range and parameters for monitoring and assessment. Seals indicators not relevant for region IV.	***
			Distributional range of cetacean species regularly present.			**For cetaceans, broadscale international surveys (SCANS, CODA and European Seabirds at Sea Surveys (ESAS)) at low temporal frequency. National**		Consider requirements for the continuation of existing large-scale surveys to strengthen regular monitoring programme for cetaceans and gain agreement on common	**

Criterion	Indicator	Link to other Descriptors	Parameter/Metric [1]	Target [1]	Baseline [1]	Monitoring [2]	Pressure [3]	Advice/ consideration	Feasibility [4]
						monitoring and surveys by some countries on smaller local scales.		protocols for data collection and interpretation. Further develop mechanisms such as the JCP to enable collation of data and production of accurate transboundary assessments	
	Species: Distributional pattern within the latter, where appropriate (1.1.2)	None	**Distributional pattern of grey and harbour seal haul-outs & breeding colonies due to anthropogenic activities**	**No decrease with regard to baseline due to anthropogenic activities.**	**Baseline mostly derived from SCANS I (1994) or SCANS II (2005); or if available, from historical data (i.e. at a time with little human influence).**	**All seal monitoring data is based on hauled out and some tagged animals at sea.**	No single pressure, but potential, substantial impact of biological pressure on small cetatceans through bycatch	Progress expert discussions to define and agree the range and parameters for monitoring and assessment. Seals indicators not relevant for region IV	***
		None	**Distributional pattern of cetacean species regularly present due to anthropogenic activities**	**No decrease with regard to baseline due to anthropogenic activities**	**Baseline mostly derived from SCANS I (1994) or SCANS II (2005); or if available, from historical data (i.e. at a time with little human influence)..**	**For cetaceans, broadscale international surveys (SCANS, CODA and ESAS) at low temporal frequency. National monitoring and surveys by some countries on smaller local scales.**	No single pressure, but potential, substantial impact of biological pressure on small cetatceans through bycatch	Consider requirements for the continuation of existing large-scale surveys to strengthen regular monitoring programme for cetaceans and gain agreement on common protocols for data collection and interpretation. Further develop mechanisms such as the JCP to enable collation of data and	**

Criterion	Indicator	Link to other Descriptors	Parameter/Metric [1]	Target [1]	Baseline [1]	Monitoring [2]	Pressure [3]	Advice/ consideration	Feasibility [4]
								production of accurate transboundary assessments	
	Species: Area covered by the species (for sessile/benthic species) (1.1.3)		**N/A**						
1.2 Population size	Species: Population abundance and/or biomass, as appropriate (1.2.1)	**1.3.1 Population demographics**	**Abundance of grey and harbour seal at haul-out sites & within breeding colonies;**	**No statistically significant decrease with regard to baseline due to anthropo-genic activities**	**Baseline mostly derived from SCANS I (1994) or SCANS II (2005); or if available, from historical data (i.e. at a time with little human influence)..**	**All seal monitoring data is based on hauled out and some tagged animals at sea.**	No single pressure, but potential, substantial impact of biological pressure on small cetatceans through bycatch	Progress expert discussions to define and agree the range and parameters for monitoring and assessment.	***
			Abundance at the relevant temporal scale of cetacean species regularly present.	**No statistically significant decrease with regard to baseline due to anthropo-genic activities.**	**Baseline mostly derived from SCANS I (1994) or SCANS II (2005); or if available, from historical data (i.e. at a time with little human influence).**	***For cetaceans, broadscale international surveys (SCANS, CODA and ESAS) at low temporal frequency. National monitoring and surveys by some countries on smaller local scales These can then be collated on a European wide basis through mechanisms such as the JCP to produce***	No single pressure, but potential, substantial impact of biological pressure on small cetatceans through bycatch	Consider requirements for the continuation of existing large-scale surveys to strengthen regular monitoring programme for cetaceans and gain agreement on common protocols for data collection and interpretation. Further develop mechanisms such as the JCP to enable collation of data and production of	**

Criterion	Indicator	Link to other Descriptors	Parameter/Metric [1]	Target [1]	Baseline [1]	Monitoring [2]	Pressure [3]	Advice/ consideration	Feasibility [4]
						a transboundary assessment.		accurate transboundary assessments	
1.3 Population condition	Species: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)	None	**Harbour seal and Grey seal pup production**	**No statistically significant deviation from long-term variation / no decline of ≥10%**	Current population	**Monitoring already exists for this indicator, in the framework of the OSPAR EcoQOs, comparability among countries is warrantied, even if there is not a strictly similar sampling procedure amoung countries.**	No single pressure	**Different targets were proposed, our suggestion is to follow the OSPAR EcoQO as an agreed target, at least for the North Sea Region.**	***
			Numbers of individuals per species (mammals) being bycaught in relation to population estimates	**Less than Annual bycatch rate is reduced to below x% of the best population estimate, where x depends on the species.**	**Current rate of bycatch**	***Monitoring of bycatch varies by MS and population estimates are being made through SCANS surveys,***	**Biological pressures**	EcoQO for harbour porpoise, to be expanded to other species. The selected species may vary among CPs, linked to sub-regional differences.	**
			Numbers of individuals per species (reptiles) being bycaught	**Decreasing trend.**	**Current rate of bycatch**	***Different rate of implementation of monitoring programmes among CPs.***	**Biological pressures**	The selected species may vary among CPs, linked to sub-regional differences.	**

5.3 Birds

5.3.1 Criteria from Commission Decision

Species distribution (1.1)

Species distribution may only require limited attention when determining GES for marine birds. This is because most species are highly mobile and have large ranges that are mostly constrained by climatic, geographic and physiographic factors, rather than by human pressures except at a very local level.

Population size (1.2) and 4.3: Abundance/distribution of key Trophic groups/species

The criterion level target should be similar to that proposed for an OSPAR EcoQO on seabird population trends as an index of seabird community health: a limit is set on the proportion of species for which breeding abundance is within target levels; the EcoQO or GES is achieved if this proportion exceeds the limit. The indicator is the annual measure of abundance (e.g. pairs, individuals) expressed as a percentage of species-specific baseline (Target-setting Method 3). The baseline is set in the past and is based on expert judgement of when population levels were considered to be least impacted by human activities (Baseline setting Method A). The indicator targets are set as positive and negative deviations from the baseline (e.g. +/- 30%).

The EcoQO on seabird population trends has not yet been adopted by OSPAR but is 'under development' as data is collated from countries within the Greater North Sea. The EcoQO was developed for breeding populations of seabirds in functional groups: offshore and inshore surface- and pelagic-feeding birds; but only partially reflects the state of the non-breeding populations of these groups. Insufficient data exist to enable trends in offshore non-breeding abundance to be estimated, but there is probably scope to expand monitoring to compile indicators and targets on inshore wintering aggregations of pelagic- and benthic-feeding birds. There are also sufficient time-series data on abundance during winter and migration to compile indicators for inter-tidal benthic feeders. Most species in these groups breed widely dispersed in the Arctic and over-winter in Europe, therefore abundance on non-breeding grounds is a more appropriate indicator than breeding population size.

Indicators and targets developed for Criterion 1.2 (population size) would also be appropriate for assessing GES under criterion 4.3: Abundance/distribution of key Trophic groups/species.

Population condition (1.3) and 4.1 productivity of key species or trophic groups

This criterion is considered relevant to the definition of GES for marine birds. Most marine bird species are long-lived and slow to reproduce. Changes in their breeding numbers alone are a poorer indicator of short-term environmental change or acute pressure impacts from pressures (e.g. to food supply) than are other demographic characteristics (e.g. breeding success).

The EcoQO on Local sandeel availability to black-legged kittiwakes (under development) presents an example of how targets could be set for demographic characteristics (c.f. indicator 1.3.1). The EcoQO assumes that if black-legged kittiwakes are unable to breed successfully for several years in succession, then it is likely that sandeel abundance (or that of other small shoaling fish) is low, representing a serious risk of adverse effects on many predator species. The target is set at a limit of mean annual breeding success over a specified period – if the mean breeding success falls below the limit, the viability of the population is considered to be under threat.

Kittiwakes are a good indicator species as their survival and breeding success are closely linked to food supply and the factors (such as climate) that affect it. Further work is needed to determine a) the most appropriate period over which to assess breeding success (i.e. the 3 years recommended by the EcoQO may be too short to indicate a threat of serious or irreversible harm to kittiwake populations); b) most appropriate limit; and c) to include other species that are representative of other functional groups. The determination of GES using these criteria may be limited to those areas where sufficient monitoring of breeding success of kittiwakes and other

applicable species is undertaken. Incidentally, other demographic characteristics that might be good indicators of population condition are monitored at only a few sites and in a few species.

Indicators and targets developed for Criterion 1.3 (population condition) would also be appropriate for assessing GES under criterion 4.1 productivity of key species or trophic groups.

A synthesis of the information provided here is presented in Table 8.4 of **Annex 8.7**.

5.3.2 Potential common indicators for birds

Conclusions

- Inclusion of targets reflecting the general status of the marine environment without necessarily having a direct connection to the impacts of pressures.
- A common set of criteria should be developed for selecting species to constitute each indicator. Indicators should not be limited to declining or vulnerable species.
- Exclusion of EcoQOs on oiled guillemots, litter in fulmar stomachs and pollutants in bird eggs: these targets relate to pressures under D8 Contaminants and D10 Litter and not to biodiversity state or impacts.

Advice per indicator

Species Distribution

- 1.1.1 Distributional Range: Distributional range of breeding and non-breeding marine birds
- 1.1.2 Distributional Pattern: Distributional pattern of breeding and non-breeding marine birds.
- The proposed indicators and targets for 1.1 Species Distribution contained common elements that were used to construct a generic indicator and target for each of 1.1.1 species distributional range and 1.1.2 distributional pattern.
  1.1.1 Distributional Range: Distributional range of breeding and non-breeding marine birds
  1.1.2 Distributional Pattern: Distributional Pattern of breeding and non-breeding marine birds
- The new indicators cover all types of marine bird species including all appropriate functional groups at breeding colonies and at sea. Metrics for both indicators will vary with the type of data collected e.g. colony position and size for breeding seabirds, number of birds per unit area of sea for seabirds at sea.

Population Size

- Species-specific trends in relative abundance of non-breeding and breeding seabird and waterbird species in all functional groups;
- Use the draft EcoQO on seabird populations as a target, because it is easy to understand and data are generally available. It was originally designed for breeding seabird populations but should be adapted for other populations such as breeding waterbirds and marine bird species that breed outside Europe but migrate through or over-winter in European seas. There are currently indicators of breeding seabird populations for the EcoQO in OSPAR Region 2 and 3.

Population Condition

- Breeding success/failure of a selection of waterbird and seabird species
- Annual breeding success of kittiwake (where applicable):
  Use the indicator and target proposed by the UK on kittiwake productivity. These are a modification of the draft EcoQO on Local sandeel availability to Black-legged kittiwakes: the original target of 0.6 chicks per pair is replaced by a variable target that takes into account variation in annual breeding success that is attributable to prevailing climatic conditions.

- Breeding success/ failure of a selection of waterbird and seabird species:
  The bird sub group at the OSPAR Biodiversity Workshop (Amsterdam, 2-4 November 2011) also recommend a more generic seabird breeding success/failure indicator that provides a watching-brief over other species and can be used in the Bay of Biscay, wider Atlantic and parts of the North Sea where kittiwake do not breed. Further work is required to develop a target for such an indicator.
- Non-native/invasive mammal presence on island seabird colonies:
  Land-based pressures that affect birds that depend on the marine environment for food (such as depredation at breeding seabird colonies), should be included in indicators and targets under MSFD (as is eutrophication under Descriptor 5, which originates from land-based sources). A target was proposed under 1.3 to restore or maintain key island seabird colonies free of non-native or invasive predatory mammals.
- Mortality of seabirds from fishing (bycatch) and aquaculture (where applicable).

Ecosystem structure

The Bird sub group at the OSPAR Biodiversty Workshop (Amsterdam, 2-4 November 2011) suggested using indicators for 1.2. Suggest developing an indicator and target based on species number, species evenness or other indicators of specific assemblages. Such indicators could be derived from data collected for the indicators on population size (1.2.1).

Productivity & abundance/distribution of key species groups (criteria 4.1/4.3)

The Bird sub groupSuggested using indicators for 1.1 and 1.2 and 1.3

See table 5.2. See also table 7.1 for common parameters relating to Descriptor 4 on food webs.

Table 5.2 Common approach towards indicators and targets for GES 1 and 4: birds

The following table outlines the GES indicators and detailed advice on parameters, targets and preferred approach, *ie*. candidate common indicators. The Table uses Descriptor 1 as a starting point and includes references to related indicators in Descriptor 4. The Table is based on responses to an inventory of nationally identified indicators returned by all Contracting Parties, except Ireland and Iceland, and subsequent discussion in the OSPAR biodiversity workshop (2-4 November 2011, Amsterdam). ICG-COBAM(3) 2011 has further condensed this work into the current advice. Colours indicate the level of consensus in these discussions.

[1] Agreement Level: **Green = high; *Orange = some*;** Red = none; black = not enough information

[2] Current Monitoring**: Green = sufficient; *Orange = some, but more required*;** Red = none; black = not enough information[3] Pressure – see Annex 8.4 for more detailed definitions of each theme. 'No single pressure' = no identified links between the parameter/metric and a specifc type of pressure.

[4] Feasibility: *** Already operational; ** some further development of indicator/baseline/targets required; and/or more monitoring required; *concept is sound but requires substantial development and additional monitoring.

Criterion	Indicator	Link to other Descriptors	Parameter/ Metric[1]	Target[1]	Baseline[1]	Monitoring[2]	Pressure[3]	Advice/ consideration	Feasibility[4]
1.1 Species distribution	Species: Distributional range (1.1.1)	None	**Distributional range of breeding and non-breeding marine birds** **(different parameters for breeding seabird colonies, wintering shorebirds & marine birds at-sea)**	***No major shifts or shrinkage in the range of marine birds in 75% of species monitored (separate assessments for each functional group, and for range of breeding birds and range of inshore waterbirds)***	***Set as past distributions where data is available; otherwise use the start of new time-series.***	***Monitoring of marine birds at-sea in North Sea is confined to waters of DE, BE, DK, NL, SE?, FR? None in Celtic Seas . UK is currently scoping a monitoring scheme for offshore seabirds in North Sea and Celtic Seas coastal waters. Monitoring of shorebirds in North Sea and Celtic Seas concentrated in***	No single pressure	Further discussion needed between Contracting Party experts to: a) select constituent species; b) agree on paramters/metrics c) select baseline range for each species; d) define target range for each species; e) coordinate data collation and reporting across Contracting Parties.	**

Criterion	Indicator	Link to other Descriptors	Parameter/ Metric[1]	Target[1]	Baseline[1]	Monitoring[2]	Pressure[3]	Advice/ consideration	Feasibility[4]
						transitional waters, so may need additional monitoring of coastal waters.			
	Species: Distributional pattern within the latter, where appropriate (1.1.2)	None	**Distributional pattern of breeding and non-breeding marine birds (different parameters for breeding seabird colonies, wintering shorebirds & marine birds at-sea)**	*No major shifts or shrinkage in the distributional pattern of marine birds in 75% of species monitored (separate assessments for each functional group, and for distribution of breeding colonies and distribution of birds at sea - both inshore and offshore)*	*Set as past distributions where data is available; otherwise use the start of new time-series.*	*Monitoring of marine birds at-sea in North Sea is confined to waters of DE, BE, DK, NL, SE?, FR? None in Celtic Seas . UK is currently scoping a monitoring scheme for offshore seabirds in North Sea and Celtic Seas coastal waters. Monitoring of shorebirds in North Sea and Celtic Seas concentrated in transitional waters, so may need additional monitoring of coastal waters.*	No single pressure	Further discussion needed between Contracting Party experts to: a) select constituent species; b) agree on paramters/metrics c) select baseline range for each species; d) define target range for each species; e) coordinate data collation and reporting across Contracting Parties.	**
1.2 Population size	Species: Population abundance and/or biomass, as appropriate (1.2.1)	4	**Species-specific trends in relative abundance of non-breeding and breeding marine bird species in all functional**	*Changes in abundance of marine birds should be within individual target levels in 75% of species*	*Set as past distributions where data is available; otherwise use the start of new time-series.*	*Monitoring at-sea of aggregations of seabirds in North Sea is confined to waters of DE, BE, DK, NL, SE?, FR? None*	No single pressure	Target and indicator are based on the draft EcoQO on seabird population trends. Target threshold of 75% proposed by ICES (2008). UK to put out to	**

