ICES WKGESFᴵꜱʜ REPORT 2016

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Report of the Workshop on Guidance on the Practical Methodology for delivering an MSFD GES Assessment on D3 for an MSFD Region/Subregion (WKGESFish)

18–19 March 2016

Copenhagen, Denmark

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Executive summary

WKGESFish met at ICES headquarters in Copenhagen, Denmark from the 18–19 March, 2016. The workshop explored methods on how to perform an integrated assessment of Descriptor 3 of the Marine Strategy Framework Directive (MSFD). WKGESFish explored how to:

- Define the criteria or procedure to select the list of assessed commercially exploited fish and shellfish stocks (ToR1);
- Define the criteria for the assessment of [these] stocks in relation to GES for Descriptor 3 (ToR2);
- Conduct the assessment of Criteria 3.1, 3.2 and 3.3, to evaluate the GES status of selected stocks (ToR3).

The selection of species (ToR1) for regional assessments should be based on the regional list from the Data Collection Framework (DCF). For national assessments of D3 Member States should select the species and stocks which they are obliged to sample for stock variables within their national DCF-programmes.

Based on the outcomes of the back-to-back works WKIND3.3i, WKGESFish considered Criteria 3.1 (level of pressure of fishing) and 3.2 (reproductive capacity of the stock) as operational criteria for the assessment of GES (ToR2). Criterion 3.3 was not included in the considerations of WKGESFish as WKIND3.3i did not identify any operational or appropriate indicators for the criterion.

WKGESFish explored the methods for integrating indicator assessment results within stocks across Criteria 3.1 and 3.2 as well as the aggregation of stocks within criteria (ToR3). The latter option was considered as preferable by most workshop participants, because the aggregation of stocks within criteria would avoid the problems associated with combining indicators with differing evidence base and levels of confidence (primary vs. secondary indicators), as well as the conceptual problem of combining pressure-related indicators (3.1) with state-related indicators (3.2).

WKGESFish also considered the aggregation of information on different stocks of the same species to species level, within a region. It was considered preferable to retain the focus on stocks rather than aggregating to species, as this promotes coherence with the CFP (which considers stocks) and avoid masking assessments when different stocks of a given species might have different GES status.

To account for the aforementioned problems, WKGESFish recommends aggregating primary and secondary indicators within each criterion applying a two-stage reporting approach. Primary and secondary indicators within each criterion would be aggregated separately allowing full transparency on the evidence base while making the best use of available information.

1 Opening of the meeting

The workshop on guidance on the practical methodology for delivering an MSFD GES assessment on D3 for an MSFD region/subregion (WKGESFish) was held from the 18–19 March, 2016 at the ICES headquarters in Copenhagen, Denmark. The meeting was chaired by W. Nikolaus Probst and attended by 19 scientists from 12 countries (Figure 1.1).
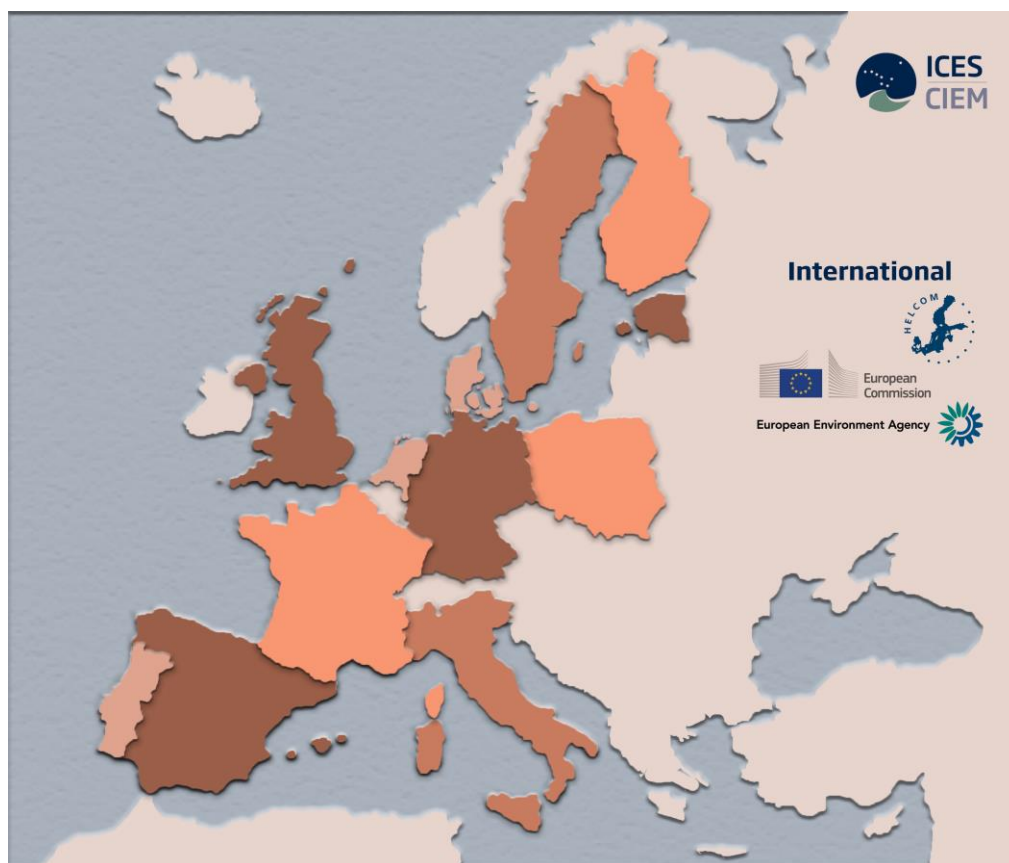

