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Report of the Workshop to review the 2010 Commission Decision on criteria and methodological standards on good environmental status (GES) of marine waters; Descriptor 4 Foodwebs

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Executive summary

Descriptor 4 Foodwebs: *All elements of the marine foodwebs, 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.*

The Workshop to review the 2010 Commission Decision on criteria and methodological standards on good environmental status (GES) of marine waters; Descriptor 4 Foodwebs met in Copenhagen, 26-27 August 2014 to provide input to the review of the possible approach to amend Decision 2010/477/EC. The workshop participants were experts in MSFD implementation and/or scientists specialising in assessing foodwebs. The workshop was planned by a "core team" of 6 scientists. Participants came from across the ICES area and from other non-ICES EU countries (NE Atlantic, Baltic and Mediterranean MSFD regions). Those from ICES countries were nominated by ICES Delegates and ACOM, and those from non-ICES countries by invitation from DGENV to the national marine directors. To conform to best practice and ICES policy, NGOs and stakeholders were permitted to attend the workshop. The 23 participants were 8 national scientists, 6 from the core team, 4 industry representatives, 3 NGO representatives, 2 managers. All participants were reminded that this was a scientific meeting and participants were prohibited from stating or lobbying for institutional policy objectives.

The topics addressed by the workshop were:

i. the review of foodweb criteria in relation to the characteristics of foodwebs (structure, function and resilience);
ii. the need to consider trophic guilds rather than species (taxonomic grouping);
iii. the properties of indicators, including considerations on the state/pressure relationships of indicators; coping with indicators which are more influenced by environmental conditions than anthropogenic pressures which led to the concept of surveillance indicators;
iv. the combination of indicators to assess GES of D4 and operational application of the suggested changes (methodological standards);
v. the proposed potential groupings of indicators from the recent ICES advice on foodwebs;
vi. the pros and cons of using common indicators;
vii. reference point setting;
viii. monitoring needs (standard methods).

The workshop was run by using three parallel, simultaneous subgroups on each topic area which then reported back to a plenary. The composition of the subgroups was altered randomly for each topic consideration.

The workshop concluded that a revision of the current three D4 criteria was necessary and recommended D4 should have just two criteria (4.1 Structure and 4.2 Function of foodwebs). This change in the decision criteria would provide significant advantages in the form of a closer relation to the important aspects of foodwebs as described in the directive and be a simplification of the existing decision. It was based on the current state of our scientific understanding and a pragmatic approach to ongoing monitoring

programmes. The categorisation of foodwebs using taxonomy should be removed from the decision and replaced with the concept of trophic guilds, meaning that the criteria should be applied across specific trophic guilds (rather than with species-specific indicators). An indicative list of trophic guilds is provided. The criterion 4.1 Structure was subdivided into biomass of guilds over time and size structure within those guilds. The workshop did not recommend that all trophic guilds in each ecosystem be assessed but that, by region, a minimum of at least 3 trophic guilds be monitored. Existing monitoring programmes and many proposed indicators can already provide the majority of the information requirements for these criteria (biomass and size of three trophic guilds and productivity of the foodweb). Of the minimum requirement of three trophic guilds per region, a maximum of one should be an exclusive fish guild.

Usually environmental influence has a high impact on foodweb structure and function. Current scientific understanding is such that anthropogenic pressure is difficult to distinguish from the environmentally influenced variability. Thus, the workshop recommended, in the absence of strong indicators reflecting pressure-state relationships, that the indicators of D4 should be treated as surveillance indicators (for monitoring change in the foodweb). Methodological standards for defining GES should describe a state (from past or present) with prescribed bounds based on our known experience of natural variability in that food web's state. Movement beyond those bounds should be seen as leaving GES, and an investigation into the cause or the change in GES status when relevant triggering a more precautionary management. Traditional methods to integrate indicators to a common GES of D4 such as one out, all out, where not viewed as appropriate for D4. Examples were given of indicator definition, range setting and monitoring than can be sued as guidelines for this process as standard methods.

The seven groupings of indicators from the recent ICES advice corresponded well with the proposed approach, although plankton and benthic guilds were mostly absent from the list. This underrepresentation should not be used as an excuse not to monitor and assess these guilds (if chosen as one of the three). When considering structure of the foodweb (D4.1), the use of the proxy of abundance of a single top predator species or population was not considered appropriate, and this was considered more suitable for D1.

1 Introduction

This report documents the main discussions at the ICES workshop to review the 2010 Commission Decision on criteria and methodological standards on good environmental status (GES) of marine waters; Descriptor 4 Foodwebs.