Criterion	Indicator	Link to other Descriptors	Parameter/ Metric[1]	Target[1]	Baseline[1]	Monitoring[2]	Pressure[3]	Advice/ consideration	Feasibility[4]
			groups.	***monitored. (separate assessments for each functional group, and for breeding and non-breeding aggregations). Species-specific annual breeding abundance should be more than x% and less than y% of the baseline (values of x and y can be species-specific).***		***in Celtic Seas . UK is currently scoping a monitoring scheme for offshore seabirds in North Sea and Celtic Seas coastal waters. Monitoring of shorebirds in North Sea and Celtic Seas concentrated in transitional waters, so may need additional monitoring of coastal waters.***		consultation two options: 75% and 90% Further discussion needed between Contracting Party experts to: a) select constituent species; b) select baseline abundance for each species; c) define target thresholds for each species (should upper threshold apply only to species that depredate other birds and benefit from anthropogenic food sources?); d) coordinate data collation and reporting across Contracting Parties.	
1.3 Population condition	Species: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)	4	**Annual breeding success of kittiwake**	***Annual breeding success is not significantly different, statistically, from the level expected in the prevailing climatic conditions (defined by***	***Annual breeding success predicted by a regression of past breeding success and SST in winter 2 years previous.***	**Breeding success of kittiwakes is monitored at colonies throughout its range in the Celtic Seas and the Greater North Sea.**	Biological pressure –	Target is a modification of the draft EcoQO on Local sandeel availability to Black-legged kittiwakes that takes into account variation in annual breeding success that is attributable to prevailing climatic conditions. Further data	**

Criterion	Indicator	Link to other Descriptors	Parameter/ Metric[1]	Target[1]	Baseline[1]	Monitoring[2]	Pressure[3]	Advice/ consideration	Feasibility[4]
				local SST in winter 2 years previous winter) in five years out of six.				analysis by Contracting Parties to determine colony-specific baselines and targets. Further discussion needed between Contracting Party experts to a) aggregate colony assessments to regional sea scale. b) coordinate data collation and reporting across Contracting Parties.	
1.3 Population condition	Species: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)	4	*Breeding success/failure of seabird species*	*Less than 5-15% of colonies failing (breeding success < 0.1 chicks per nest) per year per year in more than three out of six-years*	NA	Breeding success data collected by all relevant CPs for certain species. Need to determine if sufficient collected in each sub-region to construct an indicator.	No single pressure	Agreed that an indicator based on breeding success or failure should be developed for a wider range of species to monitor whether the kitttiwake target is indicative of GES accross the wider community of marine birds. Further discussion needed between Contracting Party experts to a) agree on proposed targets; and b) select indicator species.	**

Criterion	Indicator	Link to other Descriptors	Parameter/ Metric[1]	Target[1]	Baseline[1]	Monitoring[2]	Pressure[3]	Advice/ consideration	Feasibility[4]
1.3 Population condition	Species: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)		**Mortality of seabirds from fishing (bycatch) and aquaculture**	***Estimated mortality as a result of fishing bycatch and aquaculture entanglement does not exceed levels that would prevent targets for 1.2 population size from being achieved.***	NA	No current systematic monitoring of seabird bycatch in all countries. Some countries could extend or modify existing bycatch monitoring for cetaceans.	Biological pressure	Agreement that an indicator of bycatch is required because the extent of the impact is unknown; the impact could be substantial; and Impact could be reduced by tried and tested measures. Further work by experts to set targets on level of acceptable mortality from bycatch.	**
1.3 Population condition	Species: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)	2?	**Non-native/invasive mammal presence on island seabird colonies**	***No non-native mammals on key island seabird colonies***	NA	Extent of monitoring mammal presence known. Monitoring is straight forward and conducted at some sites. CPs need to identify 'Key islands'. Possible selection criteria are published e.g. Ratcliffe et al 2009.	Biological pressure	Agreement that that this is a major pressure and some target should be implemented. The pressure directly impacts on demographics i.e. mortality and productivity. Suggest including invasive native species e.g. foxes getting on islands where they do not naturally occur. Measures should include eradication of predators from islands and the quarantine of	**

Criterion	Indicator	Link to other Descriptors	Parameter/ Metric[1]	Target[1]	Baseline[1]	Monitoring[2]	Pressure[3]	Advice/ consideration	Feasibility[4]
								predator-free islands against invasion/reinvasion.	
1.7 Ecosystem structure	Ecosystem: Composition and relative proportions of ecosystem components (habitats and species) (1.7.1)		***biodiversity in terms of species numbers, species evenness or other indicators of specific assemblages.***	***stable***		***Monitoring of marine birds at-sea in North Sea is confined to waters of DE, BE, DK, NL, SE?, FR? None in Celtic Seas . UK is currently scoping a monitoring scheme for offshore seabirds in North Sea and Celtic Seas coastal waters. Monitoring of shorebirds in North Sea and Celtic Seas concentrated in transitional waters, so may need additional monitoring of coastal waters.***	No single pressure	Agree that indicator and target needed for 1.7 re. Marine Birds. Suggest using indicator and targets for 1.2.1 Population abundance.	**

5.4 Fish and cephalopods

This section is organised according to the mobile species grouping as adopted under OSPAR and used in the GES4BIO workshop held in Utrecht, November 2010. As a consequence, the species group covers all fish and cephalopods species but no other invertebrate species which are dealt with in the context of their benthic and pelagic associated habitats. For the fish and cephalopod species group there is a close link between the biodiversity descriptors 1, 4 and 6 which are dealt with in this Manual and Descriptor 3 on commercial fish and shellfish stocks. Fish and cephalopods cover protected species under the Habitats Directive and OSPAR Convention, as well as commercially-exploited species. Due to separate origins in their past assessment processes, these two categories currently use different reference-point and target-setting methodology. While many of the commercially exploited fish stocks have well-defined biological reference points, non-commercial bycatch species, although equally impacted by human pressures, suffer particularly from a lack of reference points. A synthesis of the information provided here is presented in Table 8.5 of **Annex 8.7**.

5.4.1 Criteria from Commission Decision

Species distribution (1.1)

The baseline-setting approach depends on whether the assessed species is rare and listed, such as those species listed by the Habitats Directive, introduced in 1994 and therefore corresponding to baseline-setting Method C. For common and/or commercial species, the baseline depends on the past state determined as being at a sustainable level, as well as the data availability:

i. For well-sampled species/stocks (e.g. by fisheries surveys) a baseline in the past (Baseline-setting Method B) is possible. This can also be used for common non-commercial species that are covered by sampling programmes;

ii. For infrequently sampled species/stocks (either due to low abundance or not covered by sampling programmes) a mixture of baselines set in the past, modelling of reference state together with expert judgment would allow a more robust baseline to be set.

The target-setting method also depends on data availability:

i. For well-sampled species-all methods are possible. The choice should be made on a case-by-case basis depending on the available information;

ii. For infrequently sampled species (either due to low abundance or unsuitability of sampling methods, or common species that are sampled but not assessed because they are not of commercial interest) directional / trend based targets (direction of change) (Method 1) will be applicable in most cases.

Population size (1.2)

Target-setting Methods 1 and 2 using a mixture of baseline-setting approaches depending on data availability.

For many commercial species, biological reference points are defined. In most cases these are set as limits beyond which the stock would suffer from impaired recruitment. Reference levels are either based on lowest observed biomass or on their stock recruit relationship and include a precautionary buffer. For non-assessed species the baseline method would be a point in the past (method B) based on the time series of the monitoring programme and/or expert judgement on population dynamics and stock recruit relationships.

The target-setting Method depends wholly on the presence of reliable information: for a number of commercial species the defined reference points can be used for this purpose. For species/stocks that have no reference points, a trends-based approach needs to be taken.

Population condition (1.3)

Target-setting Methods 1 and 2, baseline-setting method B (depending on the beginning of a data series combined with expert judgement at which point in time the population is sustainable/has full reproductive potential).

Although less meaningful, trend-setting methods are sometimes the only method available. Despite the realisation that there is an ongoing genetic drift in several fish populations (whereby the age at maturity decreases) for the GES descriptor indicator 1.3.2 "Population genetic structure" there are currently no set reference levels. The large fish indicator which tracks the proportion of fish over a certain size is described below.

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

Target-setting Method 2, using a mixture of baseline-setting approaches.

Although there are some studies on fish egg-production rates, fisheries at present have no references for fecundity levels. Once spawning stock biomass (SSB) falls below a certain threshold this triggers advice to limit fishing pressure. Although recruitment is monitored within fisheries, reference points are set indirectly on biomass and fishing pressure in order to infer on recruitment potential.

Proportion of selected species at the top of food webs (4.2)

Target-setting Method 1 and 2, baseline-setting Method B.

The Large Fish Indicator (LFI) as specified in the Commission Decision criterion (4.2.1) has been adopted as one of the Ecological Quality Objectives in the North Sea. The EcoQO for the North Sea demersal fish community has been defined as fish greater than 40cm in length should form greater than 30% of the fish community. ICES has for several years provided advice and science support on the indicator (through the Working Group on Ecosystem Effects of Fishing Activities (WGECO)). The first quarter (Q1) International Bottom Trawl Survey (IBTS) data were analysed to update the LFI trend. The value of the LFI has continued to increase, standing at 0.22 in 2008 against an EcoQO target of >0.3 (30%). This represents a substantial improvement in the status of the North Sea's Demersal fish community since its low point of 0.05 in 2002. Details of the LFI can be found in the 2007 ICES advice to OSPAR (book1, p59).

Abundance/distribution of key Trophic groups/species (4.3)

Target-setting Method 1, baseline mixture of approaches.

It is considered that using examples of key species at different trophic levels, rather than listed and therefore often rare and therefore rarely monitored and data deficient species, could be more relevant to the biodiversity Descriptors 1 and 4.

5.4.2 Pressure indicators

For commercial fish species, pressures are being dealt with in Descriptor 3 in terms of fishing mortality, whereby pressure limits are set in relation to maximum sustainable yield.

Under descriptor 4, the criteria 4.3.1 mentions specifically species that are targeted or impacted by human activities (bycatch or discards), but only as a sub-heading under a state indicator. For non-commercial species in particular, direct pressure indicators such as discard rates would be more practical to operationalise.

With respect to fish and cephalopods it is unlikely that all species will be assessed with identical methods. Therefore a selection of good indicator species/stocks will have to be agreed upon by the various Member States in order for there to be consistency in application.

5.4.3 Potential common indicators for fish

(No targets and indicators have been proposed for cephalopods).

Conclusions

- The sub group of the OSPAR Biodiversity workshop (Amsterdam, November 2011) agreed that common and generic indicators, based on comparable indicators that were proposed by Member States, were the most suitable approach to take to be able to ensure coherence across sub-regions and regions. Such indicators would need to be robust, but with sufficient flexibility to adapt to different sub-regions, as they represent huge diversity in their characteristics;
- Further work is required to operationalise the four common and generic indicators.
- A number of additional indicators were identified as having potential as common and generic indicators, with some proposals for further work.
- In identifying indicators it is important to be able to determine the main driver of change, some indicators are not responsive enough to anthropogenic pressures;
- The sub group of the OSPAR Biodiversity workshop (Amsterdam, November 2011) found different levels of commonality across the indicators proposed by the Contracting Parties for the different Commission Decision criteria. Indicators relating to species distribution and population size were the most promising; those relating to population condition demonstrated a range of ideas and may require further investigation to understand which approach would be the most comprehensible to the end user (policy-makers); among the indicators describing the fish community, there was broad agreement on the large fish indicator, some of the other proposals present more complex theoretical differences and may need more detailed investigation and review.
- Selection of indicator species is not straightforward. There was a proposal to select species that are in “long term decline” (e.g >25 years). However, given that fisheries had reached their peak in the mid 1980s, this time period would already constitute a heavily disturbed, and possibly recovering situation, and not a sustainable historic baseline. In recovery, the opportunistic species will decline, with slower growing species increasing in numbers, therefore careful consideration should be given to the species selected and what the indictor is tracking. It is also important, that the indicator reflects the time series available in order to ensure the provision of supporting datasets.
- The group agreed that there are still gaps, with no indicators or targets developed for example: deep sea and coastal species; some functional groups; size based indicators specific for non-commercial species; and genetics. In other cases, indicators for several functional groups may already be available through the implementation of other directives and could eventually be considered (e.g. Germany has some indicators for selected anadromous species in the context of the Habitats Directive).
- The OSPAR Framework is the appropriate mechanism to progress this work and it was considered necessary by the group that arrangements are made to continue this work and take it forwards.

Advice per indicator

Species distribution

- 2 common and generic indicators are proposed:
    - species distributional range (1.1.1) of a suite of selected species, eg. sensitive species.
    - species distributional pattern (1.1.2) of a suite of selected species, eg. sensitive species.

Population size

- 1 common and generic indicator is proposed:
  population abundance/biomass (1.2.1) of a suite of selected species, eg. sensitive species.

Population condition

- It was felt there is good potential for 1.3.1 (population demographics), analogues of population demographic indicators from Descriptor 3 to be applied to Descriptor 1 non-commercial species e.g.:
  Proportion of mature fish in the populations of all species sampled adequately in international and national bottom-trawl groundfish surveys

Habitat condition

- 1 common and generic indicator is proposed:
  size composition of the fish community: OSPAR EcoQO for proportion of large fish, for all species from the International Bottom Trawl Survey;
- Several proposals for indicators were considered to have potential, but need more theoretical consideration and further testing with different regional datasets. e.g:
- Mean maximum length of demersal fish and elasmobranchs
- Conservation status of elasmobranch and demersal bony fish species (IUCN) (Calculations based on Piet *et al* 2007)
- Size diversity index according to Rochet & Benoit (submitted)
- Threat indicator: Composite index according to Dulvy et al (2006)
- Fish relative abundance, Hills N1 indicator of species diversity whereby metrics need to be constructed for different size categories to capture trophic cascade issues

See Table 5.3 below. See also Table 7.1 for common parameters relating to Descriptor 4 on food webs.

Table 5.3 Common approach towards indicators and targets for GES 1 and 4: fish and cephalopods

The following table outlines the GES indicators and detailed advice on parameters, targets and preferred approach, *ie*. candidate common indicators. The Table uses Descriptor 1 as a starting point and includes references to related indicators in Descriptor 4. The Table is based on responses to an inventory of nationally identified indicators returned by all Contracting Parties, except Ireland and Iceland, and subsequent discussion in the OSPAR biodiversity workshop (2-4 November 2011, Amsterdam). ICG-COBAM(3) 2011 has further condensed this work into the current Advice. Colours indicate the level of consensus in these discussions. No proposals were put forward for Cephalopods

[1] Agreement Level: **Green = high; *Orange = some*;** Red = none; black = not enough information

[2] Current Monitoring**: Green = sufficient; *Orange = some, but more required*;** Red = none; black = not enough information

[3] Pressure – see Annex 8.4 for more detailed definitions of each theme. 'No single pressure' = no identified links between the parameter/metric and a specifc type of pressure.

[4] Feasibility: *** Already operational; ** some further development of indicator/baseline/targets required; and/or more monitoring required; *concept is sound but requires substantial development and additional monitoring.

