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Background

Assessments of marine biodiversity under different policy frameworks face the challenge to encompass multiple species, parameters and policy objectives which result in complicated assessment results. Methods aiming at integrating results have been developed in many marine areas, but many of those have focused on a limited species group or a limited aspect of marine biodiversity. Most integrated assessment methods have focused on water quality, eutrophication or contamination and surprisingly few have tackled marine biodiversity. However, in this document some preliminary conclusions have been proposed and examples from other assessment methodologies have been discussed.

The review is based on the work of the European Topic Centre for Inland, Coastal and Marine waters (ETC-ICM, a manuscript). It has been shortened and modified to the HELCOM HOLAS II purposes. Although the review material is not fully presented in this document, the scientific references have been given which allow interested readers to familiarize with the topics.

The objective of this document is to give background material for the HOLAS II process in developing the biodiversity assessment tool, which can assess the state of the Baltic marine biodiversity under the EU Marine Strategy Framework Directive and the Baltic Sea Action Plan. The document takes into account also the publically available documents of the revision of the COM DEC 477/2010/EU and the MSFD Annex III.

Action required

The Workshop is invited to

- take note of the review results
- use the information for supporting the development of the HELCOM HOLAS II biodiversity assessment tool

Review of aggregation methods in integrated assessments of biodiversity

Introduction

Multi-metric indicator-based assessment tools (MIBATs) have been used worldwide in different assessment contexts (e.g. Bricker *et al.* 1999; HELCOM 2010a) and experience in their use has produced a significant number of scientific studies (reviewed in Borja *et al.* 2014). The tools aim to simplify the complex environmental phenomena by selecting key features and associated environmental goals and, hence, providing an assessment of the state of the environment in a cost-effective way (see e.g. Jackson *et al.* 2000; Kershner *et al.* 2011). The tools differ, however, in their methodology and purpose and therefore it is likely that many of them would not be applicable to the assessments of the state of the Baltic Sea under HOLAS II, fulfilling also the requirements of the EU Marine Strategy Framework Directive (2008/56/EC, hereafter MSFD). The MSFD requires an assessment of the state of the marine environment in six-year cycles.

The assessment according to the MSFD covers eleven qualitative descriptors of marine environment, associated criteria, a list of marine ecosystem components and pressures affecting them. The European Commission guidelines for the assessment are under preparation but the latest version of the discussion paper (Anon. 2015) proposes an assessment framework where specific descriptors and criteria are integrated to result in simpler and more informative assessment results. This would require tailor-made assessment tools for the MSFD framework.

Recent reviews of assessment methodologies and practices have concentrated on integration rules, spatial assessment scales and hierarchy of assessments (Borja *et al.* 2008, 2014; Prins *et al.* 2014). This review will continue along the same lines, but aims to bring the rather academic discussion into more practical level, with the objective of paving the way for operational assessment tools in European marine environment. This will be achieved by analyzing not only the principles of the tools, but also the data requirements, experience of using such tools, levels of technical/statistical supporting work required, levels of expert judgement (e.g. in determining status from the outputs provided), how easy it is to interpret the results, and suitability for MSFD assessment purposes.

This review is based on the work of the European Topic Centre for Inland, Coastal and Marine waters (ETC-ICM, a manuscript). It has been shortened and modified to the HELCOM HOLAS II purposes. Although the review material is not fully presented in this document, the scientific references have been given which allow interested readers to familiarize with the topics. In this document, the focus will be in assessment tools for marine biodiversity, but experience from other tools is also discussed and included in the review results.

The required building blocks of an MSFD appropriate assessment tool

The European Commission's discussion paper (Anon. 2015) gives a framework and sets the objectives for the requirements on an MSFD appropriate assessment tool. Such a tool should be able to assist in evaluating the state of the environment based on multiple metrics. It should be a simple, rational and a scientifically robust system and be able to support comparable assessments of different geographic areas, but simultaneously take into consideration the area-specific characteristics (CCME 2008). It should be constructed in such a way to facilitate peer review and re-examination and to be easily developed as more information becomes available. It should provide a means to help management prioritize the remediation of an area. Other building blocks for the work are found from the European Regional Sea Conventions' assessments and objectives.