Figure 1.1. Origin of participants of WKGESFish. Intensity of colour is related to the number of participants.

2   Introduction

The assessment of Descriptor 3 (D3) of the Marine Strategy Framework Directive (MSFD) requires the assessment of commercially exploited fish populations (EU-COM, 2008b). The D3 assessment should be based on the level of pressure of the fishing activity (Criterion 3.1), the reproductive capacity of the stock (Criterion 3.2) and the population age and size distribution (Criterion 3.3) (EU-COM, 2010a).

In the scientific literature, two examples have attempted to assess D3 within a subregional context (Borja *et al.*, 2011; Probst *et al.*, 2013). Though both studies relied heavily on indicators of stock assessments (F and SSB), they differed in the way the information from single stocks was combined and assessed. These two studies clearly indicate that integrative assessments can be done in very different ways and their D3 assessment results will very much depend on this method (Ojaveer and Eero, 2011; Moe *et al.*, 2015; Probst and Lynam, 2016). Similar to the scientific literature, the national Article 8 assessments of D3 by the EU-member states were not entirely coherent (Article 12 report COM/2014/97). From the Article 12 report it was evident that the member states diverged in their initial assessments of environmental status, definitions of good environmental status (GES) and settings of environmental targets, partly due to the fact that *"further scientific advice should be sought and developed at EU level so as to provide clear guidelines on a stock-by-stock basis and better indicators for this proposed criterion 3.3…"*.

To guide the Member States in the implementation of the MSFD with regards to D3, ICES has hosted a series of workshops (WKMSFDD3, WKMSFDD3+). Information from these workshops as well as from the back-to-back workshop WKIND3.3i (14–17 March, 2016, also at ICES headquarters), was used to address the following terms of reference (ToR):

- ToR1: Define the criteria or procedure to select the list of assessed commercial exploited fish and shellfish stocks.
- ToR2: Define the criteria for the assessment of [these] stocks in relation to GES for Descriptor 3.
- ToR3: Conduct the assessment of criterion 3.1, 3.2 and 3.3, to evaluate the GES status of selected stocks (as examples).

3   Terminology used

3.1   'Aggregation' vs. 'integration'

The definition of the words 'aggregation' and 'integration' are often used synonymously. However, both words can carry different notations i.e. 'aggregation' refers to the combination of several elements which are similar (e.g. the same indicators across species or stocks), whereas 'integration' refers to the synthesis of several elements, which are not comparable (e.g. the integration of several indicators within a stock or species) (Borja *et al.*, 2014). WKGESFish therefore decided upon the following terminology:

Throughout this report the term 'aggregation' is for the combination of assessments of stocks within a criterion (e.g. F across all stocks of the Baltic Sea). The term 'integration' is used for the combination of criteria assessments within a stock (e.g. C3.1 and C3.2 within North Sea plaice).