Criterion	Indicator	Link to other Descriptors	Parameter/Metric [1]	Target[1]	Baseline[1]	Monitoring[2]	Pressure[3]	Advice/ consideration	Feasibility[4]
1.1 Species distribution	Species: Distributional range (1.1.1)	None	Distributional range (e.g. survey strata: depth or geographical spatial units) of a suite of selected species (e.g. sensitive species adequately sampled (according to specified criteria) by sample gear).	The trend in distributional range should alter in a predictable specified direction towards community recovery.	Baseline reflects historical condition where overall exploitation is considered to be sustainable	This indicator can be applied to any species sampled by any survey method commensurate with good scientific practice.	No single pressure	Applicability to the Wider Atlantic (Region V) unkown. The criteria for selecting species needs to agreed. Species-specific targets and baselines need to be given further consideration.	**
	Species: Distributional pattern within the latter, where appropriate (1.1.2)	1.2.1 Population abundance/biomass	Distributional pattern within range (e.g. survey strata: depth or geographical spatial units) of a suite of selected species (e.g. sensitive species	The trend in distributional pattern should alter in a predictable specified direction towards community	Baseline reflects historical condition where overall exploitation is considered	This indicator can be applied to any species sampled by any survey method commensurate with good	No single pressure	May be desirable to prioritise or link indicators that contribute to this target (principle effect of the pressure will be to reduce abundance this will generally lead to reductions in	**

			adequately sampled (according to specified criteria) by sample gear).	recovery.	to be sustainable	scientific practice.		distribution range and increased patchiness). The criteria for selecting species needs to agreed. Species-specific targets and baselines need to be given further consideration.	
1.2 Population size	Species: Population abundance and/or biomass, as appropriate (1.2.1)		Population abundance/ biomass of a suite of selected species (e.g. sensitive species adequately sampled (according to specified criteria) by sample gear). Bycatch rates of Chondrichthyes	The trend in population abundance/ biomass should alter in a predictable specified direction towards community recovery. Reduce the bycatch in cartilaginous fishes	Baseline reflects historical condition where overall exploitation is considered to be sustainable .	This indicator can be applied to any species sampled by any survey method commen-surate with good scientific practice. Use data from observer programme	No single pressure . Biological pressure	The criteria for selecting species needs to agreed. Species-specific targets and baselines need to be given further consideration. Consideration should be given to extending the bycatch indicator to all vulnerable species, particularly those not covered by monitoring programmes	**
1.3 Population condition	Species: Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)		Proportion of mature fish in the populations of all species sampled adequately in international and national fish surveys					Progress expert discussions to define the target. Testing is also required. Cross reference to D3 progress.	*
1.6 Habitat condition	Condition of the typical species	4.2.1 Large fish	OSPAR EcoQO for proportion of	For each region the	Baseline reflects	This indicator can	No single pressure	Targets to be established for each	***

	and communities (1.6.1)		large fish: for all species from the International Bottom Trawl Survey N.B. Moved by ICG-COBAM from 1.7 because the indicator is at the community level and not the ecosystem level.	proportion (by weight) of fish greater than a specific size in length caught during routine demersal fish surveys (e.g. the ICES International Bottom Trawl Survey) should be greater than a defined target (e.g. 0.3 for the North Sea).	historical condition where overall exploitation is considered to be sustainable.	only be applied to surveys that sample the community.		marine region relative to a region specific reference period, and dependent on the species composition included in the indicator calculation. Being a food web metric, pelagic species may be included - thus new targets will need to be established. Consideration needs to be given to fish communities that are currently not regularly surveyed (e.g. deepsea fish).	
			Conservation status of elasmobranch and demersal bony-fish species.a (IUCN)	Reference level as given in DCF:=>1 for a.) decreasing trend for b.)		This indicator can only be applied to surveys that sample the community.	No single pressure	The relationship with GES needs to be described.	**
			Mean maximum length of demersal fish and elasmobranchs	a stable or increasing trend	Baseline reflects historical condition where overall exploitation is considered to be sustainable	This indicator can only be applied to surveys that sample the community.	No single pressure	Targets to be established for each marine region relative to a region specific reference period, and dependent on the species composition included in the indicator calculation	**

6 Descriptor 2 – Non indigenous species

6.1 Introduction

In the context of the bidiversity descriptors dealt with in this Advice Manual, Descriptor 2 merits special attention, given that it represents a pressure on native biodiversity rather that a state-based aspect of biodiversity assessment. Non-indigenous species (NIS) which become invasive provide one of the greatest threats to biodiversity across the globe. These invasive species are known under the Convention on Biological Diversity as invasive alien species (IAS). The huge ecological and economic impacts imposed by the minority of NIS that become invasive are increasingly being understood. It has been estimated that damage caused by invasive species worldwide amounts to almost five percent of the world economy[49].

To understand the scope of Descriptor 2, general clarification on definitions is needed.

6.2 Definitions for Descriptor 2

Non-indigenous species (NIS) can be defined as 'species, subspecies or lower taxa introduced outside of their natural range (past or present) and outside of their natural dispersal potential. This includes any part, gamete or propagule of such species that might survive and subsequently reproduce. Their presence in the given region is due to intentional or unintentional introduction resulting from human activities', or they have spread from an area where they are considered non-indigenous (secondary introduction)[50].

Invasive Alien Species (IAS) is synonymous with *Invasive Non-Indigenous Species* (the term used within the Commission Decision). Invasive NIS are a 'subset of NIS which have spread, are spreading or have demonstrated their potential to spread elsewhere, and have an adverse effect on biological diversity, ecosystem functioning, socio-economic values and/or human health in invaded regions'[51]. Only a minority of NIS become invasive.

The impact invasive NIS have on the environment to which they have been introduced (described as '*biological pollution*'[52]) can be categorised at various levels;

- Individual (internal biological pollution by parasites or pathogens);
- Population (by genetic change);
- Community (structural shift);
- Habitat (modification of physical-chemical conditions);
- Ecosystem (alteration of energy and organic material flow)[53].

These adverse effects can be almost immediate or develop over time. For example the Chinese Mitten Crab (*Eriocheir sinensis*) arrived on UK shores around 60 years ago via ballast water but showed no signs

[49] Defra, (2008) The Invasive Non-Native Species Framework Strategy for Great Britain

[50] Non-Indigenous Species Task Group Report, 2010

[51] Non-Indigenous Species Task Group Report, 2010

[52] Non-Indigenous Species Task Group Report, 2010

[53] Non-Indigenous Species Task Group Report, 2010

of being invasive. Dry conditions during the late 1990s reduced the flow of rivers in the south, allowing an expansion of the migratory breeding pattern. They are now considered invasive due to damage to streams and rivers (burrowing), and predation on native species[54].

6.3 Issues with selecting targets

Any targets and/or measures introduced under Descriptor 2 should be considered at the sub-regional or broader level. National prevention measures may be ineffective if operated in isolation due to the methods of introduction (e.g. via ballast water).

It is recommended that targets should be developed for newly-introduced species, and where action can be taken to reduce the impact of an existing invasive NIS. It may not be cost-effective or appropriate to set targets where species are already well-established, and where eradication and/or the reduction of their impact is impossible. This needs to be assessed on a case-by-case basis.

Pressure targets for this Descriptor will not be considered here, and will be taken forward by EIHA.

6.4 Existing targets and indicators

6.4.1 International objectives

The Convention on Biological Diversity (CBD) framework goal relevant to invasive NIS (or IAS) is to *control threats from invasive alien species* and the two targets are to:

- *Control pathways for major potential invasive alien species, and to;*
- *Have management plans in place for major alien species that threaten ecosystems, habitats or species (UNEP, 2005)[55].*

Further CBD strategic goals and 2020 headline targets were agreed at the 2010 'Revision of the Strategic Plan for the Post 2010 Period' meeting in Nagoya, Japan. The relevant additional target is:

- *By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.*

6.4.2 EU-level objectives

To progress towards the 2020 target to halt the loss of biodiversity, the EU (through the EEA Streamlining European 2010 Biodiversity Indicators) outlined a strategy for the development of this target – breaking it down into indicators which can be developed and measured. These include;

- Numbers of alien species in Europe since 1900;
- Worst invasive species threatening biodiversity across Europe;

[54] IUCN Marine Menace – Alien invasive species in the marine environment

[55] UNEP (2005) – p.93 UNEP (United Nations Environmental Programme) (2005). Report of the Subsidiary Body on Scientific, Technical and Technological Advice on the work of its tenth meeting. Bangkok, 7-11 February. Documentation made available for Conference of the Parties to the Convention on Biological Diversity, eighth meeting, Curitiba, Brazil, 20-31 March 2006 as UNEP/CBD/COP/8/2. Available at: http://www.cbd.int/doc/meetings/cop/cop-08/official/cop-08-02-en.pdf

- Impact / abundance of invasive NIS;
- Cost analysis of invasive NIS.

The Commission is developing a Strategy on Invasive Alien Species (IAS) by 2012.

The Water Framework Directive, although not specifically mentioning NIS through the text, refers to NIS in both Annex II and V, indicating that they need to be assessed both as environmental pressures and because they undermine 'naturalness'.

6.5 Baseline for targets

Due to lack of data and a full understanding of how NIS are introduced, where they occur, how abundant they are and factors influencing their survival, establishing baseline information for trend comparisons may be very difficult. Furthermore, secondary spread of these species may occur due to human mediated dispersal via local vectors e.g. regional shipping, shellfish movements or via natural dispersal, facilitated by climate change. Therefore it is recommended that an important feature of targets under this descriptor should be to prevent transfer of species (addressing pathways and vectors) which will inevitably lead to lower incidences of new introductions of invasive NIS despite the difficulties in identifying a trend through monitoring.

Current knowledge on NIS tends to focus on coastal and nearshore habitats, where most studies and identification of new arrivals is undertaken. Consequently NIS are generally a 'coastal/nearshore' phenomenon, as data are sparse or non-existent for offshore and deep-water areas. Where genetic studies of assumed 'native' species are undertaken, it can reveal well-established species are actually NIS. As such our knowledge base and consequent action may be biased towards coastal/nearshore areas.

6.6 Criteria from the Commission Decision

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 NIS, particularly invasive NIS, notably in risk areas, in relation to the main vectors and pathways of spreading of such species (2.1.1)

It may not be possible to develop targets on the basis of abundance, occurrence and spatial distribution of invasive NIS due to the lack of sufficiently detailed knowledge on their current status. Such targets are also constrained by the difficulty of removing these species once they have become established in any location.

Trend-based targets for new introductions of NIS, however, may be possible using a combination of best available information on abundance/distribution and expert judgement. Such targets could however be based on long-term monitoring at high-risk sites, for example, in selected marinas or ports.

Pathway/vector management targets to prevent or at least minimise the risk of introduction and spread of NIS should be adopted in the first instance. Given that only a proportion of these species become established and only some will be invasive, these measures maximise the potential to reduce adverse impacts and associated costs.

2.2. Environmental impact of invasive non-indigenous species

- Ratio between invasive NIS 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 invasive NIS at the level of species, habitats and ecosystem, where feasible (2.2.2).

Trend-based targets based on some form of bio-pollution index may be possible, although the methods are currently not well developed within the marine environment. Such targets could however be based on monitoring at sites of high conservation value (Marine Protected Areas), or high-risk areas (marinas and ports).

Targets could focus on the reduction in the impact of NIS through implementation of effective management measures. This could include horizon scanning to identify potential new threats and development of contingency/rapid response plans for species indentified as at high risk of being introduced by 2020.

6.7 Risk-based approach

The high-level framework in Figure 11 details key actions required to address the problems caused by IAS and could provide the basic tool to support GES. This strategy is already adopted in the terrestrial and freshwater environment, and follows the three-stage hierarchical approach adopted by the CBD (CBD (2000) CBD COP 5 Decision V/8 Alien species that threaten ecosystems, habitats or species http://www.cbd.int/decision/cop/?id=7150 (accessed 10 July 2012) as the main ways of dealing with invasive NIS.)

Stage 1: Identification of invasive NIS and risk analysis mechanism using 'black lists', and/or EU/OSPAR species monitoring portal.

Stage 2: Prevention - is given the highest priority throughout all NIS/IAS strategies, this maximises the potential for reducing adverse impacts and the costs associated with tackling invasions once they have become established.

Stage 3: Detection / surveillance / monitoring – currently information on marine invasive NIS is sporadic across the sub-region. Potential need to establish a coordinated data point, including taxon-specific bodies.

Stage 4: Control and eradication – this would include rapid measures to eradicate new invasive NIS. Once established, there is little evidence that the control of species through containing them within a limited area, preventing (or slowing) their spread or eradication in particular areas has worked in the marine environment.

6.8 Target-setting decision tree

To ensure a coordinated approach to this Descriptor, a set of principles for assessing and identifying what actions are feasible in respect of NIS/IAS has been developed.

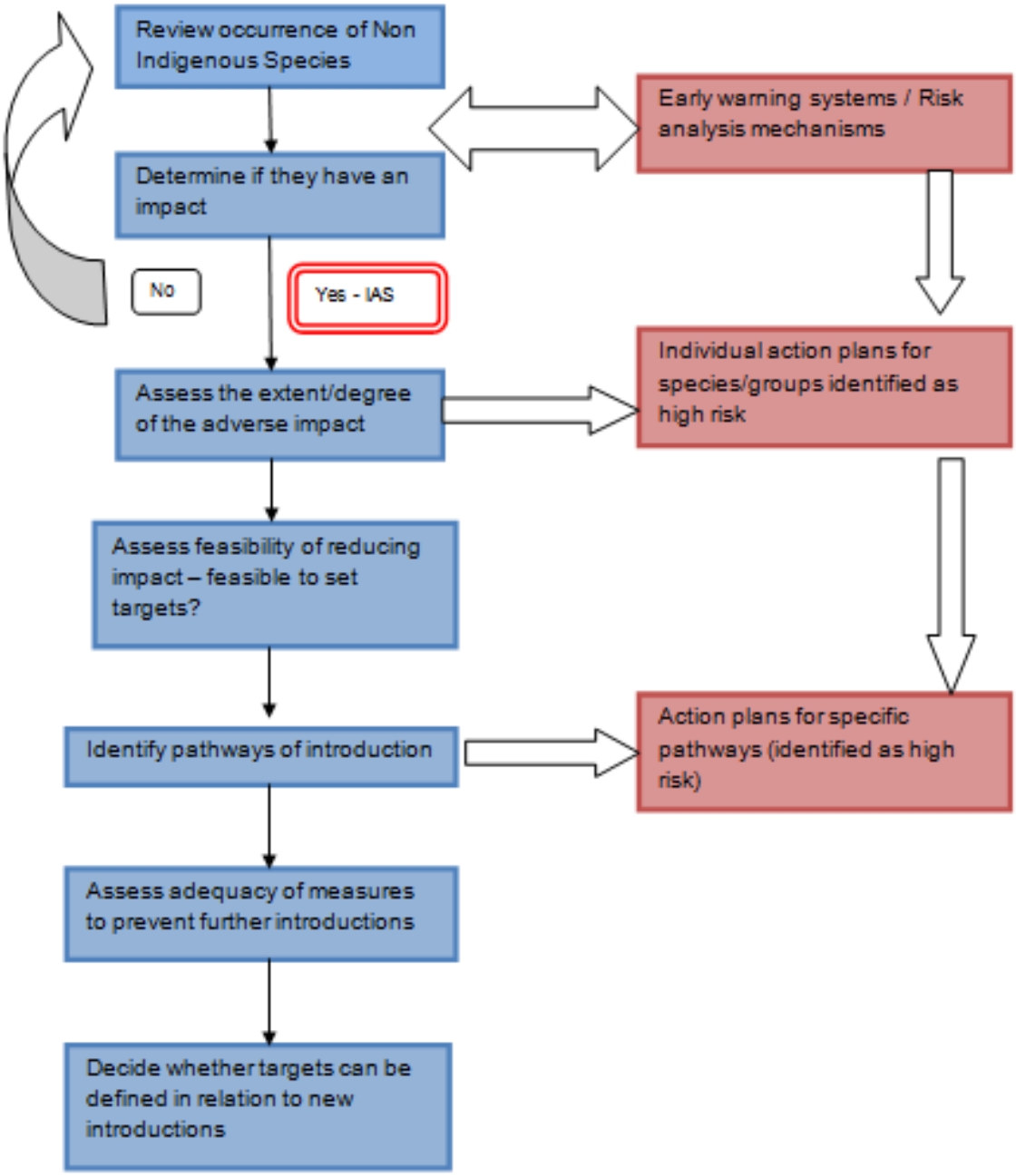

Figure 11 *Decision tree for non-indigenous species.*

6.9 Potential common indicators for non-indigenous species

Conclusions

Two potential common indicators were defined, both of them in need of further development. One indicator relates to Commission Decision indicator 2.1.1 (see below) and the other is an operational

indicator: pathways management measures to prevent the transfer of species. It was questioned whether such a target will be acceptable.