Three elements below outline the building blocks of an operational multi-metric indicator-based assessment tool:

Indicator level

The indicator level refers to the HELCOM core indicators. The indicators should also take into account the COM DEC 477/2010/EU, which is under revision. The indicators have been largely operationalized in the RSCs (e.g. the HELCOM core indicators, OSPAR common indicators) and take into account the marine elements listed in Table 1 of the MSFD Annex III.

According to the requirements set for HELCOM core indicators, and in addition to the requirements rising from the Annex III and the COM DEC, the indicators need to be numerical, indicate the so-called GES boundaries (i.e. numerical information indicating a desired status or trend) and be based on data from the national monitoring programmes (described in the HELCOM Monitoring Manual).

The COM DEC and the EC discussion paper (Anon. 2015) are built on the assumption that anthropogenic pressures impact the marine biodiversity and therefore also the indicators in the biodiversity assessment need to be responsive to pressures. In many cases, such a relationship has been difficult to establish (e.g. HELCOM 2012) and therefore the indicators, their GES boundaries and also the underlying data may have different quality in the assessment. This can be dealt with by assigning confidence scores to each of these components.

Integration phase

The integration phase requires careful consideration and likely combining different rules on each level of hierarchy.

The EC discussion paper (Anon. 2015) does not give any guidance how the integration should or could be carried out but it mentions that the so-called one-out-all-out principle (OOAO) would be better to use at a higher hierarchical level rather than between the indicators. Recent reviews of the integration rules (Borja *et al.* 2014; Prins *et al.* 2014) described a set of rules and also mentioned cases of hierarchical assessment elements. In the latter cases, hierarchical combinations of averaging, weighted averaging and the OOAO have been used and without exception using the OOAO among the high-level elements.

Integrated level

The outcome of the integrated assessment is a status which, in minimum, indicates whether the system is in GES or not. As the assessments have, however, tight linkages to actions to improve the state of the marine environment (i.e. the MSFD programme of measures), it may be more useful to have an output which shows also the distance to GES. This has been done, for instance, by the HEAT tool for eutrophication assessments(Fleming-Lehtinen *et al.* 2015; Andersen *et al.* 2015).

In addition to such a minimum requirement, desirable features in the assessment output would be an assessment of confidence and the possibility to see the results from different aspects, such as (1) descriptors, (2) GES criteria, (3) single indicators or (4) marine elements (i.e. mammals, seabirds, fish and benthic and pelagic habitats and communities). In a similar way also the quality of the assessment results could be back-tracked from the overall confidence to the underlying components.

Assessment tools for the state of biodiversity

Assessment of biodiversity is a complex task and therefore it is not surprising that only three quantitative tools are available which cover biodiversity broadly. Here we also evaluated more limited method

approaches in order to have methodological variability in the review. These methods are obviously not directly suitable as MSFD assessment methods. In such cases, the focus is however in multi-metric methods and in good practices of the integration rules and determination of GES.

Altogether eight tools or methods were evaluated: HELCOM Biodiversity Assessment Tool (BEAT), MARMONI biodiversity assessment tool, DEVOTES biodiversity assessment tool (NEAT), Biological Health Index (BHI), Index of Biological Integrity (IBI), Estuarine Fish Community Index (EFCI), French estuarine fish index and US EPA Benthic Index.

HELCOM Biodiversity Assessment Tool (BEAT)

BEAT is a multi-metric tool that integrates biodiversity-related indicators. All types of indicators can be used, but they need to be monotonically increasing or decreasing. A threshold is used to indicate GES at the indicator level.

Proof of concept and development history: BEAT 1.0 was developed for the HELCOM thematic assessment of biodiversity (HELCOM 2009b). A rerun of the BEAT tool was made for the HELCOM holistic assessment in 2010 (HELCOM 2010a). A slightly improved version (BEAT 2.0) was developed for the HARMONY project in the North Sea + Kattegat. Andersen *et al.* (2015) found significant correlation between the BEAT biodiversity status and the cumulative pressures in the Baltic Sea.