The aim of the workshop was to provide a forum for scientists to provide input into the review process of the marine strategy framework directive (MSFD), especially with regards to Descriptor 4, foodwebs. This workshop is part of the ICES led process to review the MSFD 2010 decision on fisheries, foodwebs, seafloor integrity and introduced energy (noise). The process has been instigated by the European Commission DG Environment to inform the national Marine Directors about the challenges facing the implementation current MFSD decision. It was carried out through the MoU between EC and ICES.

1.1 Interpretation of Descriptor 4

Descriptor 4 of the MSFD is defined as "All elements of the marine foodwebs, 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". In the workshop and this document, the following definitions were used:

- **"All elements"**: "all trophic and functional groups, comprising either one or several species. This potentially includes all living organisms and non-living organic components."
- **"Foodwebs":** "networks of feeding interactions between consumers and their food."
- **"Reproductive capacity":** "maintenance of fertility and avoidance of reduction in population genetic diversity."
- **"Normal abundance":** populations of selected foodweb components occur at levels that are within acceptable ranges to ensure their long-term viability. This means that GES boundary should be sufficient to maintain the full reproductive capacity of selected components.
- "**To the extent that they are known"**: "While examination of foodwebs should in principle include „all elements", for practical purposes it would include only those foodweb components that can effectively be sampled by established robust methods of monitoring".

1.2 Background

According with the Commission Staff Working Document 2014[1], all Member States who have reported have defined GES for Descriptor 4. Only two Member States were judged to have an adequate definition of GES, six were found to have a partially adequate definition whilst eight were found to be inadequate. Four Member States have

[1] European Commission, 2014. Staff working document Accompanying the document "The first phase of implementation of the Marine Strategy Framework Directive (2008/56/EC) - The European Commission's assessment and guidance"

not defined GES for this descriptor. The definitions provided applied to their entire marine waters, with one exception where a Member State makes a minor differentiation between its subregions.

The definitions vary enormously in their content and level of detail; most were qualitative and many were rather vague, lacking definitions of key terms used or specificity as to which elements of food/webs were addressed.

Most Member States have referred to specific foodweb components in their GES definition, sometimes in addition to defining if for all foodweb components. In the Baltic region, most Member States have put an emphasis on fish communities. Most Member States referred to components such as "key" species or "functional groups", and/or to "top predators" or "species at the top of the foodweb". Very few Member States included in their GES definitions specific species or habitats as indicators of change. Indicator species include the harbour porpoise and the harbour seal and indicator habitats include *Posidonia* meadows. Only three Member States included a reference to the pressures of foodweb components, in particular fisheries.

2 Structure of the workshop

2.1 Participants

Experts in MSFD implementation or scientific issues regarding the descriptors were invited to participate through national representatives allowing each country to nominate 1–2 participants. If nominations exceeded the meeting space available ICES reserved the right to reject participants. No nomination was refused for this workshop. Participants joined the workshop at national expense. Participants were not limited to those nominated by ICES Delegates and ACOM and participants from non-ICES EU countries were specifically encouraged via an invitation from DGENV to the national marine directors.

To conform to best practice and ICES policy, NGOs and stakeholders were permitted to attend the workshop on the understanding that policy statements were not permitted. Regional seas conventions were encouraged to participate through their member countries.

The 23 participants present consisted of 8 scientific representatives, 4 industry representatives, 3 NGO representatives, 2 managers and 6 members of the core group and secretariat. Scientists came from the NE Atlantic, Baltic and Mediterranean MSFD regions.

All participants were reminded that this was a scientific meeting and participants were prohibited from stating or lobbying for organizational policy objectives.

2.2 Structure of the workshop

The workshop was planned and organization by an ICES constructed "core team" of 6 scientists with expertise in foodwebs and MSFD implementation. The core team was made up of scientists from Denmark, Ireland, France and a scientist from JRC and two from the ICES secretariat.

The workshop began with a contextual review and an outline of the document describing the possible approach to amend Decision 2010/477/EC. The agenda was then discussed, and the possible role of climate change and environment was brought up as an item not clearly covered by the agenda, so it was added. The workshop was basically structured as follows:

1) Issues relevant to revision
    a) Revision of foodweb criteria: structure, function and resilience and the need to examine groups rather than species
    b) Using common indicators: pros and cons
    c) Aspects advised on by WKFoowI

2) Criteria for GES for D4
    a) State/pressure relationships and the concept of surveillance indicators and coping with indicators greatly influenced by environmental conditions
    b) Combining GES of indicators in GES of D4
    c) Standardized methods for indices, reference point setting and monitoring

3) Additional concerns with regards to D4

Each of the topics was addressed by parallel subgroups after a common introduction to that topic to ensure that all participants understood the task at hand. The subgroup participants were selected at random and no groups were the same between different sessions. Group work was facilitated by a designated member of the group and reported by summarizing the conclusion in plenary after each subgroup session. Generally participants were divided into three groups. This approach was used to ensure the widest possible participation in the workshop considerations and to prevent the over dominance of any individual opinions. The majority of participants contributed actively to discussions in the subgroups. There was an open and agreeable atmosphere in the subgroups and plenary. Group work allowed the listing not only of conclusions of subgroups on the topics but also on the degree of agreement between groups and hence the degree of consensus on the overall conclusions.