Advice per Commission Decision indicator
Abundance & state of NIS, in particular invasives:

- proposed common indicator: rate of new introductions of NIS (per defined period)
- All indicators proposed by Contracting Parties were for COM indicator 2.1.1. (abundance, occurrence, distribution). The targets were all trend reductions targets, which would require minor changes to ensure consistency.
- Key areas for clarification on Commission Decision criterion 2.1.1 included:
    - Should targets be developed for all NIS, including those already established, or limited to newly-introduced species?
    - Should targets only consider invasive NIS (IAS)?
    - Is it cost-effective or appropriate to set targets where species are already well-established, and where eradication and/or the reduction of their impact is potentially impossible?
    - Is it possible to set trend comparison targets where baseline data are lacking and understanding of how NIS are introduced, where they occur, how abundant they are and factors influencing their survival is limited?
    - Is it possible to develop robust indicators and targets on the basis of numbers and distribution of IAS in sub-regional waters, where knowledge of their current status is limited?
    - Should the management measures which are currently available at international level be considered as targets? *E.g*. IMO Ballast Water Management and the EU Regulation on alien species in aquaculture (708/2007/EC), which will prevent species with a high risk of environmental impact being introduced.

Environmental impact of invasive non-indigenous species

- From the inventory of Member State indicators it appeared that one target was proposed under 2.2.1, which replicated those provided under 2.1, and one in regards to high risk species specific action plans. Two other proposals have been suggested including using surveillance indicators to gather data for Commission Decision criterion 2.2.1 (Ratio of Invasive NIS/native species) and use of the Bio-Pollution Level Index (BPL) to establish the level of NIS impacts on the ecosystem component (Commission Decision criterion 2.2.2), without targets attached to them.
- No potential common indicators were identified under this Commission Decision indicator.

Table 6.1 Common approach towards indicators and targets for GES 2: NIS

The following table outlines the GES indicators and detailed advice on parameters, targets and preferred approach, *ie*. candidate common indicators. The Table is based on responses to an inventory of nationally identified indicators returned by all Contracting Parties, except Ireland and Iceland, and subsequent discussion in the OSPAR biodiversity workshop (2-4 November 2011, Amsterdam). ICG-COBAM(3) 2011 has further condensed this work into the current advice. Colours indicate the level of consensus in these discussions.

[1] Agreement Level: **Green = high; *Orange = some*;** Red = none; black = not enough information

[2] Current Monitoring**: Green = sufficient; *Orange = some, but more required*;** Red = none; black = not enough information

[3] Pressure – see Annex 8.4 for more detailed definitions of each theme. 'No single pressure' = no identified links between the parameter/metric and a specifc type of pressure.

Criterion	**Indicator**	**Link to other Descrip-tors**	**Parameter /Metric[1]**	**Target[1]**	**Baseline [1]**	**Monitoring [2]**	**Pressure [3]**	**Advice/consideration**
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)	None	Rate of new introductions (per defined period) Pathways management measures	**Reduction/prevention/translocation of new introductions by anthropogenic activities** **Or** **Trend of New introductions of non indigenous species towards zero** **Reduction in the risk of introduction of non native species through improved management of the main pathways / vectors**	Not specified In development	Not specified		Lack of baseline data What are the main pathways/vectors? How is reduction in the risk defined, and how can this be monitored?

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)							Gap identified in regards to 2.2. Some CP proposals could be considered if further information is provided
	Impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible (2.2.2).							

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7 Current status of assessment methods for the biodiversity descriptors

7.1 D1 Biodiversity

The very broad scope of this Descriptor makes its successful implementation a challenge, particularly for those Member States with very large sea areas. As a general guide, it is recommended to focus on pressures and impacts to enable an assessment of risks to biodiversity (areas and biodiversity components most likey to be affected) and hence a more targeted approach to identification of targets, indicators, monitoring and measures).

The principles of assessment techniques for species and habitats are reasonably well established, with recent experience of similar approaches (in terms of criteria and scales) under the Habitats Directive. However, other methods exist (e.g. OSPAR listing, IUCN) and the application of these principles and availability of data are less well-established. There is a need to more firmly incorporate systematic assessments of pressures and impacts at large geographical scales in order to develop robust data-driven assessments. The setting of targets and identification of indicators has traditionally had a state-based focus, often with poor linkages to impacts, pressures and ultimately to measures; this may be less effective for MSFD purposes to achieve GES. Most of the Commission Decision indicators need to be 'operationalised' by making them specific to particular species, habitats and areas (e.g. sub-regions).

Assessments at functional group level (for fish, birds, mammals) are less well-established, although the recent development of a seabird EcoQO offers appropriate metrics. Current work within ICG COBAM is focused on identification of suitable species to represent the wider status of the functional groups. Assessment techniques at ecosystem level are poorly developed and will need further efforts.

It is likely that use of existing biodiversity targets and indicators will provide only a partial picture of overall needs for this descriptor, with a need to develop further targets and indicators to address the predominant habitat types and functional groups. Due to a lack of indicators in some aspects, there is likely to be a need for continued developments for this Descriptor beyond 2012.

7.2 D2 Non-indigenous species

This descriptor is treated as a pressure having impacts on native biodiversity; the assessment of impacts from non-natives (e.g. the bio-pollution level (BPL) index) needs refinement. It may be appropriate to use indicators for this Descriptor (e.g. on the state of invasive species), but recognise that their reduction/eradication may not be feasible. Because of this targets may best be associated with measures (i.e. prevention of new introductions); EIHA leads on measures for this Descriptor.

7.3 D3 Commercial fish and shellfish

This Descriptor is not addressed directly in this Manual, but it has strong connections with the assessment of fish under Descriptor 1 (e.g. use of similar approaches) and because the effects of commercial fishing need to be taken into account (i.e. as impacts) on other aspects of biodiversity, notably functional groups of species, seabed habitats, food webs and sea-floor integrity.

7.4 D4 Food webs

This is the least well-developed of the biodiversity Descriptors, as metrics and indicators are generally not well-established. The Large Fish EcoQO for the North Sea is an exception, and could be adapted for application in other sub-regions. For other aspects, the careful selection of species and habitats for assessment of Descriptor 1 and 6 should provide the necessary underpinning information to develop suitable indicators.

Table 7.1 was developed during the meeting of ICG COBAM (3) 2011 which was held in Madrid on 28-30 November 2011. It consists of compositions from tables on the different species from MSFD Descriptor 1 (mammals, fish and birds) (c.f. Chapter 5) and on contributions from the workshop on MSFD biodiversity descriptors which was held in Amsterdam in November 2011 (indicated in yellow).

7.5 D6 Sea-floor integrity

This Descriptor has much in common with assessment of habitats under Descriptor 1. For efficiency, it is therefore recommended to treat the two together, with assessment of 'seabed substrate' types under Descriptor 6 aligned with the predominant habitat types of Descriptor 1, and with common assessment of seabed quality and setting of targets, e.g. for reductions in impacts. Whilst the Commission Decision indicators for Descriptor 6 are more oriented towards functioning of seabed communities, they are compatible with and complementary to those used for Descriptor 1. As for Descriptor 1, an overall assessment of the substrate types needs to assess the extent of impact from all pressures affecting the seabed, at the scale of the assessment area.

7.6 Potential common indicators for food webs

A Table was developed at the OSPAR Biodiversity Workshop (Amsterdam, November 2011) gathering all proposed indicators for Descriptor 4 from the indicators proposed across the various ecosystem components. In total 31 proposed indicators were identified of which 6 were exclusively mentioned for Descriptor 4. Initial questions and comments regarding the (suitability of the) proposed indicators were collected from participatns. Due to the short time available further discussions on the proposed indicators were not possible. Next steps are to develop a ‘white paper’ on Food webs and to seek expert advice, for instance through the creation of a joint OSPAR/HELCOM expert group.

Table 7.1 Common approach toward indicators and targets for GES 4

The following table outlines the GES indicators and detailed advice on parameters, targets and preferred approach, *ie*. candidate common indicators. The Table is based on responses to an inventory of nationally identified indicators returned by all Contracting Parties, except Ireland and Iceland, and subsequent discussion in the OSPAR biodiversity workshop (2-4 November 2011, Amsterdam). ICG-COBAM(3) 2011 has further condensed this work into the current advice. Colours indicate the level of consensus in these discussions..

[1]Agreement Level: **Green = high; *Orange = some*;** Red = none; black = not enough information

[2]Current Monitoring**: Green = sufficient; *Orange = some, but more required*;** Red = none; black = not enough information

[3]Feasibility: *** Already operational; ** some further development of indicator/baseline/targets required; and/or more monitoring required; *concept is sound but requires substantial development and additional monitoring.

Criterion	Indicator	Link to other Descriptors	Parameter/Metric	Target	Baseline	Monitoring	Pressure	Advice/ consideration	Feasibility
4.1. Productivity of key species or trophic groups	Performance of key predator species using their production per unit biomass (productivity) (4.1.1).		**Annual breeding success of kittiwake**	***Annual breeding success is not significantly different, statistically, from the level expected in the prevailing climatic conditions (defined by local SST in winter 2 years previous winter) in five years out of six.***	***Annual breeding success predicted by a regression of past breeding success and SST in winter 2 years previous.***	**Breeding success of kittiwakes is monitored at colonies throughout its range in the Celtic Seas and the Greater North Sea.**	Biological disturbance – selective extraction of species, including incidental non-targets catches.	Target is a modification of the draft EcoQO on Local sandeel availability to Black-legged kittiwakes that takes into account variation in annual breeding success that is attributable to prevailing climatic conditions. Further data analysis by CP's to determine colony-specific baselines and targets. Further discussion needed between CP experts to a) aggregate colony assessments to regional sea scale. b) coordinate data collation and	

Criterion	Indicator	Link to other Descriptors	Parameter/Metric	Target	Baseline	Monitoring	Pressure	Advice/ consideration	Feasibility
								reporting across CPs.	
			breeding succes of key predators	natural breeding succes					
			Abundance of prey fish species of grey seals. Abundance of prey fish species of harbour seals.	No decline in abundance of the main prey species of grey and harbour seals (both total and individual species) (separated by up to five years, OSPAR) on the Dutch Continental Shelf.					
4.2. Proportion of selected species at the top of food webs	Large fish (by weight) (4.2.1).		Fish: OSPAR EcoQO for proportion of large fish: for all species from the International Bottom Trawl Survey	Fish: For each region the proportion (by weight) of fish greater than a specific size in length caught during routine demersal fish surveys (e.g. the ICES International Bottom Trawl Survey) should be greater than a defined target (e.g. 0.3 for the North Sea).	Fish: Baseline reflects historical condition where overall exploitation is considered to be sustainable.	Fish: This indicator can only be applied to surveys that sample the community.	Fish: Removal of species.	Fish: Targets to be established for each marine region relative to a region specific reference period, and dependent on the species composition included in the indicator calculation. Being a food web metric, pelagic species may be included - thus new targets will need to be established. Consideration needs to be given to fish communities that are currently not regularly surveyed (e.g. deepsea fish).	***

Criterion	Indicator	Link to other Descriptors	Parameter/Metric	Target	Baseline	Monitoring	Pressure	Advice/ consideration	Feasibility
					.	This indicator can only be applied to surveys that sample the community.		.	***?
			Mean maximum length of demersal fish and elasmobranchs	a stable or increasing trend	Baseline reflects historical condition where overall exploitation is considered to be sustainable	This indicator can only be applied to surveys that sample the community.	Removal of species.	Targets to be established for each marine region relative to a region specific reference period, and dependent on the species composition included in the indicator calculation	***?
									***
4.3. Abundance/distribution of key trophic groups/species	Abundance trends of functionally important selected groups/species (4.3.1).		**Mammals/reptiles:** **Numbers of individuals within species (mammals and reptiles) being bycaught in relation to population estimates**	**Mammals/reptiles:** **Less than 1.7% of the population of harbour porpoise**	**Mammals/reptiles:** Current population	**Mammals/reptiles:** No regular monitoring of the population. This may suppose a dificulty to apply the indicator.	**Fishing**	**Mammals/reptiles:** EcoQO for harbour porpoise, to be expanded to other species. The selected species may vary among CCPP, linked to sub-regional	**

Criterion	Indicator	Link to other Descriptors	Parameter/Metric	Target	Baseline	Monitoring	Pressure	Advice/ consideration	Feasibility
								differences.	
			Numbers of individuals within species (mamals and reptiles) being bycaught	**Decreasing trend.**	**Current rate of bycatch**	***Different rate of implementation of monitoring programs among CCPP.***	**Fishing**	**The applicability of this indicator seems to be higher since no population estimates are needed. On the other hand, the usefullness of the indicator is limited because it is not directly related to the state of the populations.** The selected species may vary among CCPP, linked to sub-regional differences.	**
			Fish: Bycatch rates of Chondrichthyes	Fish: Reduce the bycatch in cartilaginous fishes		Fish: Use data from observer programme	Removal of non-target species.	Fish: Consideration should be given to extending the bycatch indicator to all vunerable species, particularly those not covered by monitoring programmes	
			Seabirds: **Species-specific trends in relative abundance of non-breeding and breeding marine bird species in all functional groups.**	**Seabirds:** ***Changes in abundance of marine birds should be within individual target levels in 75% of species monitored. (separate assessments for***	**Seabirds:** ***Set as past distributions where data is available; otherwise use the start of new time-series.***	**Seabirds:** ***Monitoring at-sea of aggregations of seabirds in North Sea is confined to waters of DE, BE, DK, NL, SE?, FR? None in Celtic Seas . UK is currently scoping a monitoring***	No single pressure	**Seabirds:** Target and indicator are based on the draft EcoQO on seabird population trends. Target threshold of 75% proposed by ICES (2008). UK to put out to consultation two	

Criterion	Indicator	Link to other Descriptors	Parameter/Metric	Target	Baseline	Monitoring	Pressure	Advice/ consideration	Feasibility
				each functional group, and for breeding and non-breeding aggregations). Species-specific annual breeding abundance should be more than x% and less than y% of the baseline (values of x and y can be species-specific).		*scheme for offshore seabirds in North Sea and Celtic Seas coastal waters. Monitoring of shorebirds in North Sea and Celtic Seas concentrated in transitional waters, so may need additional monitoring of coastal waters.*		options: 75% and 90% Further discussion needed between CP experts to: a) select constituent species; b) select baseline abundance for each species; c) define target thresholds for each species (should upper threshold apply only to species that depredate other birds and benefit from anthropogenic food sources?); d) coordinate data collation and reporting across CPs.	
			Breeding success/failure of seabird species	*Less than 5-15% of colonies failing (breeding success < 0.1 chicks per nest) per year per year in more than three out of six-years*	NA	Breeding success data collected by all relevant CPs for certain species. Need to determine if sufficient collected in each sub-region to construct an indicator.	No single pressure	Agreed that an indicator based on breeding success or failure should be developed for a wider range of species to monitor whether the kitttiwake target is indicative of GES accross the wider community of marine birds. Further discussion needed between CP experts to a) agree on proposed targets;	**

Criterion	Indicator	Link to other Descriptors	Parameter/Metric	Target	Baseline	Monitoring	Pressure	Advice/ consideration	Feasibility
								and b) select indicator species.	
			Mortality of seabirds from fishing (bycatch) and aquaculture	***Estimated mortality as a result of fishing bycatch and aquaculture entanglement does not exceed levels that would prevent targets for 1.2 population size from being achieved.***	NA	No current systematic monitoring of seabird bycatch in all countries. Some countries could extend or modify existing bycatch monitoring for cetaceans.	Biological disturbance – selective extraction of species, including incidental non-targets catches.	Agreement that an indicator of bycatch is required because the extent of the impact is unknown; the impact could be substantial; and Impact could be reduced by tried and tested measures. Further work by experts to set targets on level of acceptable mortality from bycatch.	**
			Biovolumina Phytoplankton	watertype specific biovolume between 3 and 8 $mm^3 \cdot L^{-1}$, within offshore regions slightly below the lowest value from the coast					
			Change of plankton functional types (life form) index Ratio between: Gelatinous zooplankton & Fish larvae, Copepods & Phytoplankton; Holoplankton & Meroplankton	plankton community not significantly influenced by anthropogenic drivers					
			Dietary functional group biomass: Biomass of pelagic planktivores, pelagic	**NA**					

Criterion	Indicator	Link to other Descriptors	Parameter/Metric	Target	Baseline	Monitoring	Pressure	Advice/ consideration	Feasibility
			piscivores, demersal benthivores, demersal piscivores and omnivores; benthos						
			Relative use of haulouts by grey and harbour seals	**NA**					

8 Annexes

8.1 Lessons learned and conclusions from the OSPAR/MSFD workshop on approaches to determining GES for biodiversity held in Utrecht, The Netherlands, 23-24 November 2010.