Technical descriptions are given by Andersen *et al.* (2014). Briefly, indicators are compared against their threshold values (reference condition + acceptable deviation or alternatively a direct GES-boundary) and the result is normalized to a Biodiversity Quality Ratio (BQR). The indicator BQRs are weighted and averaged within a quality element (i.e. an indicator group). There are four quality elements in BEAT.

Integration rule: BEAT is a multi-metric tool which applies weighted averaging within groups of indicators and the OOAO between groups. BEAT is based on HEAT.

Determination of status: Each indicator is associated with a threshold. This threshold is carried through the integration and the final status. See also the technical description.

Validation: Validated against anthropogenic pressures and impacts (Andersen *et al.* 2015).

Confidence assessment: A separate quantitative confidence assessment, where the confidence on data, indicator and the GES boundary is estimated through expert judgement.

Comprehensiveness of the tool: BEAT 2.0 captures three aspects of the biodiversity (i.e. the quality elements): state of species populations (usually key species), state of species communities (usually pelagic and benthic) and state of habitats and marine landscapes). Indicators under these themes can include aspects of abundance, distribution and condition. In addition, also supporting parameters can affect the outcome of the tool. These are usually nutrient or water transparency indicators.

Suitability for MSFD assessment: The current versions do not address MSFD Com DEC criteria.

MARMONI biodiversity assessment tool

The MARMONI tool focuses on the MSFD descriptor 1. It is a web-based tool that can utilize all kinds of biodiversity indicators, because the GES definition is binomial (0 or 100).

Proof of concept and development history: The tool has been tested for three case study areas in the Baltic Sea in the Life+ MARMONI project. The tool is new and not yet further developed.

Technical descriptions: Description is given on the MARMONI web site: http://marmoni.balticseaportal.net/wp/category/biodiversity-assessment/. Quantitative indicators are assessed against their GES boundaries and consequently classified to 0 or 100. In the integration, a weighted average is calculated across indicators. The result is given for MSFD GES criteria. The end result is only partly measurable as the distance to GES cannot be assessed after the indicator integration.

Integration rule: Weighted averaging.

Determination of status: Each indicator has a specific threshold, but the final status is not associated with the indicator statuses and must be determined separately.

Validation: Indicators are validated, not the integrated assessment results.

Confidence assessment: A separate confidence assessment is made for each indicator and integrated for the MSFD criteria. The confidence assessment also takes into account how well the MSFD criteria and/or biological elements are represented in the assessment.

Comprehensiveness of the tool: The tool includes all the aspects of biodiversity if relevant indicators are available.

Suitability for MSFD assessment: Although the tool is principle is limited to D1, in practice it includes also indicators for D4 and D6 (which are interpreted to assess D1).

DEVOTES biodiversity assessment tool (NEAT)

The tool is under development by the FP7 DEVOTES project for biodiversity assessments under MSFD. Its integration rules are flexible (can be decided by the user), but it defines indicator groups according to MSFD and the confidence assessment is data driven as it is based on boot-strapping of indicator variance.

Proof of concept, development history and validation: The tool is still under development and is currently being tested and scrutinized in 9 pilot areas across EU.

Technical descriptions: Not yet available. An OpenSource tool and all relevant documentation will be available in late 2016. Preliminary descriptions through the DEVOTES project documents and presentations. The main features are based on the BEAT tool.

Integration rule: The DEVOTES tool is a multi-metric tool which applies weighted averaging within groups of indicators and the OOAO between groups.

Determination of status: Each indicator has an associated GES boundary. The GES boundary is carried through the integration and the final status.

Confidence assessment: Variance of the indicator results is used for boot strapping. The boot-strapped values show how certain the indicator result is. That is used for confidence result. The confidence assessment is data driven regarding the data, based on the standard error of status data.