3 Issues relevant to revision

3.1 Review and proposed revision of foodweb criteria: structure, function and resilience and the need to examine trophic guilds rather than species

It was proposed to replace the existing three criteria under D4 by two revised criteria (Figure 1) to obtain criteria more closely related to the important aspects of foodweb: structure, function and resilience. Structure and function both appear in the new criteria whereas resilience is still not represented. The pros and cons of the suggested new criteria were discussed in groups. The group conclusions showed a high degree of agreement on all three topics.

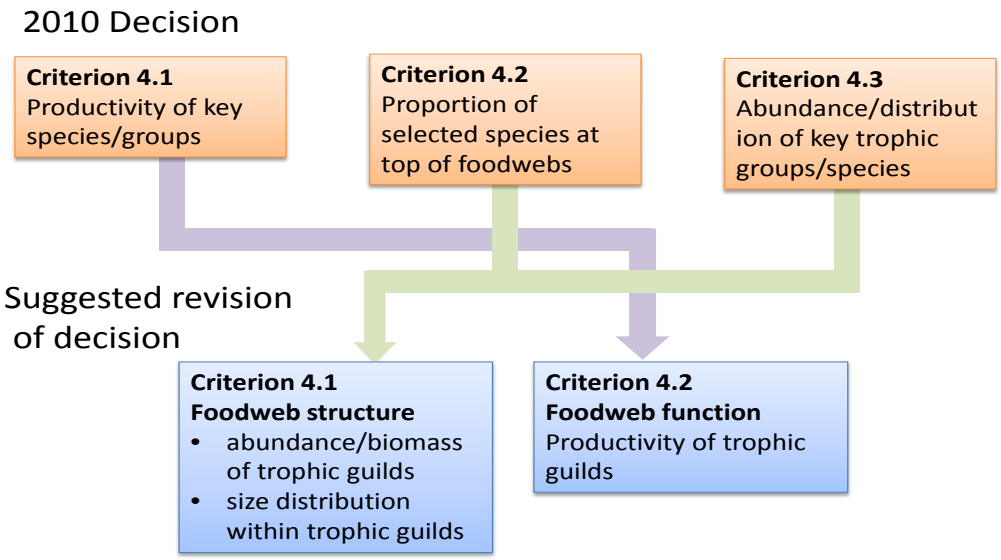

Figure 1. Suggested revision of criteria under D4.

3.2 Advantages and disadvantages of the previously used criteria

The groups considered that many aspects of the previous criteria 4.3 were also listed as biodiversity aspects under D1.7 and in practice not specific to foodwebs, as the suggested key trophic groups were generally not key trophic guilds but rather vulnerable or anadromous groups. The double listing caused confusion of which aspects should be assessed under D1 and D4. Further, the division was considered not to be in line with the objectives which could be set for the foodweb. The existing criteria were considered to be too prescriptive and implied a judgement that the top predators are the most important elements of the foodweb to be assessed. The existing criteria combine both broad objectives and very specific key objectives (top predators). It was felt that assessing the specific GES of top predators fell more within the remit of D1.

3.3 Advantages and disadvantages of the criteria "structure" and "function"

The division into structure and function were considered to be in line with natural attributes of foodwebs. By dividing into these categories the trophic levels will be given equal weight, rather as in the previous version being biased towards top predators.

Further, the new criteria should solve some of the confusion related to D4.3 and D1.7 by focusing on trophic guilds within each criteria. Within trophic guilds, species can be replaced by other species with the same functional niche without foodweb function and structure being severely affected.

It was considered to be a risk that only one ecosystem component is assessed, e.g. fish, when only two general criteria are used and that some guilds are hence ignored. This can be avoided by giving guidance on the minimum requirements to cover under each criteria. More than one ecosystem component should be covered within each criteria (i.e. Seabirds, marine mammals, fish) and more than one guild (see further details on trophic guilds below).