Cf. Section 1.3

Lessons learnt from other Directives and Regional Sea Conventions were:

a. indicators and targets should be as simple as possible, pragmatic and provide the necessary information required for assessment and management;

b. in addition to understanding population size and distribution, or habitat extent and distribution, it is also important to assess the condition or health of species and habitats as part of Good Environmental Status (all aspects are criteria in the Commission Decision);

c. in order to assess the biodiversity status of each functional group and predominant habitat type, it is likely to be necessary to select specific species and habitats which can best represent each group or habitat type and which preferably are supported by sufficient data and are particularly sensitive to one or more anthropogenic pressures. The special habitats and species which are subject to Community legislation or international conventions are also to be assessed; some of these may also be used to contribute to the assessments of the functional groups and predominant habitats in which they occur;

d. the MSFD process should, wherever possible, be based on sound science and the precautionary principle;

e. using a combination of approaches to determine the baseline, against which to set targets, was felt to be the most robust approach. Expert judgement plays an important role in determining baselines and setting targets but it is important that the provision of expert judgement is transparent and based on predefined and consistent criteria/guidance;

f. coordination of targets and baselines across Contracting Parties can be challenging, but is needed to reflect biodiversity's ecological rather than administrative patterns of distribution;

g. harmonisation of monitoring methods is not necessary, provided that results are comparable;

h. setting of targets needs to allow for flexibility and evolution over time as knowledge gaps are filled and assessment and management concepts refined;

i. it is important to define the threshold, in both qualitative and quantitative terms, at which GES is met, as use of only trend-based targets gives no clear indication of when good status is achieved.

j. It is necessary to take regional as well as sub-regional characteristics into account and to decide - where appropriate - on the setting of targets and indicators on the level of sub-regions or sub-dividsions.

General workshop conclusions were:

Mixtures of approaches are required in order to establish a baseline from which GES can be determined

a. for the species groups and the pelagic habitat, this comprises a baseline set as a past (Method B), or current state (Method C) in addition to expert judgement;

b. for the sediment and rock habitat groups, the balance tended to lie with a combination of current or past reference states (Methods Ai-iii) again combined with expert judgment.

Data availability and data quality is critical to being able to establish baselines and identify appropriate targets.

The European marine environment is not in a truly unimpacted state. The pressures put upon the oceans by man have wide-reaching effects. The concept of truly unimpacted sites (i.e. sites where the state is equal to that found before any human impact was experienced) was therefore felt not to be helpful moving forwards. Alternatively, the concept for reference state should refer to 'a state at which the anthropogenic influences on species and habitats are considered to be negligible';

The target-setting process, apart from being based on the given Descriptors of GES and on the precautionary principle will also need to reflect on aspirations for the sustainable use of the marine environment (as set out within the MSFD).

It was clear from discussions at this GES4BIO workshop that establishing state targets for GES is challenging, and that impact and pressure targets may need to be used as a proxy for state in some cases. This could be particularly important in the context of defining population sizes for mobile species, where predator-prey dynamics and their high mobility provide long-term uncertainties over their population sizes in given areas.

The different species groups and habitat types of the marine environment are dynamic and inextricably linked. The targets that are set for GES cannot therefore be considered in isolation. In successfully progressing towards one particular target, there may be implications for other targets.

The overall concepts applied in the Water Framework Directive and Habitats Directive of defining good status as target values in relation to defined baselines (reference points) was considered appropriate for biodiversity application in MSFD. However, further consideration was needed on the basis for setting these baselines and on defining targets at acceptable levels of deviation from these baselines. For example, MSFD baselines should take account of distributions and abundances of species and habitats that have been lost in the past e.g. Flat oyster bed habitats. Using a baseline set at the current state would mask previous deteriorations in range, extent and condition of habitats and species.

Approaches used in some OSPAR EcoQOs (e.g. for the seabird group) were considered appropriate for the purposes of the MSFD, as they are easy to understand, pragmatic and supported by monitoring data. Species on the OSPAR List of threatened and/or declining species are in many cases less suitable for use as indicators for relevant functional groups within MSFD in cases where they are scarce and thus difficult to monitor. It is, however, necessary to select at least key species of this list which are known to respond to certain pressures.

Without an articulation of GES it will be very difficult to set concrete state targets. It will, nevertheless be possible to recognise a degraded environment, and how steps might be taken to reduce impacts by managing the pressures.

It is anticipated that it will not be possible by 2012 to have a final, refined picture of GES, what it means and how progress towards GES can be measured. There is still a need to further evolve the thinking behind the concepts, and some information is not yet available. It is therefore conceivable, that by 2012, the initial assessment, set of GES characteristics, environmental targets and associated indicators will be a first attempt, with the opportunity for further development and refinement in the subsequent six-year reporting period. The perspective of the European Commission is that it is imperative to be as clear as possible as to the meaning of GES (i.e. the state-based targets) as this should not change significantly with time, but may be refined on the basis of new evidence.

8.2 Terminology

Cf. section 2.2; 2.6.3

Terminology of the Marine Strategy Framework Directive

Final version (22 February 2011)

The attached list of common terminologies/definitions for the implementation of the Marine Strategy Framework Directive (MSFD) has been developed by the OSPAR Intersessional Correspondence Group on the Coordination of Biodiversity Assessment and Monitoring (ICG COBAM) in relation to biodiversity issues in the first place. The Intersessional Correspondence Group for the Implementation of the MSFD (ICG-MSFD) agreed to distribute it to other OSPAR subsidiary bodies for consistent application, and supplementation by these bodies, if such supplementation is considered necessary. ICG-MSFD also agreed to make this document available to the EU Working Group on Good Environmental Status (WG GES) for its deliberations.

Background

The terminology of the Marine Strategy Framework Directive (MSFD; 2008/56/EC), of the EU Commission's Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (2010/477/EU) and of relevant guidance literature (e.g. the report of ICES/JRC Task Group 1) is neither consistent nor self-explanatory. Therefore, a proposal of definitions and interpretations was submitted by Germany to OSPAR's Intersessional Correspondence Group on the Coordination of Biodiversity Assessment and Monitoring (ICG-COBAM) in July 2010 and has been further developed by ICG-COBAM until its January 2011 meeting where it was agreed with minor changes (ICG-COBAM(1) 11/11/01-E, Annex 4). A contentious section of the definition of 'Environmental targets' has been deleted in the attached final version. It was replaced by a reference to Annex IV to Directive 2008/56/EC.

Several terms in the appended list have a focus on biodiversity-related aspects of the MSFD such as 'listed features' or 'predominant habitat type' since it is the task of ICG-COBAM to develop guidance for the primarily state-based Descriptors biodiversity (D1), non-indigenous species (D2), marine food webs (D4) and sea-floor integrity (D6). The interpretations delivered for the more generic terms, however, are applicable to the implementation of the MSFD in general.

ICG-MSFD(1) 2011 agreed to distribute the MSFD terminology to other OSPAR subsidiary bodies for consistent application. These bodies may supplement the list with additional terms/definitions, if so required. However, the list is not meant to be exhaustive but should rather be restricted to key terms for the implementation of the Directive and there is no intention to include basic terms such as 'assessment'.

ICG-MSFD decided furthermore to submit this document to the WG GES as contribution to the development of more generic advice on common terminology (ICG-MSFD(1) 11/8/1 § 4.3 (b)(i)).

In particular, the document is not intended to amend the legal definitions (e.g., 'environmental target') given in the Directive, but to take these as a basis and to provide a pragmatic approach to their interpretation, where this is considered helpful or necessary.

List of terms

'Good Environmental Status (GES)'

The desired state of the marine environment and its components. A definition is provided in Art. 3.5 of the Directive and defined in terms of 11 Descriptors in Annex I of the Directive. More specifically, it is determined for a number of criteria and indicators as given by the EU Commission's Decision on 'criteria and methodological standards'.

'Criterion'

Specific criteria are listed for each GES Descriptor in Part B of the annex to the September 2010 Decision document. For instance "Species Distribution" of a relevant species or species functional group is criterion 1.1 for Descriptor 1 "Biological Diversity is maintained…" To avoid confusion between the use of the term "criteria" in this specific context and its use in other respects (such as the criteria used to guide indicator selection), it is recommended these specific criteria be referred to as "GES criteria".

For Descriptor 1, 'criteria' refer to particular aspects of biodiversity that require their status to be assessed, through the application of appropriate indicators, to determine whether each aspect meets good environmental status or not . Thus the population size of a particular species or functional group of species is a criterion by which to judge whether that aspect of biodiversity in a particular region meets good environmental status or not. Similarly, the habitat extent is a criterion to judge whether the habitat in a specified region meets GES or not.

'Environmental target'

According to Art. 3 (MSFD), "environmental target means a qualitative or quantitative statement on the desired condition of the different components of, and pressures and impacts on, marine waters in respect of each marine region or sub-region". According to Art. 10, environmental targets are needed to guide progress towards achieving Good Environmental Status (GES) and shall take into account Annex III Table 2 and the characteristics set out in Annex IV.

'Indicator'

Given the complexity of biodiversity, both in its range of character and the number of aspects that contribute to an assessment of state, it is common practice to use a set of indicators to assist in monitoring and assessment programmes and to help simplify this complexity. There are a variety of different types of indicators: state (including impact), pressure and response. These help limit the number of parameters that need to be monitored to those which can most effectively represent wider functional and structural aspects of the ecosystem. Where possible, state indicators should closely respond (in space and time) to a particular anthropogenic pressure (by responding to the impact of the pressure) and hence be linked to associated management requirements.

The assessment of environmental state provided by one or more indicators should allow inferences to be made on the wider state of biodiversity components in that ecosystem. State means the actual (measured or otherwise assessed) environmental condition (e.g. of a species, species functional group, community or habitat) in a given geographical area. The assessment of state can be derived by taking direct measurements of the particular biodiversity component ('state indicators') or indirectly by measuring the prevailing anthropogenic pressures ('pressure indicators'). In this latter case, impacts of these pressures on biodiversity must be known. For assessments of ecosystem state simple indicators (e.g. the size of a bird population) or more complex indicators (e.g. the ratio of multiple phytoplankton taxa) can be applied.

State indicators (which reflect impacts from anthropogenic pressures) have been widely evaluated by ICES expert groups. There are a number of criteria that may be considered when determining the utility and applicability of this type of indicator (Table 8.1).

Table 8.1: State Indicator selection criteria (adapted from ICES and UK scientific indicator evaluation)

Criterion	Specification
Sensitivity	Does the indicator allow detection of any type of change against background variation or noise?
Accuracy	Is the indicator measured with a low error rate?
Specificity	Does the indicator respond primarily to a particular human pressure, with low responsiveness to other causes of change?
Simplicity	Is the indicator easily measured?
Responsiveness	Is the indicator able to act as an early warning signal?
Spatial applicability	Is the indicator measurable over a large proportion of the geographical to which it is to apply e.g. if the indicator is used at a UK level, is it possible to measure the required parameter(s) across this entire range or is it localised to one small scale area?
Management link	Is the indicator tightly linked to an activity which can be managed to reduce its negative effects on the indicator i.e. are the quantitative trends in cause and effect of change well known?
Validity	Is the indicator based on an existing body or time series of data (either continuous or interrupted) to allow a realistic setting of objectives?
Communication	Is the indicator relatively easy to understand by non-scientists and those who will decide on their use?

Additionally, it is usually necessary to consider the effort (cost) of implementing such indicators.

Indicators under the MSFD are considered to be specific attributes of each GES criterion that can either be qualitatively described or quantitatively assessed to determine whether each criterion meets good environmental status, or to ascertain how far each criterion departs from GES.

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

Firstly, for the assessments required under this directive, state and pressure indicators are used to assess differences between actual state and desired state (GES). Here, the indicators given in the EU Commission Decision on criteria and methodological standards (acc. Art. 9) form the basis. The indicators under several descriptors in this guidance (in particular D1 and D4) cannot be considered operational until specific and representative biodiversity components (e.g. species and habitats) as well as more specific metrics have been defined for each indicator.

Secondly, indicators are to be applied to reflect progress in achieving environmental targets. The indicators to be developed under Art. 10 (associated with environmental targets) may be identical to the indicators of the EU Commission Decision on GES. However, the development of additional indicators, in particular pressure indicators, may be necessary (e.g. indicating vectors of non-indigenous species or bycatch of seabirds and marine mammals).

In general, the geographical scale for the application of indicators needs to be defined since environmental conditions may be different between and within marine regions.

'Index'

An index represents the aggregated measurement, or calculated derivative of several different 'parameters', usually determined across different biodiversity components. In ecology, indices are frequently used to inform on biological variety in any given area or point in time. The degree of variety can be assessed on various levels, e.g. at the level of species, genes or habitats. Most commonly, such indices are determined at the level of species, e.g. the Shannon-Wiener-Index representing species diversity. This index is calculated using the species abundance 'parameters' for all species in any given sample and total of all individuals included in the sample. Within MSFD assessments indices may be applied as complex indicators.

'Parameter' / 'Metric'

A parameter or metric is a measureable single characteristic of a species or habitat (e.g. number of individuals, biomass in g/dry weight, sediment particle size diameter in mm). Parameters of this nature can be used as simple indicators, and indeed several such metrics are included in the list of indicators provided in the Commission Decision on criteria and indicators (e.g. indicator 1.2.1, population biomass).

'Reference state' / 'Reference conditions'

The value or range of values of state at which impacts from anthropogenic pressures are absent or negligible. Values used to define the reference state should be directly linked to the GES criteria used for assessment. They will vary in relation to prevailing physiographic and geographic conditions and may vary over time in relation to changing climatic conditions.

'Baseline'

The value of state at a specific point against which subsequent values of state are compared. Baselines act as yardstick against which thresholds or trends for GES can be set. Baselines can be derived from i) reference state/conditions, ii) a known state in the past, such as the beginning of a time series (e.g. the Large Fish Indicator used since 1983 as a first valid data point in the time series) or iii) as a present state. A baseline can be considered a type of 'reference point' (as referred to in Annex IV of the Directive), though the term 'reference point' should not be confused with 'reference state or reference conditions' as defined above.

'Pressure'

The mechanism (physical, chemical or biological) through which a human activity has a direct or indirect adverse effect on any part of the ecosystem, e.g. physical disturbance to the seabed.

'Ecosystem component'

A part of biological diversity representing a specific biological entity (e.g. a species, species group, population, community or habitat type/biotope). A standardised set of components (functional groups of species and predominant habitats types) is recommended for use to assess biodiversity.

'Functional groups of species'

An ecologically relevant set of species, applied here in particular to the following (highly) mobile species groups: birds, reptiles, marine mammals, fish and cephalopods. Each functional group represents a predominant ecological role (e.g. offshore surface-feeding birds, demersal fish) within the species group. Referred to in the Commission Decision on criteria and indicators (Part B, species) and in the ICES/JRC Task Group 1 -report (as 'ecotype').

'Predominant habitat type'

Habitat category referred to in Table 1 of Annex III to the Directive. Widely occurring and broadly defined habitat types (e.g. shelf sublittoral sand or mud) that are typically not covered by other legislation (see 'special habitat types').