3.2   'Primary' vs. 'secondary' indicator

The EU Commission decision 477/2010/EU distinguishes between 'primary' and 'secondary' indicators. However, the use of these terms is not entirely consistent throughout the Commission Decision and also not within D3. For Criteria 3.1 and 3.2 primary indicators refer to indicators from analytical stock assessments (F, SSB), and here secondary indicators are intended to provide information on the same properties in data-limited situations by using alternative metrics (catch ratio and survey abundance/biomass) from different data sources (catches & surveys). In Criterion 3.3, however, the secondary indicator (size at first sexual maturation) is referring to a different stock property (genetic effects) than the primary indicators (length distribution in the stock or fish community).

In this report 'primary' indicators are indicators which are obtained from analytical stock assessments or which assess the state of exploited stocks with regards to sustainability. Hence primary indicators are indicators which have an assessment benchmark in relation to MSY-reference points.

By contrast, 'secondary' indicators are indicators which cannot be assessed against MSY-reference points, but may be assessed by time-series based assessment methods (see Chapter 5.4). Secondary indicators can thus indicate whether the status of an indicator metric is changing with regards to its observed past, but they cannot indicate the distance to MSY-related reference points.

Secondary indicators are intended to capture the same property or trait as primary indicators, while using different indicator metrics.

4 ToR1: Selection of stocks

Previous ICES workshops on D3 resulted in the following ICES advice (ICES, 2015a):

"Selection of commercially exploited fish and shellfish

It is important to adopt a practical and common sense approach based on the commercial species monitored under the DCF, potentially involving three spatial scales:

- Local species relevant at a national level;
- (Sub)regional species with a distribution area that maps entirely or sufficiently to that region;
- Straddling or highly migratory species occur in several subregions and may be exploited by fisheries based in remote MSs (outside the subregion). Because of their often high landings compared to the (sub)regional species inclusion of these species may severely affect the outcome of the assessment.

This should result in the selection of a suite of species for which exploitation is considered to have significant importance for the (sub)region.

The ICES FishStat and/or FAO annual statistics can be used as an aid to determine the importance of each species based on their relative contribution to the landings. To that end a minimum threshold (e.g. >1% or >0.1%) over the landings in the last five (or more) years can be applied. Species that do not meet this threshold but are considered important (e.g. salmon in the Baltic Sea) can still be included. With the full introduction of the landings obligations, the process used to support the determination of the importance of each species should be reviewed to ensure that proper quantities in terms of catches are being used.

Finally, consideration could be made as to whether a species that currently occurs at a low level (e.g. due to overexploitation) but with historically high landings, should be included in the suite of species."

WKGESFish was requested to provide further guidance on this issue and from the discussions during the workshop two points emerged:

- For the regional assessments the regional list of commercially exploited stocks as listed under the Data Collection Framework (DCF) shall be considered (EU-COM, 2008a; EU-COM, 2010b).
- For the assessment by member states the national list of commercially exploited stocks obtained from the national DCF sampling programmes should be considered. The basis for selecting stocks is thereby the exploited stocks by the national fleet rather than the occurrence of stocks in territorial waters. The assessment of these stocks would be supported by the data collected under the national DCF. The national selection of stocks to be sampled is based on the national share of the total allowable catch (TAC) or Community share of TAC (for regions where non-EU countries participate in the fisheries). Derogations for sampling of stock-related variables (age, length, age@length, age@maturity, length@maturity) can be requested if a member states is catching less than 200 tonnes or 10% of the Community share of the TAC (EU-COM, 2010b).

5   ToR2: Definition of criteria for the assessment of exploited stocks

One important aspect that emerged from the back-to-back meeting WKIND3.3i (14–17 March, 2016) was that the majority of workshop participants did not consider any indicator under Criterion 3.3 to be operational or useable for the assessment of GES. Hence WKGESFish focused on Criterion 3.1 (F or catch ratio) and Criterion 3.2 (SSB or biomass indices) for the assessment of stocks and discussed options of how the assessment of single criteria could be combined either within a stock (across criteria) or within a criterion (across stocks).

5.1   Integration of criteria within stocks

For integration of indicator metrics within stocks WKGESFish considered Criterion 3.1 (Level of fishing pressure, F or Catch ratio) and Criterion 3.2 (Reproductive capacity, SSB or Biomass indices). Indicators for Criterion 3.3 were not considered to be operational by WKIND3.3i and thus were excluded for the time being by WKGESFish. However, it should be noted that some participants within WKIND3.3i considered the indicators on selectivity were applicable to assess GES, and further, that size-based indicators on the size distribution within stocks may become operational in the near future. Hence indicators for Criterion 3.3 may have to be included into the assessment of GES at a later stage.