3.4 Should resilience be used as a third criterion?

Resilience is not a strictly defined concept, but is often interpreted as the ability of a system to return to its original state after a perturbation. The lack of a clear definition makes it difficult to measure. Foodwebs are constantly changing and adapting to outside drivers and thereby retaining function. Hence, resilience on a detailed level and structure/function may not be mutually compatible. It is possible that it is a naturally emerging property of structure and function, and hence resilience may be ensured by attaining structure and function are within GES boundaries. A system can move into an altered, stable state or can flip between states, but for unobserved states we cannot appraise resilience. In general, the understanding of resilience is poor when we are moving into the unknown, i.e. out of boundaries, such as when stocks are rebuilt, and this could initiate a decrease in resilience. Hence, the understanding of resilience was deemed to be too poor to construct a separate criterion for this, and that resilience may be accounted for in structure and function with indicator ranges set to capture resilience to the extent possible.

In conclusion, the groups found that it would not be beneficial to force common indicators across or within regions. Rather, there should be an open process where MS can coordinate their developmental work, divide labour and review proposals for indicators. There should however be minimum requirements to the aspects which should be covered under each criteria (see next section) and common methodological standards for how to assess progress towards GES should be developed. Common indicators can be used at regional or subregional scales where the objectives of the indicators are in accordance between MS. However, the appropriate indicators in each region will depend on what is most appropriate to the given ecosystem.

3.5 Definition of trophic guilds

The concept of trophic guilds is a well-defined ecological concept which reduces the confusion between "functional groups" used in D1 and originally used "key trophic groups/species" used in D4. It will rarely if ever be possible to cover all species in all guilds, and this should not be requirement. As the guild is the unit of importance, species composition was considered less relevant, unless changes in species composition resulted in changes in structure or function of the foodweb. The selection of indicator species can be a useful method, but only when these indicator species reflect the status of a specific guild. The group felt that there was a need to provide guidance on the appropriate aggregation level and hence the minimum number of trophic guilds which should be considered. It was also felt, that though the trophic guild would be the most relevant aggregation level, data would generally be collected separately on different

taxonomic categories. Hence, the available data may be difficult to sum into total estimates for a given guild, and it may be more appropriate to investigate taxonomic compartments of guilds separately. As public attention is often centred on taxonomy, this division is a natural intermediate step to achieve trophic guilds and has the advantage that taxonomic information can also be displayed. An example of a guild division is given in table 1.

Taxonomic groups can be subdivided where necessary. For example, phytoplankton can be divided into diatoms, microflagellates, dinoflagellates and picoplankton and zooplankton into mesozooplankton carnivores, mesozooplankton omnivores, merozooplankton omnivores and microzooplankton herbivores. Marine reptiles, though important from a biodiversity point of view, were considered to be of limited interested in European trophic guilds. Not all guilds are equally important in all ecosystems, and hence, there can be ecosystems where all guilds do not need to be represented. Similarly, there can be ecosystems where other guilds are important or where guilds need to be subdivided. As a general rule, at least three trophic guilds should be considered spanning as widely as possible from primary producers to apex predators.

Table 1. Trophic guilds. X denotes where the taxonomic groups contribute significantly to each guild. Nekton includes bony fish, elasmobranchs and squids, a.o.

Guild\Taxonomic group	Phytoplankton1	Zooplankton	Benthos	Nekton excl. warmblooded	Seabirds	Marine mammals
Primary producers	X					
Secondary producers		X				
Filter-feeders			X			
Deposit-feeders			X			
Planktivores			X	X	X	X
Sub-apex pelagic predators				X	X	X
Sub-apex demersal predators			X	X	X	X
Apex predators				X	X	X

[1]**In shallower waters, macrophytes may also be important.**

The estimation of indicators for the different guilds may present challenges in practice. For example, many species consume almost equally from two different guilds (e.g. secondary producers and planktivores) and hence are difficult to assign to a specific guild. Further, several species change guild assignment as they grow. In many cases, the data available covers only part of a particular guild, leading to a need to use parts of the guild only in indicators. The group found that detailed technical guidelines on how to deal with these issues would be useful in future process.