Comprehensiveness of the tool: If relevant indicators are available, it covers all aspects of biodiversity. It is able to use only indicators that on a single threshold value and contain standard error of status data.

Suitability for MSFD assessment: Assesses the MSFD biodiversity descriptors.

Biological Health Index (BHI)

The Biological Health Index is a tool for fish assemblages (Cooper *et al.* 1994).

Proof of concept and validation: It has been used in South Africa in specific estuary types, within which the assessment result is given.

Technical descriptions are given by Cooper *et al.* (1994) and Harrison *et al.* (2000). The BHI is calculated using the formula:

$$BHI = 10 \times J \times \frac{\ln(P)}{\ln(P_{max})}$$

, where: *J* = the number of species in the system divided by the number of species in the reference community; *P* = the potential species richness (number of species) of each reference community and Pmax = the maximum potential species richness from all the reference communities. The index ranges from 0 (poor) to 10 (good).

Integration rule: Scoring.

Determination of status and validation: A threshold is found by a validation exercise from the range of scores.

Confidence assessment: No specific confidence assessment.

Comprehensiveness of the tool: Limited to fish assemblages, but within that it is fairly comprehensive (i.e. assesses diversity, species composition, nursery function and trophic integrity).

Suitability for MSFD assessment: Too limited. In case of fish, all relevant aspects are covered.

Index of Biological Integrity (IBI)

The IBI is a multimetric index for fish community, reflecting important components of community ecology: taxonomic richness, habitat and trophic guild composition, individual health, and abundance (Karr 1981, Karr *et al.* 1986, Roset *et al.* 2007). IBI classifies sites by ranking them over a range of biotic condition from no fish and poor sites to excellent ones with a rich community.

Proof of concept and development history: There are many versions of the IBI, as the parameters and characteristics vary across regions where it has been used. A review of the IBI is given by Roset *et al.* (2007).

Technical descriptions: Technical description is given by Karr *et al.* (1986). Each parameter in IBI is scored from 1 to 5, depending on the strength of the deviation from the excellent expected scenario at reference sites.

Integration rule: No information.

Determination of status: Most of the IBI versions use the reference condition approach.

Validation: Several validation studies, for instance against habitat degradation or water quality (see Roset *et al.* 2007).

Confidence assessment: Not known.

Comprehensiveness of the tool: Includes several ecologically relevant aspects for fish communities.

Suitability for MSFD assessment: Limited to fish communities only.

Estuarine Fish Community Index (EFCI)

The EFCI is not an assessment tool but a community index consisting of 14 fish parameters.

Proof of concept and development history: EFCI has been used in the South African estuaries. Its further development is unknown.

Technical descriptions: Described by Harrison & Whitfield (2004). The index consists of 5 parameters on species diversity and composition, 2 parameters on species abundance, 4 parameters on nursery function and 4 parameters on trophic integrity.

Integration rule: Scoring. Each parameter is given a score depending on its relation to a threshold. EFCI is the sum of all scores.

Determination of status: The status is defined as a threshold on the score values. It is found by validating the results against other assessment results (e.g. contamination status).

Confidence assessment: No confidence estimate.

Comprehensiveness of the tool: Limited to fish assemblages, but within that it is fairly comprehensive (i.e. assesses diversity, species composition, nursery function and trophioc integrity).

Suitability for MSFD assessment: Too limited. In case of fish, all relevant aspects are covered.

French estuarine fish index

The French estuarine fish index (hereafter FEFI) is a multimetric index and consists of four metrics: total density (TD), density of diadromous migrant species (DDIA), density of marine juvenile migrants (DMJ) and density of benthic species (DB).

Proof of concept and validation: Only one description was available (Delpech *et al.* 2011) with no information of the use of the tool. No information on the validation.

Technical description is given by Delpech *et al.* (2011).

Integration rule: Each metric was scored and the scores summed.

Determination of status: A threshold on the range of scores.

Confidence assessment: Not given.

Comprehensiveness of the tool: Limited to fish assemblages.

Suitability for MSFD assessment: Too limited.