'Listed features'

Species or habitat types which are listed under Community legislation (e.g. Birds and Habitats Directive) or international conventions (for protection). Table 1 of Annex III to the Directive refers to these habitat types as 'special'. For descriptors and criteria assessing biodiversity state (in particular Descriptor 1), listed features shall be linked to specific indicators.

'Special habitat types'

Referred to in Table 1 of Annex III to the Directive as types identified under other Community legislation or international conventions ("as being of special scientific or biodiversity interest", see 'listed features').

8.3 EcoQOs and links to GES criteria

Cf. Section 3.2.1

Table 8.2: Overview of the relation between OSPAR EcoQOs and the GES Descriptors and criteria

GES / EcoQOs	**1.1**	**2.1**	**2.2**	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	**4.1**	**5.1**	**5.2**	**7.1**	**8.1**	**9 (1-5)**
1 Biodiversity		1.1 1.2 1.3	1.2				1.3	1.2				X	X	
2 Non-indigenous species														
3 Commercial fish	3.2.1													
4 Food webs			4.3				4.3	4.3	4.2.1					
5 Eutrophication														5.1.1&2 5.2.1-4 5.3.1-2
6 Sea-floor integrity											?			
7 Hydrographical conditions														
8 Contaminants				8.2.2[56]	8.1					8.2.1				
9 Contaminants in seafood														
10 Marine litter						10.2.1								
11 Energy, including noise														

Key to EcoQOs for the North Sea: 1.1 spawning stock biomass of commercial fish species; 2.1 seal population trends; 2.2 bycatch of harbour porpoises; 3.1 proportion of oiled common guillemots; 3.2 concentrations of mercury and organohalogens in seabird eggs; 3.3 plastic particles in the stomachs of fulmars; 3.4 Local sand eel availability to black-legged kittiwakes; 3.5 seabird population trends; 4.1 proportion of large fish in fish communities; 5.1 imposex in female dog whelks; 5.2 Changes in zoobenthos in relation to eutrophication; 7.1 threatened and/or declining species; 8.1 threatened and/or declining habitats; 9 eutrophication

Note: Where an "X" is indicated the EcoQO can contribute to a Descriptor of the Commission Decision. When there is a specific relationship then the criterion of the descriptor is indicated.

[56] EcoQO proportion of oiled common guillemots primarily refers to smaller operational oil spills and less to 'significant pollution events' (criterion 8.2.2).

Preliminary analysis by OSPAR's working group on marine protected areas, species and habitats MASH 2006) and Biodiversity Committee (BDC 2007) came to the following conclusions on the use of the North Sea EcoQOs in other OSPAR regions and the development of other systems of EcoQOs:

a. several of the EcoQOs developed for the North Sea do not apply to other regions;

b. the threats for some of the North Sea EcoQOs are not relevant to all the regions;

c. for some EcoQOs there may be a need to use different species as comparable indicators for different regions;

d. during the identification and selection of EcoQOs applicable to areas beyond the North Sea there was a need to consider in particular:

    i. the selection of those EcoQOs that might be applicable across the whole OSPAR maritime area;

    ii. the selection of those EcoQOs which may help EU Contracting Parties in fulfilling the requirements that may derive from the MSFD;

    iii. the costs and benefits of EcoQOs.

8.4 Pressure definitions

Cf.Section 3.4 Approaches to setting targets for pressures

Source: Inter-MSFD 2004 - This is an amended version of the document submitted to both EIHA and ICG-COBAM based on comments received from the Netherlands, Spain, Germany, France ICG-COBAM and the UK. Given the range of responses not all suggested revisions have been applied verbatim, however, it is believed that the spirit and intention of all the recommendations from Contracting Parties listed above have been included.

Pressure theme	Pressures	Code	Pressure Descriptor	MSFD Annex III Table 2
Hydrological changes (inshore/local)	Temperature changes - local	H1	Events or activities increasing or decreasing local water temperature. This is most likely from thermal discharges, e.g. the release of cooling waters from power stations. This could also relate to temperature changes in the vicinity of operational sub sea power cables. This pressure only applies within the thermal plume generated by the pressure source. It excludes temperature changes from global warming which will be at a regional scale (and as such are addressed under the climate change pressures).	Significant changes in thermal regime (e.g. by outfalls from power stations)
Hydrological changes (inshore/local)	Salinity changes - local	H2	Events or activities increasing or decreasing local salinity. This relates to anthropogenic sources/causes that have the potential to be controlled, e.g. freshwater discharges from pipelines that reduce salinity, or brine discharges from salt caverns washings that may increase salinity. This could also include hydromorphological modification, e.g. capital navigation dredging if this alters the halocline, or erection of barrages or weirs that alter freshwater/seawater flow/exchange rates. The pressure may be temporally and spatially delineated derived from the causal event/activity and local environment.	Significant changes in salinity regime (e.g. by constructions impeding water movements, water abstraction)
Hydrological changes (inshore/local)	Water flow (tidal current) changes – local, including sediment transport considerations *[possibly split water flow & sediment transport, i.e. separate into 'Hydrological' & 'Physical']*	H3	Changes in water movement associated with tidal streams (the rise and fall of the tide, riverine flows), prevailing winds and ocean currents. The pressure is therefore associated with activities that have the potential to modify hydrological energy flows, e.g. Tidal energy generation devices remove (convert) energy and such pressures could be manifested leeward of the device, capital dredging may deepen and widen a channel and therefore decrease the water flow, canalisation &/or structures may alter flow speed and direction; managed realignment (e.g. Wallasea, England). The pressure will be spatially delineated. The pressure extremes are a shift from a high to a low energy environment (or vice versa). The biota associated with these extremes will be markedly different as will the substrate, sediment supply/transport and associated seabed elevation changes. The potential exists for profound changes (e.g. coastal	X

			erosion/deposition) to occur at long distances from the construction itself if an important sediment transport pathway was disrupted. As such these pressures could have multiple and complex impacts associated with them.	
Hydrological changes (inshore/local)	Emergence regime changes – local, including tidal level change considerations *[possibly split emergence regime & tidal level changes]*	H4	Changes in water levels reducing the intertidal zone (and the associated/dependant habitats). The pressure relates to changes in both the spatial area and duration that intertidal species are immersed and exposed during tidal cycles (the percentage of immersion is dependant on the position or height on the shore relative to the tide). The spatial and temporal extent of the pressure will be dependant on the causal activities but can be delineated. This relates to anthropogenic causes that may directly influence the temporal and spatial extent of tidal immersion, e.g. upstream and downstream of a tidal barrage the emergence would be respectively reduced and increased, beach re-profiling could change gradients and therefore exposure times, capital dredging may change the natural tidal range, managed realignment, saltmarsh creation. Such alteration may be of importance in estuaries because of their influence on tidal flushing and potential wave propagation. Changes in tidal flushing can change the sediment dynamics and may lead to changing patterns of deposition and erosion. Changes in tidal levels will only affect the emergence regime in areas that are inundated for only part of the time. The effects that tidal level changes may have on sediment transport are not restricted to these areas, so a very large construction could significantly affect the tidal level at a deep site without changing the emergence regime. Such a change could still have a serious impact. This excludes pressure from sea level rise which is considered under the climate change pressures.	X
Hydrological changes (inshore/local)	Wave exposure changes - local	H5	Local changes in wave length, height and frequency. Exposure on an open shore is dependant upon the distance of open seawater over which wind may blow to generate waves (the fetch) and the strength and incidence of winds. Anthropogenic sources of this pressure include artificial reefs, breakwaters, barrages, wrecks that can directly influence wave action or activities that may locally affect the incidence of winds, e.g. a dense network of wind turbines may have the potential to influence wave exposure, depending upon their location relative to the coastline.	X
Pollution and other chemical changes	Transition elements & organo-metal (e.g. TBT) contamination.	P1	The increase in transition elements levels compared with background concentrations, due to their input from land/riverine sources, by air or directly at sea. For marine sediments the main elements of concern are Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead and Zinc Organo-metallic compounds such as the butyl tins (Tri butyl tin and its derivatives) can be highly	Introduction of non-synthetic substances and compounds (e.g. heavy metals, hydro-carbons, resulting, for example,

	Includes those priority substances listed in Annex II of Directive 2008/105/EC.		persistent and chronic exposure to low levels has adverse biological effects, e.g. Imposex in molluscs.	from pollution by ships and oil, gas and mineral exploration, atmospheric deposition, riverine inputs)
Pollution and other chemical changes	Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	P2	Increases in the levels of these compounds compared with background concentrations. Naturally occurring compounds, complex mixtures of two basic molecular structures: - straight chained aliphatic hydrocarbons (relatively low toxicity and susceptible to degradation) - multiple ringed aromatic hydrocarbons (higher toxicity and more resistant to degradation) These fall into three categories based on source (includes both aliphatics and polyaromatic hydrocarbons): - petroleum hydrocarbons (from natural seeps, oil spills and surface water run-off) - pyrogenic hydrocarbons (from combustion of coal, woods and petroleum) - biogenic hydrocarbons (from plants & animals) Ecological consequences include tainting, some are acutely toxic, carcinomas, growth defects.	Introduction of non-synthetic substances and compounds (e.g. heavy metals, hydro-carbons, resulting, for example, from pollution by ships and oil, gas and mineral exploration, atmospheric deposition, riverine inputs)
Pollution and other chemical changes	Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex II of Directive 2008/105/EC.	P3	Increases in the levels of these compounds compared with background concentrations. Synthesised from a variety of industrial processes and commercial applications. Chlorinated compounds include polychlorinated biphenols (PCBs), dichlor-diphenyl-trichloroethane (DDT) & 2,3,7,8-tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD) are persistent and often very toxic. Pesticides vary greatly in structure, composition, environmental persistence and toxicity to non-target organisms. Includes: insecticides, herbicides, rodenticides & fungicides. Pharmaceuticals and Personal Care Products originate from veterinary and human applications compiling a variety of products including, Over the counter medications, fungicides, chemotherapy drugs and animal therapeutics, such as growth hormones. Due to their biologically active nature, high levels of consumption, known combined effects, and their detection in most aquatic environments they have become an emerging concern. Ecological consequences include physiological changes (e.g. growth defects, carcinomas).	Introduction of synthetic compounds (e.g. priority substances under Directive 2000/60/EC which are relevant to the marine environment such as pesticides, anti-foulants, pharmaceuticals, resulting, for example, from losses from diffuse sources, pollution by ships, atmospheric deposition and biologically active substances)

Pollution and other chemical changes	Introduction of other substances (solid, liquid or gas)	P4	The 'systematic or intentional release of liquids, gases …' (from MSFD Annex III Table 2) is being considered e.g. in relation to produced water from the oil industry. It should therefore be considered in parallel with P1, P2 and P3.	Introduction of other substances, whether solid, liquid or gas, in marine waters resulting from their systematic and/or international release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions
Pollution and other chemical changes	Radionuclide contamination	P5	Introduction of radionuclide material, raising levels above background concentrations. Such materials can come from nuclear installation discharges, and from land or sea-based operations (e.g. oil platforms, medical sources). The disposal of radioactive material at sea is prohibited unless it fulfils exemption criteria developed by the International Atomic Energy Agency (IAEA), namely that both the following radiological criteria are satisfied: (i) the effective dose expected to be incurred by any member of the public or ships crew is 10 μSv or less in a year; (ii) the collective effective dose to the public or ships crew is not more than 1 man Sv per annum, then the material is deemed to contain de minimis levels of radioactivity and may be disposed at sea pursuant to it fulfilling all the other provisions under the Convention. The individual dose criteria are placed in perspective (i.e. very low), given that the average background dose to the UK population is ~2700 μSv/a. Ports and coastal sediments can be affected by the authorised discharge of both current and historical low-level radioactive wastes from coastal nuclear establishments.	Introduction of radio-nuclides
Pollution and other chemical changes	Nutrient enrichment	P6	Increased levels of the elements nitrogen, phosphorus, silicon (and iron) in the marine environment compared to background concentrations. Nutrients can enter marine waters by natural processes (e.g. decomposition of detritus, riverine, direct and atmospheric inputs) or anthropogenic sources (e.g. waste water runoff, terrestrial/agricultural runoff, sewage discharges, aquaculture, atmospheric deposition). Nutrients can also enter marine regions from 'upstream' locations, e.g. via tidal currents to induce enrichment in the receiving area. Nutrient enrichment may lead to eutrophication (see also organic enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.	Inputs of fertilisers and other nitrogen - and phosphorous-rich substances (e.g. from point and diffuse sources, including agriculture, aquaculture, atmospheric deposition)

Pollution and other chemical changes	Organic enrichment	P7	Resulting from the degraded remains of dead biota & microbiota (land & sea); faecal matter from marine animals; flocculated colloidal organic matter and the degraded remains of: sewage material, domestic wastes, industrial wastes etc. Organic matter can enter marine waters from sewage discharges, aquaculture or terrestrial/agricultural runoff. Black carbon comes from the products of incomplete combustion (PIC) of fossil fuels and vegetation. Organic enrichment may lead to eutrophication (see also nutrient enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.	Inputs of organic matter (e.g. sewers, mariculture, riverine inputs)
Pollution and other chemical changes	Deoxygenation	P8	Any deoxygenation that is not directly associated with nutrient or organic enrichment. The lowering, temporarily or more permanently, of oxygen levels in the water or substrate due to anthropogenic causes (some areas may naturally be deoxygenated due to stagnation of water masses, e.g. inner basins of fjords).. This is typically associated with nutrient and organic enrichment, but it can also derive from the release of ballast water or other stagnant waters (where organic or nutrient enrichment may be absent). Ballast waters may be deliberately deoxygenated via treatment with inert gases to kill non-indigenous species.	X
Physical loss (Permanent Change)	Physical loss (to land or freshwater habitat)	L1	The permanent loss of marine habitats. Associated activities are land claim, new coastal defences that encroach on and move the Mean High Water Springs mark seawards, the footprint of a wind turbine on the seabed, dredging if it alters the position of the halocline. This excludes changes from one marine habitat type to another marine habitat type.	Sealing (e.g. by permanent constructions)
Physical loss (Permanent Change)	Physical change (to another seabed type)	L2	The permanent change of one marine habitat type to another marine habitat type, through the change in substatum, including to artificial (e.g. concrete). This therefore involves the permanent loss of one marine habitat type but has an equal creation of a different marine habitat type. Associated activities include the installation of infrastructure (e.g. surface of platforms or wind farm foundations, marinas, coastal defences, pipelines and cables), the placement of scour protection where soft sediment habitats are replaced by hard/coarse substrate habitats, removal of coarse substrate (marine mineral extraction) in those instances where surficial finer sediments are lost, capital dredging where the residual sedimentary habitat differs structurally from the pre-dredge state, creation of artificial reefs, mariculture i.e. mussel beds. Protection of pipes and cables using rock dumping and mattressing techniques. Placement of cuttings piles from oil & gas activities could fit this pressure type, however, there may be an additional pressures, e.g. "pollution and other chemical changes" theme.	Smothering (e.g. by man made structures, disposal of dredge spoil)