3.6 Aspects (groupings of indicators) advised on by WKFoowI and the recent ICES advice to DGENV.

The workshop investigated the advice produced by ICES based on WKFoowI to look for consistency, the need for minimum requirements, whether the aspect covered the

criteria sufficiently and how any suggested gaps can be included in the suggested aspects. WKFOOWI focused directly at currently applicable indicators whereas the current workshop took a broader look at the aspects to ensure their long-term applicability. The aspects advised on by WKFoowI were:

D4.1.1. Biomass of important trophic guilds

D4.1.2. Mean weight of zooplankton

D4.1.3. Proportion of large fish (large fish indicator, LFI)

D4.1.4. Mean length of the surveyed community

D4.2.1 Primary production or primary production required to sustain fisheries

D4.2.2. Seabird/sea mammal breeding success

D4.2.3. Mean weights-at-age of predatory fish

3.6.1 General assessment of the aspects (groupings of indicators) in relation to the criteria "structure"

The workshop advised that the D4 approach should be based on a to a trophic guild based approach to the criteria rather than the taxonomic approach applied by WKFoowI. They found that the suggested criteria were highly focused on fish whereas the group thought that information on phytoplankton, benthos and non-fish top predators was also needed. It should be recognized that significant compositional changes in species composition are not included in the current form and that such shifts in species as well as size may cause shifts in function.

The groups found that D.4.1.1 can cover the requirement for covering several trophic levels when combined when a minimum requirement to choose no less than 3 trophic guilds spanning a wide range from primary producers to top predators.

The aspects describing size structure of different guilds (4.1.2-4.1.4) seem to mix structural and functional aspects and the level of detail seems to differ between these aspects and 4.1.1. 4.1.3 and 4.1.4 seemed to be too focused on specific taxonomic groups (fish) rather than on trophic guilds. The groups considered that it would be preferable to rephrase these into the single common aspect of size structure for each regionally important guild. This could be measured as mean length, proportion of large fish or mean weight as found most appropriate to the specific guild. In the current wording, the size structure of phytoplankton, benthos, pelagic fish and marine mammals are not included. Size structure of fast growing groups such as seabirds and marine mammals has less structural importance than for slow growing groups such as plankton and fish. Hence, there does not appear to be a need for size structural indicators for these groups.

Together, these two aspects will cover the need for following several trophic layers and to use more than one indicator for the structural indicator. It should be noted, however, that the majority of these indicators will be highly sensitive to single events such as high recruitment years or environmental anomalies.

3.6.2 General assessment of the aspects (groupings of indicators) in relation to the criteria "function"

The suggested aspects for function mainly cover higher trophic levels or makes inference on lower trophic levels. Secondary producers, forage fish and benthos are not represented in the aspects and depending on the interpretation of 4.2.1, phytoplankton may or may not be included directly. Without information on these intermediate levels,

it is not necessarily possible to say what is causing the change in higher trophic level productivity and whether this is related to lack of productivity of lower trophic levels. This is of particular importance since changes in productivity at higher trophic level could be unrelated to foodweb changes. For example, a change in seabird breeding success or mean weight at age of fish can have other reasons than just food availability (e.g. temperature, contaminants, disease or fisheries induced evolution). Primary production to sustain fisheries may not be a good indicator for stocks fished at Fmsy and this indicator responds to climate change and eutrophication as well as foodweb changes. The title in the recommendation does not include "to sustain fisheries", indicating that the review group had similar concerns.

Together, the three aspects cover the requirement to cover more than one trophic level and have more than one indicator if 4.2.3 is expanded to cover zooplankton, lower, middle and top predators. In the current version, zooplankton and benthos productivity are not included. Though this is likely to be due to the currently insufficient sampling, it would be important to include these groups. To account for the current lack of sampling in many areas, the guideline can be to include these when this is practically feasible.

3.7 Using common indicators: pros and cons

There are advantages to having pan-regional definition of minimum requirements for the number and criteria coverage of proposed indicators as this ensures that the descriptor is adequately monitored. Further, having common indicators within larger areas can provide cost-efficiency in data collection and the estimation of indicators, especially if these aspects can be coordinated within the region, for example under the regional seas organizations. Where monitoring is standardized within or across regions, there are also potential gains in common method development and room for making new indicators at any point in time as long as the monitoring has been thorough. Common indicators for subregions within larger regions have the advantage of being more easily integrated than widely differing indicators.

The development of new indicators is more efficient when reviewed at an early stage by other scientists, for example through presentation and discussion in ICES groups. Member states can use these groups to coordinate their work and share resources and expertise therefore deciding on indicators. However, there are no major cost benefits of developing indicators at pan-regional levels and such tight coordination is likely to hinder the development of new indicators and ideas if agreement on one indicator acts to limit the suggestion of alternative indicators. Indicator development is often restricted to currently accepted indicators which tends to halt new development and the adaption of indicators. All measurements are adapted to our current understanding of the system and hence, any development in the system or our understanding of it requires constant development of new indicators to ensure that these continue to measure the most relevant aspects. Further, the process of implementing common indicators is lengthy and often either science has moved on or the environment has changed in a way that the indicator has lost its relevance. Having just a few commonly defined indicators increases this risk. Despite these caveats, the group considered that with limited funding, a list of potential indicators for Member States to choose from can be useful.