5.1.1   Advantages and disadvantages of integration of criteria within a stock

Integrating the indicators of each D3-criterion within a stock is associated with pros and cons, depending on the decision of whether a valid GES assessment can be based on only two primary indicators for Criteria 3.1 and 3.2 (Option 1), a primary and secondary indicator (Option 2), two secondary indicators (Option 3), or only one primary (Option 4) or only one secondary indicator (Option 5) (Figure 5.1.1.1).

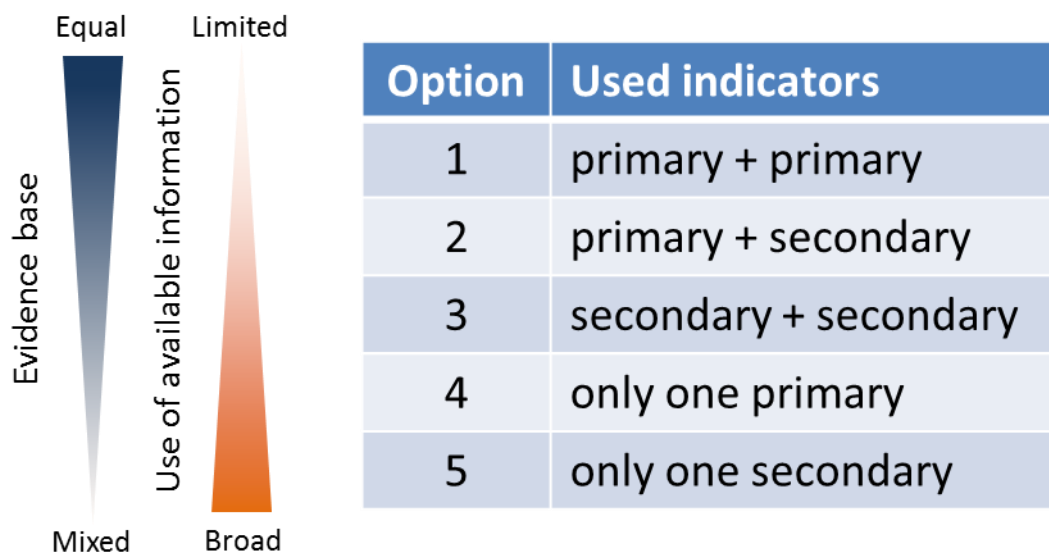| Option	Used indicators
1	primary + primary
2	primary + secondary
3	secondary + secondary
4	only one primary
5	only one secondary

Figure 5.1.1.1. Trade-offs between the use of evidence based and available information when integrating within stocks.

Depending on the choice made, the assessments would be faced with the challenge of either integrating indicators with mixed evidence bases, or not considering available information from secondary indicators (Figure 5.1.1.2). WKGESFish noted that the integration within stocks approach was compliant with the request in the ToRs and would provide combined information on the pressure and on the status of a single stock, which may be desirable in specific cases. On the other hand, it was stated that the GES-benchmarks for primary and secondary indicators would not be similar (MSY vs. change in time if a time-series based approach was used for secondary indicators). If secondary indicators were excluded from the assessment, the associated loss of information was considered as a disadvantage for the integration within stocks.
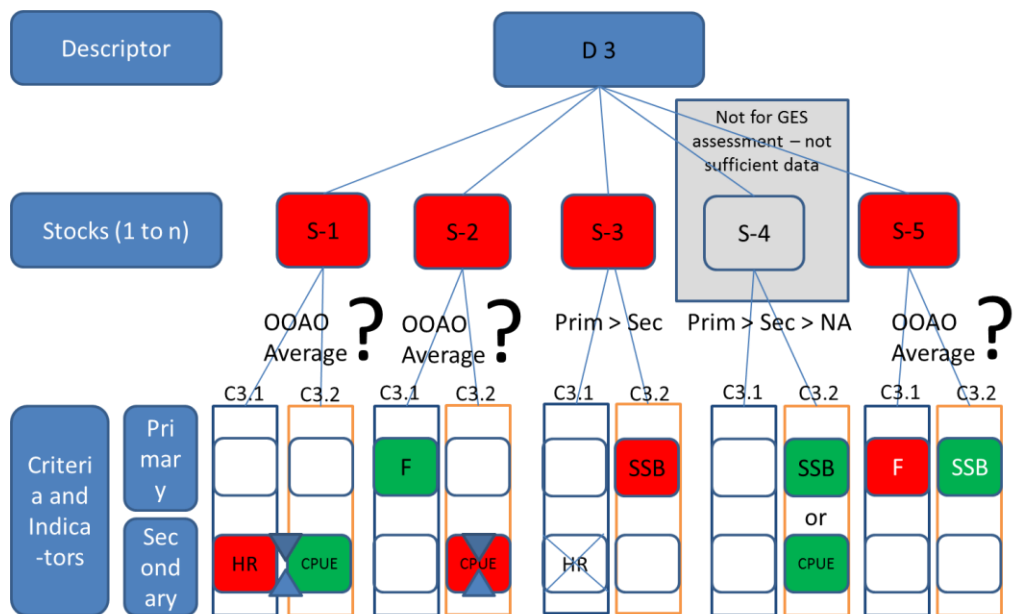