US EPA Benthic Index

The US EPA Benthic Index consists of two benthic parameters which are integrated by a conditional rule. While it is limited to the benthic community, it is included in the review because it is multi-metric, i.e. it integrates two different components by an integration rule.

Proof of concept and validation: It is being used nation-wide in the US coastal waters and it is part of the EPA National Coastal Condition Report (US EPA 2012).

Technical descriptions: The tool is described by US EPA (2012). The index reflects changes in benthic community diversity and the abundance of pollution-tolerant and pollution-sensitive species.

Integration rule: Conditional rules to integrate the two parameters.

Determination of status: Good, fair and poor status are based on thresholds in index scores, which are given for each of the two parameters separately and then integrated.

Confidence assessment: No confidence estimated.

Comprehensiveness of the tool: The tool is purely restricted to the state of benthos (diversity and condition).

Suitability for MSFD assessment: Too restricted for the MSFD biodiversity assessment. Addresses the COM DEC criteria 1.6 and 6.2.

Comparison of the biodiversity tools

Seven biodiversity assessment tools in the evaluation have been documented and six of them have been validated against external data. However, the evaluation showed that a bigger problem with the tools is their suitability to the MSFD assessment as defined by the directive, COM DEC (and its proposed revision) and the EC discussion document for the MSFD implementation (Anon. 2015). The only tools directly addressing the GES criteria are the NEAT tool and, in principle, the MARMONI tool. The BEAT tool was developed before the COM DEC, and therefore it does not consider the MSFD criteria in its grouping of indicators. The other tools are limited to fish communities or benthos.

Many of the tools apply some form of one-out-all-out (OOAO) principle when making the final assessment. This was not the case in tools which sum up the indicator scores. Despite that, the biodiversity tools have basically four types of integration rules. The MARMONI tool is the only tool depending entirely on weighted averaging, the NEAT tool and BEAT tools integrate hierarchically (first by weighted averaging and then by OOAO, the EFCI, BHI, IBI and French Estuarine fish index score and sum the components, and the EPA Benthic Index integrates by a conditional rule. The two latter approaches (i.e. scoring and summing and conditional rules) are difficult to apply in in cases were Member States have different data and indicators, as the use of different number of indicators in the tool requires separate validation of the tool or different conditional rules. Therefore the summing and conditional rules are not recommended as the methods for the HOLAS II biodiversity assessment.

The MARMONI tool, NEAT and BEAT are multi-metric tools which rely on independent indicators. The indicators have GES boundaries to enable also individual assessment of GES. The tools group the indicators according to GES criteria (NEAT and MARMONI) or HELCOM BSAP policy objectives (BEAT) and the assessment result is an integrated score of the indicators. There are, however, two big differences in the MARMONI tool compared with the NEAT and BEAT tools, which are technically similar (except some details). The integrated assessment result in the MARMONI tool is independent on the indicator GES boundaries, because each indicator is scored either 0 (non-GES) or 100 (GES) and the final score is a weighted mean of

those values. This means that the MARMONI outcome is a mean value which is not related to the indicator-specific GES boundaries and therefore requires an additional validation to indicate which mean value is in GES or non-GES. The NEAT and BEAT tools, however, carry the indicator GES boundaries along the integration process, and the final score is determined on the basis of the indicator GES boundaries.

All but three tools were considered too limited in their suitability to the MSFD assessment and only the NEAT was considered as fully aligned with the MSFD requirements (as they are currently). The MARMONI tool would require double setting of GES boundaries (first on indicator level and then on overall level). The BEAT tool would still require alignment with the MSFD GES criteria. In the other tools, the limitations included limited set of marine elements or then the integration relied on summing of parameter scores (which requires specific validation in different areas).

Observations from eutrophication assessments

Eutrophication assessments have entirely different set-up than the biodiversity assessments (e.g. combining chemical, physical and biological results) but the experience from the eutrophication assessment tools can still be beneficial for development of a tool for the HOLAS biodiversity assessment.