			This pressure excludes navigation dredging where the depth of sediment is changes locally but the sediment typology is not changed.	
Physical damage (Reversible Change)	Habitat structure changes - removal of substratum (extraction)	D1	Unlike the "physical change" pressure type where there is a permanent change in sea bed type (e.g. sand to gravel, sediment to a hard artificial substrate) the "habitat structure change" pressure type relates to temporary and/or reversible change, e.g. from marine mineral extraction where a proportion of seabed sands or gravels are removed but a residual layer of seabed is similar to the pre-dredge structure and as such biological communities could re-colonise; navigation dredging to maintain channels where the silts or sands removed are replaced by non-anthropogenic mechanisms so the sediment typology is not changed.	Selective extraction (e.g. by exploration and exploitation of living and non-living resources on seabed and subsoil)
Physical damage (Reversible Change)	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	D2	The disturbance of sediments where there is limited or no loss of substrate from the system. This pressure is associated with activities such as anchoring, taking of sediment/geological cores, cone penetration tests, cable burial (ploughing or jetting), propeller wash from vessels, certain fishing activities, e.g. scallop dredging, beam trawling. Agitation dredging, where sediments are deliberately disturbed by and by gravity & hydraulic dredging where sediments are deliberately disturbed and moved by currents could also be associated with this pressure type. Compression of sediments, e.g. from the legs of a jack-up barge could also fit into this pressure type. Abrasion relates to the damage of the sea bed surface layers (typically up to 50cm depth) Activities associated with abrasion can cover relatively large spatial areas and include: fishing with towed demersal trawls (fish & shellfish); bio-prospecting such as harvesting of biogenic features such as maerl beds where, after extraction, conditions for recolonisation remain suitable or relatively localised activities including: seaweed harvesting, recreation, potting, aquaculture. Change from gravel to silt substrate would adversely affect herring spawning grounds.	Abrasion (e.g. impact on the seabed of commercial fishing, boating, anhoring)
Physical damage (Reversible Change)	Changes in suspended solids (water clarity)	D3	Changes in water clarity from sediment & organic particulate matter concentrations. It is related to activities disturbing sediment and/or organic particulate matter and mobilising it into the water column. Could be 'natural' land run-off and riverine discharges or from anthropogenic activities such as all forms of dredging, disposal at sea, cable and pipeline burial, secondary effects of construction works, e.g. breakwaters. Particle size, hydrological energy (current speed & direction) and tidal excursion are all influencing factors on the spatial extent and temporal duration. This pressure also relates to changes in turbidity from suspended solids of organic origin (as such it excludes sediments - see the "changes in suspended sediment" pressure type). Salinity, turbulence,	X

			pH and temperature may result in flocculation of suspended organic matter. Anthropogenic sources mostly short lived and over relatively small spatial extents.	
Physical damage (Reversible Change)	Siltation rate changes, including smothering (depth of vertical sediment overburden)	D4	When the natural rates of siltation are altered (increased or decreased). Siltation (or sedimentation) is the settling out of silt/sediments suspended in the water column. Activities associated with this pressure type include mariculture, land claim, navigation dredging, disposal at sea, marine mineral extraction, cable and pipeline laying and various construction activities. It can result in short lived sediment concentration gradients and the accumulation of sediments on the sea-floor. This accumulation of sediments is synonymous with "light" smothering, which relates to the depth of vertical overburden. "Light" smothering relates to the deposition of layers of sediment on the seabed. It is associated with activities such as sea disposal of dredged materials where sediments are deliberately deposited on the sea bed. For "light" smothering most benthic biota may be able to adapt, i.e. vertically migrate through the deposited sediment. "Heavy" smothering also relates to the deposition of layers of sediment on the seabed but is associated with activities such as sea disposal of dredged materials where sediments are deliberately deposited on the sea bed. This accumulation of sediments relates to the depth of vertical overburden where the sediment type of the existing and deposited sediment has similar physical characteristics because, although most species of marine biota are unable to adapt, e.g. sessile organisms unable to make their way to the surface, a similar biota could, with time, re-establish. If the sediments were physically different this would fall under L2. Eleftheriou and McIntyre, 2005 describe that the majority of animals will inhabit the top 5-10 cm in open waters and the top 15 cm in intertidal areas. The depth of sediment overburden that benthic biota can tolerate is both trophic group and particle size/sediment type dependant (Bolam, 2010). Recovery from burial can occur from: - planktonic recruitment of larvae - lateral migration of juveniles/adults - vertical migration (see Chandrasekara and Frid, 1998; Bolam et al, 2003, Bolam & Whomersley, 2005). Spatial scale, timing, rate and depth of placement all contribute the	Changes in siltation (e.g. by outfalls, increased run-off, dredging/disposal or dredge spoil)

			relative importance of these three recovery mechanisms (Bolam et al, 2006). As such the terms "light" and "heavy" smothering are relative and therefore difficult to define in general terms. Bolam, 2010 cites various examples: - H. ulvae maximum overburden 5 cm (Chandrasekara & Frid, 1998) - H. ulvae maximum overburden 20 cm mud or 9 cm sand (Bijerk, 1988) - S. shrubsolii maximum overburden 6 cm (Saila et al, 1972, cited by Hall 1994) - N. succinea maximum overburden 90 cm (Maurer et al 1982) - gastropod molluscs maximum overburden 15 cm (Roberts et al, 1998). Bolam, 2010 also reported when organic content was low: - H. ulvae maximum overburden 16 cm - T, benedii maximum overburden 6 cm - S. shrubsolii maximum overburden <6 cm - Tharyx sp.A. maximum overburden <6 cm	
Other physical pressures	Litter	O1	Marine litter is any manufactured or processed solid material from anthropogenic activities discarded, disposed or abandoned (excluding legitimate disposal) once it enters the marine and coastal environment including: plastics, metals, timber, rope, fishing gear etc and their degraded components, e.g. microplastic particles. Ecological effects can be physical (smothering), biological (ingestion, including uptake of microplastics; entangling; physical damage; accumulation of chemicals) and/or chemical (leaching, contamination).	Marine litter
Other physical pressures	Electromagnetic changes	O2	Localised electric and magnetic fields associated with operational power cables and telecommunication cables (if equipped with power relays). Such cables may generate electric and magnetic fields that could alter behaviour and migration patterns of sensitive species (e.g. sharks and rays).	X
Other physical pressures	Underwater noise changes	O3	Increases over and above background noise levels (consisting of environmental noise (ambient) and incidental man-made/anthropogenic noise (apparent)) at a particular location. Species known to be affected are marine mammals and fish. The theoretical zones of noise influence (Richardson et al 1995) are temporary or permanent hearing loss, discomfort & injury; response; masking and detection. In extreme cases noise pressures may lead to death. The physical or behavioural effects are dependant on a number of variables, including the sound pressure, loudness, sound exposure level and frequency. High amplitude	Underwater noise (e.g. from shipping, underwater acoustic equipment)

			low and mid-frequency impulsive sounds and low frequency continuous sound are of greatest concern for effects on marine mammals and fish. Some species may be responsive to the associated particle motion rather than the usual concept of noise. Noise propagation can be over large distances (tens of kilometres) but transmission losses can be attributable to factors such as water depth and sea bed topography. Noise levels associated with construction activities, such as pile-driving, are typically significantly greater than operational phases (i.e. shipping, operation of a wind farm).	
Other physical pressures	Introduction of light	O4	Direct inputs of light from anthropogenic activities, i.e. lighting on structures during construction or operation to allow 24 hour working; new tourist facilities, e.g. promenade or pier lighting, lighting on oil & gas facilities etc. Ecological effects may be the diversion of bird species from migration routes if they are disorientated by or attracted to the lights. It is also possible that continuous lighting may lead to increased algal growth.	X
Other physical pressures	Barrier to species movement	O5	The physical obstruction of species movements and including local movements (within & between roosting, breeding, feeding areas) and regional/global migrations (e.g. birds, eels, salmon, whales). Both include up river movements (where tidal barrages & devices or dams could obstruct movements) or movements across open waters (offshore wind farm, wave or tidal device arrays, mariculture infrastructure or fixed fishing gears). Species affected are mostly birds, fish, mammals.	X
Other physical pressures	Death or injury by collision	O6	Injury or mortality from collisions of biota with both static &/or moving structures. Examples include: Collision with rigs (e.g. birds) or screens in intake pipes (e.g. fish at power stations) (static) or collisions with wind turbine blades, fish & mammal collisions with tidal devices and shipping (moving). Activities increasing number of vessels transiting areas, e.g. new port development or construction works will influence the scale and intensity of this pressure.	X
Biological pressures	Visual disturbance	B1	The disturbance of biota by anthropogenic activities, e.g. increased vessel movements, such as during construction phases for new infrastructure (bridges, cranes, port buildings etc), increased personnel movements, increased tourism, increased vehicular movements on shore etc disturbing bird roosting areas, seal haul out areas etc	X
Biological pressures	Genetic modification & translocation of	B2	Genetic modification can be either deliberate (e.g. introduction of farmed individuals to the wild, GM food production) or a by-product of other activities (e.g. mutations associated with radionuclide contamination). Former related to escapees or deliberate releases e.g. cultivated species such as farmed salmon,	X

	indigenous species		oysters, scallops if GM practices employed. Scale of pressure compounded if GM species "captured" and translocated in ballast water. Mutated organisms from the latter could be transferred on ships hulls, in ballast water, with imports for aquaculture, aquaria, live bait, species traded as live seafood or 'natural' migration. Movement of native species to new regions can also introduce different genetic stock.	
Biological pressures	Introduction or spread of non-indigenous species	B3	The direct or indirect introduction of non-indigenous species, e.g. chinese mitten crabs, slipper limpets, Pacific oyster and their subsequent spreading and out-competing of native species. Ballast water, hull fouling, stepping stone effects (e.g. offshore wind farms) may facilitate the spread of such species. This pressure could be associated with aquaculture, mussel or shellfishery activities due to imported seed stock imported or from accidental releases.	Introduction of non-indigenous species and translocations
Biological pressures	Introduction of microbial pathogens	B4	Untreated or insufficiently treated effluent discharges & run-off from terrestrial sources & vessels. It may also be a consequence of ballast water releases. In mussel or shellfisheries where seed stock are imported, 'infected' seed could be introduced, or it could be from accidental releases of effluvia. Escapees, e.g. farmed salmon could be infected and spread pathogens in the indigenous populations. Aquaculture could release contaminated faecal matter, from which pathogens could enter the food chain.	Introduction of microbial pathogens
Biological pressures	Removal of target species	B5	The commercial exploitation of fish & shellfish stocks, including smaller scale harvesting, angling and scientific sampling. The physical effects of fishing gear on sea bed communities are addressed by the "abrasion" pressure type D2, so B5 addresses the direct removal / harvesting of biota. Ecological consequences include the sustainability of stocks, impacting energy flows through food webs and the size and age composition within fish stocks.	Selective extraction of species, … (e.g. by commercial and recreational fishing)
Biological pressures	Removal of non-target species	B6	Bycatch associated with all fishing activities. The physical effects of fishing gear on sea bed communities are addressed by the "abrasion" pressure type (D2) so B6 addresses the direct removal of individuals associated with fishing/ harvesting. . Ecological consequences include food web dependencies, population dynamics of fish, marine mammals, turtles and sea birds (including survival threats in extreme cases, e.g. Harbour Porpoise in Central and Eastern Baltic).	Selective extraction of species, including incidental non-target catches (e.g. by commercial and recreational fishing)

8.5 Consideration of assessment scale specific to each biodiversity Descriptor

cf. 3.5 Assessment scales

8.5.1 Biodiversity and scale

The ICES/JRC Task Group 1 report recommends that assessments should be carried out at the scale of 'ecological assessment areas' that reflect both the ecological scales exhibited by the biodiversity components and the scales at which management measures will be effective. The assessment areas should be nested within a sub-region to enable aggregation at the sub-regional and, if necessary, regional scales. The number of assessment areas in a region or sub-region should be kept to a minimum, so as to not overly complicate the assessment process. Also if assessment areas are small, there is a risk that there is insufficient spatial resolution in the data to produce accurate assessments. In such circumstances, expanding monitoring to increase resolution may be prohibitively expensive.

There are significant gaps in knowledge for many biodiversity components, for both spatial and temporal scales, especially for the deep sea. Although a "top-down" approach (that is, the subdivision of a sub-region to define a relevant assessment unit) is conceptually more comfortable than a "bottom-up" approach (using available and standardized datasets to define relevant assessment areas and aggregating to broader scales), the "bottom-up" approach has advantages in practical application. Within the MSFD assessment and monitoring cycles, it should be possible to link these two approaches and refine assessment areas and scales. However, in the mean time whilst there is still a gap in knowledge, a pragmatic approach could be to prioritise data acquisition for monitoring in high-pressure areas and simultanesously in reference areas.

8.5.2 Non-indigenous species and scale

The ICES/JRC Task Group 2 report (Olenin *et al*., 2010)[57] proposes the assessment of impacts from invasive non-indigenous species (NIS) should begin at the local scale, such as "hot-spots" and "stepping stone areas" for introductions of non-indigenous species (e.g. marinas, port areas, aquaculture installations, offshore structures) or in areas of special interest (e.g. marine reserves, Natura 2000 sites, lagoons). Depending on the taxonomic/functional group an NIS belongs to, the assessment can involve areas from confined benthic habitats to the entire water column. Local scale assessments can be further integrated into the next spatial level evaluations at a sub-regional (e.g. Gulf of Finland in the Baltic or Adriatic Sea in the Mediterranean) or a regional sea level.

The attributes of biological invasions are occuring at different temporal scales (e.g. days/weeks for phytoplankton and years/decades for benthic communities and fish). The temporal scales addressed should vary depending on the taxonomic/functional group of an invasive NIS.

[57] 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. Ed. H. Piha. JRC Scientific and Technical Reports, EUR 24342 EN - 2010.

8.5.3 Food webs and scale

The ICES/JRC Task Group 4 proposes that attributes of food webs can, in principle, be applied at any spatial or temporal scale limited by practicality. The fundamental time scale over which ecosystem assessments might be required is annual. The temporal scale necessary to assess growth, mortality and feeding fluxes between food web components should be annual to integrate over seasonal variability at the lowest trophic levels. More frequent assessments, for example those that could be undertaken monthly, are operationally difficult to undertake and maintain, and their interpretation becomes complicated by seasonal dynamics. For the higher trophic levels, some smoothing of annual rates may be required to eliminate inter-annual variability. For longer-lived species such as piscivorous fish, mammals and birds, assessments on an annual basis may be too frequent, since variability at this scale becomes more influenced by unexplained external processes such as recruitment variability, and less by internal population processes.

Similar issues apply to considerations of appropriate spatial scales: at small spatial scales, such as parts of a MSFD Sub-Region, immigration and emigration by advection and migrations become important components of change. For large, long-lived taxa, spatial scales which integrate over migration ranges may be appropriate, but these scales may span fundamentally different habitats and communities for lower trophic levels, for example plankton or benthos, to the point that a synthesis at this scale becomes questionable. Ultimately, it seems likely that the appropriate spatial scale at which to assess food webs will be set by the purpose for which the assessment is required rather than any ecological considerations. Other practical considerations, such as the availability and spatial extent of monitoring data for key taxa, are also likely to influence the scale at which assessments are made (Rogers *et al*., 2010)[58].

8.5.4 Sea-floor integrity and scale

Scale for assessing environmental status of the sea-floor is particularly challenging and set out in the ICES/JRC Task Group 6 report for Descriptor 6 (Rice *et al*., 2010)[59]. There are three reasons for such a challenge:

i. the wide range of human activities causing pressures that may degrade the status of the sea-floor operate at different but always patchy spatial scales;

ii. the patchiness of the human activities causing the pressures also means that the scales of initial impacts of those activities are usually also local. Not only are the activities and their impacts patchy, but all monitoring of the sea-floor is also patchy, with emphasis being put on looking at temporal changes rather than changes in geographic distribution;

iii. there are many differences between coastal and deeper-water benthic communities. Some of these differences are simply consequences of history; because of proximity and greater ease of sampling much more is known of the coastal and nearshore sea-floor habitats and communities than is known of offshore and deep-sea habitats and communities. Some are

[58] S. Rogers, M. Casini, P. Cury, M. Heath, X. Irigoien, H. Kuosa, M. Scheidat, H. Skov, K. Stergiou, V. Trenkel, J. Wikner & O. Yunev (2010) Marine Strategy Framework Directive, Task Group 4 Report, Food Webs. Ed. H. Piha. JRC Scientific and Technical Reports, EUR 24343 EN - 2010.

[59] J. Rice, C, Arvanitidis, A. Borja, C, Frid, J. Hiddink, J. Krause, P. Lorance, S.Á. Ragnarsson, M. Sköld and B. Trabucco (2010) Marine Strategy Framework Directive, Task Group 6 Report, Sea-floor Integrity. Ed. H. Piha. JRC Scientific and Technical Reports, EUR 24334 EN-2010.

ecological; although knowledge is less complete offshore and in the deep-sea, many studies suggest that the dominant space and time scales are both greater in these ecosystems.