Figure 5.1.1.2. Issues associated with the application of the integration of Criteria 3.1 and 3.2 within stocks using primary and secondary indicators. For Stock 1 (S-1) integration would be based on two secondary criteria, S-2 and S-3 would be assessed against a primary and a secondary indicator. A two-stage approach could be applied for stocks such as S-3 and S-2, for which in this example harvest ratio (HR=catch ratio) will not be assessed because the primary criterion on SSB fails GES. Assessment benchmarks for secondary indicators could be more precautionary for stocks, in which the second criterion is also secondary (blue triangles). For S-4 only data on one primary or secondary indicator (SSB or Survey abundance, cpue) are available, therefore this stock may not be assessed against GES. The integration of S-5 would be based on two primary indicators and represents the optimal evidence base.

The methods to estimate MSY-based proxy reference points for data-poor stocks (ICES categories 3 and 4 stocks) have recently been progressed by ICES, WKLIFE V (ICES, 2015b), and therefore it can be expected to obtain operational primary indicators on the level of fishing pressure (Criterion 3.1) for many stocks of the North Atlantic and the Mediterranean Sea in the near future. However, these methods will not provide reference points for the reproductive capacity of many stocks (Criterion 3.2) and hence these stocks, when assessed against Criteria 3.1 and 3.2, could only be assessed against one primary or a primary and a secondary indicator, again highlighting the problems of integrating information with differing evidence bases.

5.2 Aggregation of stocks within criteria

Due to the problems associated with integrating Criteria 3.1 and 3.2 within stocks (see previous Chapter 5.1), WKGESFish considered the alternative option of aggregating stocks within the criteria of D3. WKGESFish concluded that the aggregation within criteria would allow the use of all available primary indicators for Criterion 3.1, although for many data-poor stocks no primary indicators for Criterion 3.2 would be available.

A graphical aggregation within Criteria 3.1 and 3.2 has been presented by ICES (ICES, 2014), but this could be modified to show the number of stocks or the percentage of total landings at GES within each criterion. Greenstreet *et al*. (2012) and Probst *et al*. (2013) demonstrate how such metrics could be used for an aggregated assessment using a probabilistic method of determining the GES threshold.

However, the aggregation of stocks within criteria does not circumvent the problem of diverging evidence bases for primary and secondary indicators (see Chapter 5.1). One option would be to aggregate stocks with primary indicators separately from stocks with secondary indicators.

5.3 Aggregation methods

The discussion of WKGESFish focused mainly on two aggregations methods, the One-Out-All-Out approach (OOAO) and averaging methods. Probabilistic methods were only briefly discussed during the meeting, but are included here in the report as these methods may hold high potential for the determination of GES threshold levels for the aggregation of stocks, either within criteria or across the integrated stocks.

The discussions focused on integration within stock (i.e. aggregating Criterion 3.1 - fishing pressure and Criterion 3.2 - reproductive potential of the stock) and within criteria. The nature of the indicators (primary vs. secondary) was also taken into account and a brief summary of pros and cons of each method are provided below:

5.3.1 One–Out–All–Out (OOAO)

The OOAO integration method implies that within each stock, both Criteria 3.1 and 3.2 have to achieve GES, i.e. both conditions should be met: $F \leq F_{MSY}$ (or its proxy) and SSB $\geq$ MSYB$_{trigger}$ (or its proxy). Applying the OOAO to aggregation within each criterion implies that all stocks in criterion 3.1 must meet condition $F \leq F_{MSY}$ (or its proxy) and all stocks in criterion 3.2 must meet condition SSB $\geq$ MSYB$_{trigger}$ (or its proxy).