Basically, all the same methodological approaches can be seen in eutrophication assessment tools than in the biodiversity assessment tools. The ETC-ICM review included eight eutrophication tools (Assessment of Estuarine and Coastal Trophic Status [ASSETS], TRophic IndeX [TRIX], HELCOM Eutrophication Assessment Tool [HEAT], Common Procedure for the Identification of the Eutrophication Status [OSPAR COMP],EPA NCA Water Quality Index [WQI], Estuarine Water Quality Index of South African estuaries [eWQI], IFREMER method, and Transitional Water Quality Index [TWQI]).

Most of the eutrophication assessment tools rely on summing of parameter scores which is a difficult method for an international assessment, where different monitoring methods, parameters, indicators and targets complicate the assessment system. As a result of the review, only two methods were found independent of this approach: ASSETS and HEAT. ASSETS is, however, mainly focused on estuaries where river loads are included as an indicator to the tool.

The eutrophication tool HEAT (version 3.0) fulfils the criteria set in the review and has been used in three marine regions. In the Baltic Sea it has been under development in the HELCOM eutrophication group for years and is now accepted by the Baltic MS to be used under the MSFD descriptor 5 assessment. It has also been adopted by the Black Sea Commission (by name BEAST) and been tested in the region (Mantikci et al. 2015). It was also used to assess the eutrophication state of the North Sea in the HARMONY project area (Norway, Denmark, Sweden and Germany). The latest use of the HEAT tool showed evidence for improved environmental status (i.e. less eutrophication) in the Baltic Sea by using time series data for almost a hundred years (Andersen et al. 2015). The technical workshop for descriptor 5 by the European Joint Research Center (JRC) used HEAT as a good example for eutrophication assessment in a European scale.

The result from the review showed that an indicator-based tool with hierarchically structured integration rule (where weighted averaging is applied on a lower integration level and OOAO on a higher level) is a reliable method for integration of different indicators and data in an international setting.

Outcomes of the review

The analyses of the thematic tools showed a couple of general results which can be used to guide in selecting suitable tools for the HELCOM HOLAS biodiversity assessment. First, it was marked that tools relying on summing up assessment components (i.e. parameters, indicators, sub-indices, etc.) are less suitable for the

MSFD purpose because their GES determination is always dependent on the number of assessment components in the tool and this needs to be found and validated in each case. For example, an assessment area X has 10 indicators and an assessment area Y has 12 indicators. When the indicator scores are summed (e.g. between 0-5), the areas will have different scales and the GES boundary needs to be set separately for each area. In principle, also the use of conditional rules has this same limitation: the rules need to be adjusted according to indicator availability. This disadvantage may be cancelled out by defining rules that take into account missing values. Hence, tools which rely on averaging, one-out-all-out principle or combinations of these (and possibly combined with the former approaches) are most suitable for the MSFD purposes.

The second remark concerned indicators and the determination of a threshold for their desired status (i.e. the GES boundaries). As the COM DEC and the associated draft guidance document have focused on indicators which can be individually used to assess a desired state, it becomes clear that these GES boundaries – on the level of assessment indicators – are needed in the determination of the final status. It is not the purpose of this report to evaluate the availability of GES boundaries in indicators, but it is noted that there are several different approaches in the indicators, such as

- one GES boundary on a monotonically increasing (or decreasing) scale,
- two GES boundaries setting a range for the desired status on a curved scale (positive or negative),
- conditional GES boundary (e.g. if parameter *x* and parameter *y* exceed value *n*; or if parameter *x* is increasing and parameter *y* exceeds value *n*).

Therefore the tools need to allow different types of indicators and the GES boundaries are used to produce the overall assessment result. Among the reviewed tools, the ones using stand-alone indicators can likely cope with the diverse data and indicators of the European Regional Sea Conventions and the Member States.

In the biodiversity assessment, the NEAT tool is the only tool which has been tested in the European-wide scale (FP7 project DEVOTES) and shows potential for being used for EU biodiversity assessments. The NEAT tool does, however, still lack proper scientific documentation and its testing is not finalized or documented and, hence, a re-evaluation of the tool is needed once the documentations become available.