Having EU-wide common pan-regional indicators defined in detail was not considered to be the optimal approach to monitoring GES. Regions have different important trophic guilds and different species composition within guilds and it is more important

to have correct aspect coverage than to have consistency between regions. Indicator targets will usually also differ between subregions. A decision to aim for common indicators across all regions can lead to a competition between countries to get their indicators accepted as a common one and since member states have invested a lot in existing indicators, there will be other factors affecting the decision than scientific rigor. Further, if only a few indicators were defined, there is a danger that member states will aim for indicator without reaching GES in its broader interpretation as fulfilling the targets of the indicator becomes a mean in itself, rather than ensuring that it assesses health of the system.

4 Criteria for GES for D4

4.1 State/pressure relationships and the concept of surveillance indicators and coping with indicators greatly influenced by environmental conditions

4.1.1 Pressure state relationship of marine foodwebs

The choice of state indicators for the MSFD can either be limited to the ones that have a very clear pressure-state relationship and measure the response of the system to management measures or, alternatively, indicators can be selected which monitor the health of the marine ecosystem and any potential deviation from a "healthy state". Pressure indicators can also be chosen but these would always be proxies of implied impact on the state of the ecosystem, rather than a direct measurement of the state.

Marine foodwebs are strongly influenced by natural variability and their link to human pressures is complex. D4 indicators can respond to multiple, interacting drivers, including anthropogenic pressures and indirect effects. The current knowledge of ecosystem functioning is constrained. Hence, changes are not easy to interpret and cannot necessarily be reversed by management action. Due to these reasons, the workshop agreed, that the second objective, i.e. using indicators to monitor the health of the system is more appropriate to marine foodwebs. Foodweb indicators for D4 would take on the role of surveillance indicators and inform the assessment of any potential problems in marine foodweb structures and/or functions. They should also alert for action.

4.1.2 How can surveillance indicators be used?

For chosen indicators, boundaries are set around a range of natural variability. Indicators are tracked for directional changes and/or movement outside boundaries. Regular tracking within assessments periods can give early warning signs of potential problems. Once a problem is identified, the cause is investigated and the next steps are identified. The next step is to take necessary action. The intermediate steps of investigating the cause and identifying necessary steps are added because pressure-state relationships are not always clear. The extra time spent on this intermediate step will not make management inefficient because foodwebs adapt slowly and measures can be adaptive and react to the latest information.

If the problem identified is clearly related to manageable pressures, relevant management measures are required to respond. In this case, the concept of surveillance indicators should not be used to avoid taking appropriate management actions. Fish guild biomass, is one example that can be tightly linked to fishing pressure and in this case, management action should be taken.

If the link to pressures is not as clear, management could be alerted to be more precautionary. If there are environmental changes causing out of bounds signals, this can have implications on target setting and the ability to reach GES in other descriptors. Natural events that are reoccurring in the medium term (e.g. within one to two reporting cycles), could inform that environmental anomalies can reduce the potential of reaching GES. The example of salt inflow in the Baltic Sea was given. If natural changes are unidirectional, targets and indicators might have to be revised in D4 and/or in other descriptors because there is an indication that the "prevailing climatic conditions" have changed.

4.1.3 Suggested decision framework (methodological standards)

Surveillance indicators track marine foodwebs, monitor whether changes are happening, and whether these changes are out of bounds. D4 marine foodwebs react to pressures that are already documented in other descriptors, such as fishing, contaminants, and eutrophication. A framework needs to be developed on how to deal with the descriptor, if one or several indicators show that the system is out of bounds.

This framework could be used as a decision tree:

- Is the system "out of bounds"? Boundary setting will depend on time-series, data availability and uncertainty. It is important to consider the changes in all indicators simultaneously. For example, if everything is within the same end of the acceptable ranges, this may indicate a particular situation.
- What are the causes?
    - If changes are mostly pressure related, management action is required. Actions on D4 will in most instances require management measures that more directly address other descriptors, such as: eutrophication, fisheries and contaminants.
    - If changes are environmentally induced, then the questions are whether targets and indicators are still relevant or need to be reevaluated, and whether the changes can impact on the ability to reach GES.

The use of surveillance indicators is inconsistent with green and red traffic lights, and therefore with indicator weighting. The purpose is to investigate the causes for change and the most appropriate response/action to this change.