One of the advantages of the OOAO approach is that it is easy to understand and communicate, it highlights failures of achieving GES for single elements (precautionary principle) and its binary outcome is in line with the requirements of the MSFD (is/is not in GES) (Borja *et al*., 2014; ICES, 2016). However, it does not provide information on the distance of the assessment result from its benchmark level and does not allow uncertainty to be taken into account at the integrated/aggregated level.

Therefore, the OOAO integration within stocks may result in highlighting problems in stocks that just barely miss their target and could lead to a large number of false alarms (e.g. if a stock is fluctuating around the benchmark or needs more time for recovery).

Primary indicators are currently not available for all stocks (e.g. data-limited stocks), and the assessment of secondary indicators may be associated with higher uncertainty (Probst and Oesterwind, 2014). Hence the risk of overestimating the failure of GES

by using OOAO increases significantly. For this reason OOAO is not recommended to be used in situations in which assessments are associated with uncertainty (Borja and Rodriguez, 2010; Borja *et al.*, 2014; Moe *et al.*, 2015).

Particularly the assessment benchmarks of F (F_{MSY}) and SSB ($MSY_{Btrigger}$) may be associated with high degrees of uncertainty, and with recovering stocks MSY-based reference points will require a more dynamic interpretation and will not provide a single solution within a multispecies context (Kempf, 2010).

To prevent the problems of using indicators with diverging evidence bases, a two-step approach could be applied within each stock, for which information from primary and secondary indicators are combined. If for example a primary and a secondary indicator are available for Criteria 3.1 and 3.2, respectively, the secondary indicator of Criterion 3.2 could only be assessed, if the primary indicator of Criterion 3.1 indicates GES. If the primary indicator is 'not GES', then the stock will automatically be considered to be not at GES).

Despite the aforementioned issues most participants of WKGESFish considered the OOAO to be an appropriate method for the integration of criteria within stocks (ICES, 2016).

5.3.2 Averaging

Two averaging approaches were considered during the workshop: non-weighted average, where indicators are combined using arithmetic average or median (Probst and Lynam, 2016) and weighted average, where different weights are assigned to indicators (Borja *et al.*, 2011; Borja *et al.*, 2014). These approaches would require the standardisation of indicator values, e.g. by normalisation or to a scale of 0–1, prior to averaging.

Non-weighted averaging assumes that Criterion 3.1 and 3.2 (when integrating within stock) or that each stock (when aggregating across criterion) are of equal importance or relevance for assessing GES under D3.

Weighted average approaches could be used to account for uncertainty associated with the assessments by weighting the assessment results with the confidence. Alternatively, weighted averages were identified as an option for the aggregation within criteria, if data on stock catch or landings was used as weights. Weighted averaging approaches would also allow the incorporation of expert judgement. However, the harmonisation and agreement on the procedures on how to set the weights may be challenging (as several approaches could be envisaged) or could be subjective when weighting is based on expert judgement and weighting options are more a management decision than a scientific one.

5.3.3 Probabilistic methods

Probabilistic aggregation methods (PAM) use probability functions such as the binomial distribution to assess the probability of an observed result. PAM are especially useful when aggregating across many similar elements such as species-specific indicator metrics within a criterion (Greenstreet *et al.*, 2012). PAM can be used to answer questions like: *"How likely is the observed number of species or stocks at GES?"* or *"How many species should be at GES to indicate a non-random GES at the criterion level?"* The advantage of PAM is that they are somewhat a relaxation of the OOAO as PAM allow for some misses (failures of GES) within an aggregation while the aggregated GES may still be achieved (Probst and Lynam, 2016).

5.4 The operationalisation of secondary indicators within Criteria 3.1 and 3.2

WKGESFish expressed the view that the combination of well-established, theoretically sound primary indicators (such as F and SSB) cannot be readily combined with secondary indicators (see Chapter 5.1). However, the use of secondary indicators within the MSFD assessment of environmental status was generally considered to be favourable, as this would ensure the use of as much available information as possible. This is particularly important for some MSFD regions, where analytical assessments are not available for a large proportion of stocks. Therefore a subgroup was tasked to explore the potential of making secondary indicators operational.