The current discussion of the structure of the MSFD biodiversity assessment

The structure of the MSFD assessment of the marine biodiversity is not a straightforward issue and, at the moment, such a structure or guideline does not exist. The reasons for the unclear situation are at least the following:

- a process to revise the COM DEC 477/2010/EU has started and new COM DEC has not been agreed on;
- a discussion document (Anon. 2015, so-called 'cross-cutting issues document') has been developed by the Commission and it brings new ideas for the assessment of GES; these ideas have brought forward the so-called pizza-and-satellites' diagram where the biodiversity assessment is the 'pizza' in the middle and it consists of various 'state-based descriptors' of the MSFD Annex I and marine elements of the MSFD Annex III;
- HELCOM HOLAS II core team has decided to follow relevant EU guidance in the biodiversity assessment, as far as it is available within the timeline of the project;
- while the HOLAS II method development has already started, the MSFD implementation guidelines are not yet ready. Workshops have been set for this winter and spring of 2016 to support the process

As HELCOM has circa ten years' of experience in integrated assessments, with several scientific publications presenting the applied principles, use and further developments, it is important that experiences from the

Baltic Sea assessments, including the HOLAS II project and its method development, can also feed solutions to the European process.

Remarks concerning assessment principles under the Habitats Directive and the Water Framework Directive

The assessment of the state of the marine biodiversity under MSFD touches upon the assessments done under other environmental directives, mainly the Habitats Directive (HD) and the Water Framework Directive (WFD). The MSFD refers specifically to these two directives and aims to ensure comparability in assessment results and synergies in monitoring and assessment requirements.

The assessment methodology of the HD and WFD are beyond this document, but some remarks can be highlighted in order to bring material into the discussions in the HOLAS II process.

In the HD, the assessments are made for selected species and habitats (Annexes) on the basis of three elements (distribution, abundance and future outlook). The HD implementation guidelines present reference values which are used to support the assessment of the favourable conservation status. Despite the partial similarity with the MSFD D1 aspects (i.e. population distribution and size), there are big differences in the assessment methodology:

- the MSFD assessment does not include the future outlook of the species or habitats,
- the HD does not *require* numeric reference values as the basis of the assessment,
- the HD assessments, reference values and definitions of the habitats are not coordinated with the neighbouring Member States or within the marine region,
- the HD assessment applies the one-out-all-out principle among the three criteria (while MSFD has not defined that).

Because of these differences, it will be a major task to make comparable assessments under these two directives.

In the WFD, the assessments in coastal waters include biological quality elements (BQE) for phytoplankton, benthic invertebrates and macrophytes. Under each of the BQE, there can be indicators which have a ‘reference condition ’ and these indicators are intercalibrated within areas. The WFD assessment procedure allows certain amount of flexibility in national integration rules of the indicators, but the OOAO principle is in a strong role in the assessments, although physico-chemical parameters have been assigned merely a supportive role However, many countries do not apply the OOAO in the strictest sense, i.e. among all the parameters, but have averaged parameters within quality elements (with or without weighing) and used the OOAO between quality elements.

Conclusions

Integrated assessments within HELCOM HOLAS II and under the EU MSFD will require assessment tools which will ensure clarity, transparency and easy handling of the indicators included. The key backbone of the HOLAS II assessment is the regionally agreed set of Core indicators.

In the report produced during the work of ETC-ICM, based on the review of the available assessment tools, a set of assessment tools which can be used on the scale of entire Europe's marine (sub)regions and are flexible enough to deal with the different indicators and monitoring data of the EU Member States was recommended. The review noted that the HELCOM assessment approach is most suitable for an international setting and can handle the MSFD requirements and be still scientifically robust.

The NEAT tool which was part of the review is based on the same principles as the HELCOM BEAT tool, (which was used for biodiversity assessment in the first holistic assessment), and the HEAT tool (for eutrophication). As the NEAT documentation is not yet available, many features of the tool are still unclear and should be evaluated further with respect to agreement with needs of HOLAS II.

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