4.2 Link to other descriptors

Functional diversity and ecosystem functioning under D1 link tightly with D4. Surveillance indicators should be an issue under D1 as well as under D4 and there are potential benefits of coordinating the concept of surveillance indicators between D1 and D4. GES with respect to D4 could integrate outcomes from D1, D3, D6 in addition to specific D4 indicators. GES can be "uncharted territory", i.e. states we have not observed in our time-series. If there is any indication of heading towards the limits of a range, we may not know how to manage that but at least we must investigate the causes. Similarly, an indicator changing markedly inside bounds does not necessarily mean that no action is justified.

4.2.1.1 Combining GES of indicators in GES of D4

The indicators of D4 track marine foodwebs, monitor whether changes are happening, and whether these changes are out of bounds. Marine foodwebs react to pressures that are already documented in other descriptors, including fishing, contaminants, eutrophication as well as natural drivers such as the environment. This complicates the construction of a joint GES indicator for D4 as some changes may be within bounds but caused by excessive pressures and therefore already alarming, while some changes are out of bounds due to natural environmental variation and hence cannot be remedied by management measures. The groups considered several methods of aggregating indicators such with the extreme being one out all out, where one indicator outside GES causes D4 to be outside GES and the all out, where all indicators must be outside GES for D4 to be outside GES.

One out all out was considered appropriate at the criteria level. Hence, there can only be GES of D4 if both structure and function are at GES. However, the effect of the one out, all out method within each criteria would likely be a permanently state of D4 outside GES, with management action being unlikely to be able to bring the indicator inside GES. This might be counterproductive as the perception of an indicator which is always outside bounds and management action will likely lead to ignoring the issues which can be addressed through management.

The surveillance indicators of the two criteria exhibit large variation due to e.g. environmental conditions and potential long lags. As reference points are set from historical observations, falling outside these is not necessarily a danger to the foodweb (e.g. rebuilding predatory fish stocks) and even changes which are not outside the range of GES may be required to elicit responses if several indicators are persistently approaching their limits. A more detailed framework needs to be developed on how to determine GES of D4, preferably including input from policy-makers and managers to identify the preferred interpretation of GES of D4.

4.3 Standardized methods for indices, reference point setting and monitoring

Existing monitoring programmes across Europe (satellite, plankton, fish and apex predator surveys) and many proposed regional indicators developed to inform the existing criteria can already provide the majority of the information requirements for these new proposed criteria (biomass of, and size within, at least three trophic guilds and productivity of the foodweb).

Examples of different indicators were discussed to demonstrate agreed methods for indicator estimation, reference point setting and monitoring.

4.3.1 Biomass of regionally important trophic guilds

4.3.1.1 Selection of indicators

The MS identifies the trophic guilds and then coordinate with the other Member states in the subregion. The indicative list given in table 1 can be used as a starting point to assemble a matrix of guild and taxonomic groups, data available, species to include and, through expert judgement, the proportion of all biomass covered in the guild and the indicator importance in region. As a minimum, three guilds that reflect lower, middle and higher levels of the foodweb covering several ecosystem components that are important at sub regional scale should be chosen. The selection should then be coordinated regionally to benefit from coherent monitoring and assessment of the functional guilds.

4.3.1.2 Definition of natural range

Natural range can be defined based on long-term time-series within the sub region if available, or if these are not available, using a stepwise approach based on expert judgement. Climate change, regime shifts and other information on the environment should be taken into account to interpret the time-series and natural range.

4.3.1.3 Monitoring and detecting signals

It should be evaluated on a subregional scale whether the existing monitoring already provides adequate data to calculate the biomass of the selected guilds or whether additional monitoring needs to be considered for important guilds. Once monitoring has

been conducted, short-term and long-term trends, and the indicator relative to the natural range are evaluated to determine links with manageable pressures.

4.3.2 Primary production:

4.3.2.1 Selection of indicators

It should be noted that there is a difference between the interpretation of primary production indicators used to monitor eutrophication and indicators of foodweb function. Whereas in the former context, an increase in primary production or chlorophyll a is interpreted as a sign of increasing eutrophication, the latter interprets an increase in primary production or chlorophyll a as an increase in production and hence beneficial to the foodweb. Ideally, primary production should be measured rather than using proxies such as chlorophyll a. It is highly correlated over large-scales, and this should be considered when defining the indicator in detail. The identification of indicators should also reflect the best available data.

4.3.2.2 Definition of natural range

The natural range can be defined based on long-term time-series or model predictions. The definition should take climate change, regime shifts and other information on the environment into account to interpret the time-series and natural range.

4.3.3 Seabird breeding success

4.3.3.1 Selection of indicators

While breeding success of kittiwake is an OSPAR candidate D1 indicator, it is not applicable in all regions. However, Audouin's gull or Sandwich tern, though not exact guild equivalents to kittiwake, could be considered as possible examples in the Mediterranean. The indicator often shows correlations on large spatial scales and hence can be integrated across subregions. A practical indicator could be the number of chicks fledged per nest from a given number of nesting attempts at sample colonies.