The ICES/JRC Task Group 6 report provides a practical way forward. It is recommended to apply a risk-based approach, either starting from the threats posed by human activities, or from key ecosystem components likely to be impacted.

The first approach is based upon spatial distribution of human activities, in particular those that most likely cause the largest impacts on the sea-floor. Monitoring should be stratified along the known gradients of occurrence of pressures resulting from these activities. Assessments should start in the areas of highest risk and if impacts do not exceed targets for state/impact indicators it can be assumed that the activities are overall sustainable. Alternatively, if impacts do exceed targets for GES, then assessments would be conducted for lower risk areas, to determine how far along the gradient impacts are considered unsustainable.

The second approach builds upon sensitivity maps, i.e. vulnerability to human pressures of various features of benthic habitats that are considered key to ecological functioning. High vulnerabilty combined with significant levels of threat by human activities would indicate high-risk areas. Monitoring and assessment would start in those areas and proceed to progressively lower-risk areas until the quality status is within targets for GES.

At a higher geographic scale good environmental status could be related to the proportion of the area where key features of benthic habitats are assessed as at low risk, or if impacts of human activities in high-risk areas could be managed or mitigated (*e.g*. moved to less ecologically important areas).

8.6 Biodiversity components: species and habitat lists

8.6.1 Developing lists of common habitats and species across the OSPA Region and Sub-regions

The following lists of species and habitats (embedded files) contain the latest iteration of lists of predominant habitat types and functional groups of species which are intended to be used for assessment across each sub-region (cf. 8.6.2).

The lists contain both ‘listed’ and ‘additional’ species and habitats from the following sources:

a. Listed species and habitats from Community legislation and international agreements, each assigned as appropriate to the relevant functional group or predominant habitat type;

b. Additional species being considered within some sub-regions for potential use to represent the broader functional group in which they occur. This selection is guided by the criteria below and is an ongoing process.

The lists are intended as a common starting point for defining and selecting of indicators for GES. These lists aim to serve Member States in the selection of species and habitats that fulfil their assessment needs. Coordination of the selection process within and across sub-regions will facilitate effective and coordinated monitoring among neighbouring Member States and within each sub-region.

The species lists contain those species already listed in other reporting requirements and a preliminary proposal of predominant/common species developed by some Contracting Parties for Regions IV and V. They also include a subset of more common, or widespread species representative for of the condition of the wider community of the relevant ecosystem component, where this is not achieved using ‘listed species’ alone. These lists are not definitive or exhaustive and will be further developed by ICG-COBAM.

However, the attached version can already be regarded as guidance for species assessments under MSFD.

The following guidance on the selection criteria for species within each functional group (from ICG-COBAM(1) 11/4/1) provides a clear view on the operability (practicability) and effectiveness of indicators based on the suggested species. The selection of species to be assessed under MSFD in the OSPAR maritime area (MSFD sub-region b) should take into consideration:

a. their abundance and distribution (i.e. also naturally predominant species as well as species that are predominant as an effect of human activities should be included);

b. their sensitivity towards specific human activities;

c. their suitability for the respective indicators and descriptors of the Commission Decision;

d. the practicability (including cost-effectiveness) of monitoring them;

e. their inclusion in existing monitoring programmes and time-series data;

f. their association with specific habitats.

8.6.2 Draft lists of predominant habitats and species

Habitats list

Habitat components 150311.xls

Draft Species list (under development by region as at December 2011)

OSPAR Region II

2011-01-12_MSFD species_v5_North Sea

OSPAR Region III

MSFD species_Celtic Seas.xls

OSPAR Region IV and V

0504_MSFD_D1_Ospar_LMSpecies_ES_FR

8.6.3 Recommendations for futher development and uses of the species lists

General

a. All sub-regions, including the North Sea should include additional species as well as listed species. This action would ensure consistency with the other sub-regions and would also follow the advice from within the regional co-ordination process in the NE Atlantic.

b. The selection of species within each sub-region, under each component, needs to be aligned with the common set of indicators being proposed in Tables 4.1 (Mammals & Reptiles), 4.2 (Fish) and 4.3 (Birds) of the OSPAR MSFD Biodiversity Manual. It would be useful to compile a candidate list of species for each common indicator. Selection could be based on the criteria listed below, or on alternative or additional criteria, specific to a particular

component (e.g. advice from ICG-COBAM on whether to include in assessments of GES those listed species that are not selected as part of the common set of indicators (see 0 and 3.1.3))

i. Particular sensitivity towards specific human pressures/activities

ii. Commonness (global occurrence and/or locally abundance)

iii. Practicability to monitor the species / Inclusion in existing monitoring programmes

iv. D4 criterion 1: groups with fast turnover rates, that will respond quickly to ecosystem change

v. D4 criterion 2: groups/species that are targeted by human activities or that are indirectly affected by them (in particular, by-catch and discards)

vi. D4 criterion 3: groups/species at the top of the food web

vii. D4 criterion 5: groups/species that are tightly linked to specific groups/species at another trophic level.

Marine Birds

c. The selection of marine bird species should be limited to those that occur regularly in the MSFD assessment area. A common set of criteria should be developed for selecting species to constitute each indicator (i.e. 'additional species'); as recommended by the bird group at the Amsterdam workshop. The criteria identified above could be refined further and applied to all regions. For example the UK also used the following criteria to select additional bird species:

i. State in lifecycle when using MSFD coastal and offshore areas (e.g. breeding, migrating,) – NB spreadsheets for Bay of Biscay and Macaronesia already contain this info and break it down to occurrence in each constituent country.

ii. Monitoring season (i.e. during winter, breeding season, migration or more)

iii. Does monitoring produce representative trends at OSPAR Regional scale?

d. Waterbird species that predominate in estuaries should not be considered relevant under MSFD.

e. It is questionable whether 'coastal top-predators' are an appropriate functional group under MSFD, given that these species are reliant on the terrestrial environment and may not be very good indicators of GES in the marine environment.

f. The definition of 'listed species' for birds may need reviewing given the following points made in the UK proposals for MSFD targets and indicators (Moffat et al. 2011): 'The OSPAR *MSFD advice manual on biodiversity* recommends 'listed species' of birds should be those that are included in Annex 1 of the Birds Directive and on the OSPAR list of threatened and declining species. The Birds Directive actually applies to all wild migratory bird species and Annex 1 of the Birds Directive lists those species for which nationally important aggregations should be designated as Special Protection Areas, as opposed to internationally important aggregations in all other species. Hence the Birds Directive is not necessarily a useful reference for identifying species that require special protection and inclusion in assessments of GES under MSFD. Furthermore, the OSPAR List of threatened and/or declining species does not appear

to be inclusive of all relevant taxa of marine birds. Therefore we recommend that 'listed species' are also selected from the species that are awarded the highest level of protection under the Action Plan of AEWA - African Eurasian Waterbird Agreement (i.e. species listed in column A of Table 1, Annex 3 of the Agreement – (http://www.unep-aewa.org/documents/agreement_text/eng/pdf/aewa_agreement_text_2009_2012_table1.pdf) . AEWA applies to all migratory species of seabird and waterbird, except petrels and shearwaters. The only UK species of petrel or shearwater that would meet any of the AEWA criteria is Balearic shearwater, which is also included in the OSPAR list of threatened and declining species.'

Fish & Cephalopods

g. Further consideration should be given to the inclusion of Cephalopod species on the North Sea list of 'additional species'. This recommendation is consistent with the OSPAR Advice Manual: 'with respect to cephalopods a selection of good indicator species will have to be agreed upon by the various Member States in order for there to be consistency in application'.

h. The approach to selecting additional fish species should be consistent across sub-regions. The fish group at the Amsterdam Workshop proposed within each functional group, species should be selected according to how sensitive they are. The UK proposed at Amsterdam that indicators be composed of the most sensitive species and the most opportunistic. In a disturbed ecosystem, below GES, the fish community would be dominated by opportunistic species, with declining or depleted stocks of sensitive species. In a less disturbed ecosystem, that is at GES or heading towards GES, sensitive species would be abundant or increasing in abundance, while opportunistic species would be much less abundant or declining. The relative abundance of sensitive and opportunistic species is therefore a useful indicator for management when aiming to achieve or maintain GES. The sensitivity of different fish species to human pressure has been linked to their life-history characteristics. The UK defined sensitive species as those with *k*-type traits: large ultimate body size, slow growth rate and large size at maturity. Opportunistic species were defined as *r*-type species, which have the opposite traits to sensitive species. For example, in the Greater North Sea, the UK selected 76 species recorded present in at least half of the annual International Bottom Trawl Surveys (IBTS 1983 – 2008) and ranked them by their averaged life-history trait (ultimate body length, Von Bertalannfy growth parameter and length at first maturity). The 25 lowest ranked species were considered opportunist species (r-type) and the 25 highest ranked species deemed to be sensitive species (k-type) (see Greenstreet et al. in prep).

i. Listed fish species, for which sufficient records exist within monitoring data, should also be included in the selection of sensitive and opportunistic species.

j. For many of the listed fish species in the NE Atlantic, monitoring data is poor. The catadramous/anadramous listed fish species are on the Habitats Directive Annex II and all other listed fish species are on the OSPAR list of threatened and declining species. It is likely that assessments under the Habitats Directive will be used for relevant species under MSFD. For the OSPAR-listed species, member states will require advice from OSPAR on the likely future monitoring of these species in order to judge how they may be included in assessments of GES.

Marine Mammals

k. There are only two seal species that are relevant for the assessment of GES in the NE Atlantic: Atlantic grey seal and harbour seal. All other species that occur within the region are occasional visitors or vagrants.

l. The long-list of cetacean species proposed for the North Sea, Biscay and Macaronesia need to be reduced to a list of species that occur commonly and are therefore likely to yield data on distribution and abundance that could be used to construct one or more of the common set of indicators. Conversely, the list of the Celtic seas needs to be expanded to include more cetacean species: the UK has identified six species to be potential indicators.

Reptiles

m. Just one common indicator for reptiles is proposed to date: 'numbers of individuals within a species being by caught'; with a target of 'a decreasing trend'. This will be most relevant to Biscay and Macaronesia, all five species of sea turtle that occur there should be included in the indicator. Sea turtles occur so infrequently in the North Sea and the Celtic Seas that such an indicator will not be relevant there.

8.7 Synthesis tables to illustrate the most suitable target-setting and baseline-setting methods for each GES indicator or indicator class, by species functional group

Cf: 5.2 Marine mammals

Table 8.3: Target-setting and baseline setting methods for Marine Mammals

GES Descriptor Criteria	GES Descriptor Indicator/Indicator classes	Proposed Baseline-setting method	Comment on baseline	Proposed Target-setting method	Comment on target
1.1 Population Distribution	Distributional range (1.1.1)	Aii	GES should represent a larger population (based on what we know of historic population sizes) rather than simply maintain current state (cf. current FCS approach under Hab. Dir.).	1	As per FCS under Hab. Dir. range of a species is stable or increasing and not smaller than the favourable reference range.
	Distributional pattern within range (1.1.2)				
1.2 Population size	Population abundance (1.2.1)	Aii	GES should represent a larger population (based on what we know of historic population sizes) rather than simply maintain current state (cf. current FCS approach under Hab. Dir.).	1	As per FCS under Hab. Population of the species above favourable reference population and reproduction, mortality and age structure not deviating from normal
		NA		3	This is an IWC target and OSPAR EcoQO well as an ASCOBANS target Annual bycatch levels (or any anthropogenic removal) should be reduced to below

GES Descriptor Criteria	GES Descriptor Indicator/Indicator classes	Proposed Baseline-setting method	Comment on baseline	Proposed Target-setting method	Comment on target
					1.7% of the best population estimate. Based on modelling of carrying capacity
		C	Seals only: based on EcoQO on Pup production in grey seals (as a proxy of population size) and on EcoQO on harbour seal population size. Both baselines are a five-year running mean.	1	no decline of ≥10% from baseline
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)	Aii	GES should represent a larger population (based on what we know of historic population sizes) rather than simply maintain current state (cf. current FCS approach under Hab. Dir.).	1	As per FCS under Hab. Population of the species above favourable reference population and reproduction, mortality and age structure not deviating from normal
	Population genetic structure (1.3.2)				
4.3. Abundance/distribution of key trophic groups/species	Abundance trends of functionally important selected groups/species (4.3.1)	See Population abundance (1.2.1)			

Cf Section 4.5 Birds

Table 8.4 Target-setting and baseline setting methods for Marine Birds for each relevant indicator/indicator class

GES Descriptor Criteria	GES Descriptor Indicator/Indicator classes	Proposed Baseline-setting method		Proposed Target-setting method	Comment on target
1.1 Population Distribution	Distributional range (1.1.1)	Not an important indicator of GES for marine birds but may require limited attention during assessment			
	Distributional pattern within range (1.1.2)				
1.2 Population size	Population abundance (1.2.1)	B)	Based on EcoQO on Seabird population trends (under development)	3	Based on EcoQO on Seabird population trends (under development
1.3 Population Condition	Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates) (1.3.1)	n/a	Based on EcoQO kittiwake breeding success (under development)	?	Based on EcoQO kittiwake breeding success (under development)
	Population genetic structure (1.3.2)				
4.1 Productivity of key species or trophic groups	Performance of key predator species using their production per unit biomass (productivity) (4.1.1)	n/a	Based on EcoQO kittiwake breeding success (under development)	?	Based on EcoQO kittiwake breeding success (under development)
4.3. Abundance/distribution of key trophic groups/species	Abundance trends of functionally important selected groups/species (4.3.1)	B)	Based on EcoQO on Seabird population trends (under development)	3	Based on EcoQO on Seabird population trends (under development

Cf 4.6 Fish and cephalopods

Table 8.5 Target-setting and baseline setting methods for Fish and Cephalopods for each relevant indicator/indicator class

GES Descriptor Criteria	GES Descriptor Indicator/Indicator classes	Proposed Baseline-setting method	Comment on baseline	Proposed Target-setting method	Comment on target
1.1 Population distribution	Distributional range (1.1.1) Distributional pattern within range (1.1.2) Area covered by the species (for sessile/benthic species) (1.1.3)	*Mixture of approaches)*	Approach depends on species . In some cases, for species listed under the Habitats Directive, the year of implementation (1994) is used. For commercial species, the baseline depends on the past state determined as a sustainable level.	2 or 3 where possible,	Trends based option 1 might be necessary in data poor situations
1.2 population size	Population abundance and/or biomass, as appropriate (1.2.1)	Mixture of approaches	For commercial species, threshold set as lowest observed biomass using historical data.or modelled level where stock suffers from impaired recruitment.	1 or 2	*Method depends on data availability: for a number of commercial species there are defined reference points for stock assessment purposes that can be used for this purpose. For species/stocks that have no defined reference points, a trends-based approach needs to be taken.*
1.3 Population condition	Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates) (1.3.1)	See 4.2?	Set as past reference point when state was considered at	1 or 3	As per safe fish stocks ECoQO : North Sea specific.

GES Descriptor Criteria	GES Descriptor Indicator/Indicator classes	Proposed Baseline-setting method	Comment on baseline	Proposed Target-setting method	Comment on target
			sustainable levels		For other population or other geographic regions, absolute targets have not yet been defined. Although less meaningful, trend-based targets are sometimes the only method available
	Population genetic structure (1.3.2)			1	Genetic drift (shift in age at maturity). Currently no reference levels have been set.
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)			2	No reference for fecundity levels. SSB below a threshold triggers pressure limits. In fisheries recruitment is monitored but reference points are set on biomass and fishing pressure to infer on recruitment potential.
4.2. Proportion of selected species at the top of food webs	Large fish by weight (4.2.1)	B) Baseline set in the past		1 or 2	a and b regional dependent; deepsea: size does not reflect vulnerability; pelagic: community contains few species: size spectrum of individual species is more

GES Descriptor Criteria	**GES Descriptor Indicator/Indicator classes**	**Proposed Baseline-setting method**	**Comment on baseline**	**Proposed Target-setting method**	**Comment on target**
					relevant
4.3. Abundance/distribution of key trophic groups/species	Abundance trends of functionally important selected groups/species (4.3.1)			1	

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