4.3.3.2 Definition of natural range

Natural range can be defined based on long-term series, taking into account climate change, regime shifts, and other information on the environment to interpret time-series and natural range. Further, life-history parameters can be used to identify ranges compatible with maintaining or increasing breeding success.

4.3.3.3 Monitoring and detecting signals

Note that although ICES Advice 2014, Book 1, Annex 1.6.2.2 cites measurement of seabird breeding success (in relation to food availability) as "number of chicks per nest" for selected species, a stronger signal derives from the parent's ability to raise said chicks to fledging. In designing a monitoring program, the best data sources should be identified. Sample colonies can be selected (using randomized plots as appropriate) on a regional scale.

5 Additional concerns with regards to D4

The concerns raised with regards to D4 were mainly related to the lack of data available for lower trophic levels and benthos, which creates a cycle of not defining indicators for these groups, which again leads to lack of monitoring. It should considered a priority to implement sampling programs for these groups as knowledge of their development is crucial to interpreting changes in higher trophic levels. For example, it is not possible to relate recent changes in growth of eastern Baltic cod to changes in their benthic food, and hence the importance of this link remains unknown. Numerous similar examples exist from other areas.

6 Conclusions

The group concluded that the revision of the current three D4 criteria into the two criteria "structure" and "function" provided significant advantages in the form of a closer relation to the important aspects of foodwebs, a more widespread focus across trophic levels and less conflict with species-specific indicators under e.g. D1.7. The criteria "structure" was subdivided into biomass of guilds and size structure within those guilds, with the possibility to further subdivide these into taxonomic groups within each guild. Existing monitoring programmes and many proposed indicators can already provide the majority of the information requirements for these criteria (biomass and size of three trophic guilds and productivity of the foodweb). The groups of indicators proposed by the recent ICES advice (WKFoowI) corresponded well with this approach, though the lack of available data for plankton and benthos has led to an underrepresentation of these groups in the current indicators. This underrepresentation should not be used as an excuse not to monitor these groups and the participants advised that monitoring was initiated to allow the subsequent development of indicators. Minimum requirements for indicators under D4 were defined as the need to represent at least three different guilds and several taxonomic groups per region. The indicators of D4 were identified as surveillance indicators necessary to monitor changes in the foodweb rather than indicators responding tightly to manageable pressures. Due to this, traditional methods to integrate indicators to a common GES of D4 such as "one out, all out" leads to risks that the combined indicator will not lead to management actions in the appropriate cases. Examples of indicator definition, range setting and monitoring exist than can be sued as guidelines for this process.

7 References

ICES. 2014. EU request on proposal on indicators for MSFD Descriptor 4 (foodwebs). *In* Report of ICES Advisory Committee, 2014. ICES Advice 2014, Book 1, Section 1.6.2.2.

ICES. 2014. Report of the Workshop to develop recommendations for potentially use-ful Food Web Indicators (WKFooWI), 31 March–3 April 2014, ICES Headquarters, Co-penhagen, Denmark. ICES CM 2014\ACOM:48. 75 pp.

Annex 1: List of participants

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Annex 2: Agenda

Report of the Workshop to review the 2010 Com-mission Decision on criteria and methodological standards on good environmental status (GES) of marine waters; Descriptor 4 Foodwebs

ICES WKGMSFD D4 REPORT 2014

Draft agenda

Revised on 7 August 2014

Workshop to review the 2010 Commission Decision on criteria and methodological standards on good environmental status (GES) of marine waters; **Descriptor 4 Foodwebs**

ICES H.Q. Copenhagen, Denmark

09:00 26th August to 17:00 27th August

Chair: Anna Rindorf, Denmark

26 August 2014

1) Introductions and welcome

Participants will be welcomed to the workshop.

2) Aim of the workshop

The agenda, aims of the workshop, and expected outcomes will be reviewed. Participants will be invited to provide initial feedback on the proposed agenda and process.

3) Issues relevant to revision

- Revision of foodweb criteria: structure, function and resilience and the need to examine groups rather than species
- Using common indicators: pros and cons
- Aspects advised on by WKFoowI

27 August 2014

4) Criteria for GES for D4

- State/pressure relationships and the concept of surveillance indicators
- Combining GES of indicators in GES of D4
- Standardized methods for indices, reference point setting and monitoring
- Additional concerns with regards to D4

5) Conclusion

The main conclusions of the workshop will be reviewed and summarized.