The subgroup concluded that the only way to operationalise secondary indicators (catch rates and biomass indices, but maybe also size-based indicators and indicators of genetic change for Criterion 3.3), was to use time-series based assessment approaches (TSBA). The use of TSBA has been methodologically advanced during the recent years (Rochet *et al.*, 2010; Probst and Stelzenmüller, 2015; Bergström *et al.*, 2016). Within the environmental assessments of the Helsinki Commission (HELCOM), a time-series based approach has even been implemented within an operating assessment framework (HELCOM, 2012).

TSBA can be based on time-series decomposition or trends. Trend-based TSBA may be better suited for short time-series or time-series in which stable periods can be identified. However, trend-based TSBA cannot inform on the distance to the target and depends on the number of years included. If many years are included in the calculation of the trend, the observed changes are more reliable or significant, but may not be responsive to recent changes.

Historic values of indicator metrics may not provide a realistic GES target e.g. in case a regime shift has happened. Under such a circumstance historic states may not be achievable anymore under the current prevailing environmental conditions. If no information on the relation between the initial condition and GES for a time-series is known, these time-series should not be included in the GES-assessment, but used as surveillance indicators.

5.4.1 SWOT-Analysis on time-series based assessment (TSBA)

The subgroup explored the strength and weaknesses in a SWOT-analysis (Table 5.4.1.1) and concluding that the opportunities for the implementation of TSBA-approaches outweigh the threats, but that severe weaknesses of TSBA have to be addressed.

The most critical weakness of TSBA-assessed indicators was the missing relationship of TSBA-targets and GES (Probst and Stelzenmüller, 2015). This shortcoming could be addressed if GES would be defined differently for primary and secondary indicators. For primary indicators of D3, GES would be related to the MSY-principle (Cardinale *et al.*, 2013; Lassen *et al.*, 2014), but for secondary indicators GES had to be defined in relation to the known past.

Table 5.4.1.1. SWOT-analysis on the use of time-series based assessment methods for the operationalisation of secondary indicators.

STRENGTHS	WEAKNESSES
TSBA are generic approaches that can readily be adopted	The abundance or exploitation rate in the past may not be reference for GES under changing environmental conditions (regime shifts)
	No link to MSY/concept, this makes the comparison with primary indicators difficult, assessment against MSY not possible
	TSBA require knowledge of baseline conditions or desired trends (from historic sources, experts)
OPPORTUNITIES	THREATS
This would allow secondary indicators to be used within the assessment	Member states may settle for secondary indicators to save manpower and money
MSFD is allowing and asking for the use of secondary indicators for assessment of GES	Time line for implementing TSBA across all member states and MSFD regions for 2018-assessments may be too short
Consistent application of TSBA across Descriptors	

5.4.2   An applied example of TSBA

HELCOM is assessing the for status of the coastal fish community in the Baltic Sea using time-series based assessments on fish abundance (HELCOM, 2015). Two different types of assessment are used, and the preferred method in each case is decided based on the data properties of the time-series:

- The baseline approach is preferred, provided that the dataseries fulfils the identified requirements: (1) The monitoring series should be long enough so that the time period that is used for defining the GES boundary (the baseline period) will not overlap with the assessment period; (2) the baseline period has to cover a time period which is at least double the generation time of the predominating species in the indicator; (3) there should be no trend or major shift within the baseline period; and (4) the baseline period can be identified as representing either GES or subGES (based on supplementary knowledge such as data from adjacent areas, expertise) (Figure 5.4.2.1). The boundaries for GES are defined based on resampling using a smoothing function in order to obtain percentiles.

- If the above conditions are not fulfilled, a trend-based approach is used. The trend-based approach requires that the initial conditions can be identified as representing either GES or subGES (based on supplementary knowledge such as data from adjacent areas, expertise), and that the available number of years of study cover at least double the generation time of the predominating species in the indicator (typically ten years for coastal fish in the Baltic Sea).

Assessment criteria: For indicators where high values represent better status, the baseline approach states that the assessment values should be equal to or higher than the initial condition (baseline) if the initial condition represents GES, and higher than the initial condition if the initial condition represents subGES (Figure 5.4.2.1). The trend-based approach states that the trend should not be decreasing in the case that the initial condition represents GES, and that the trend should be increasing in the case that the initial condition represents subGES.
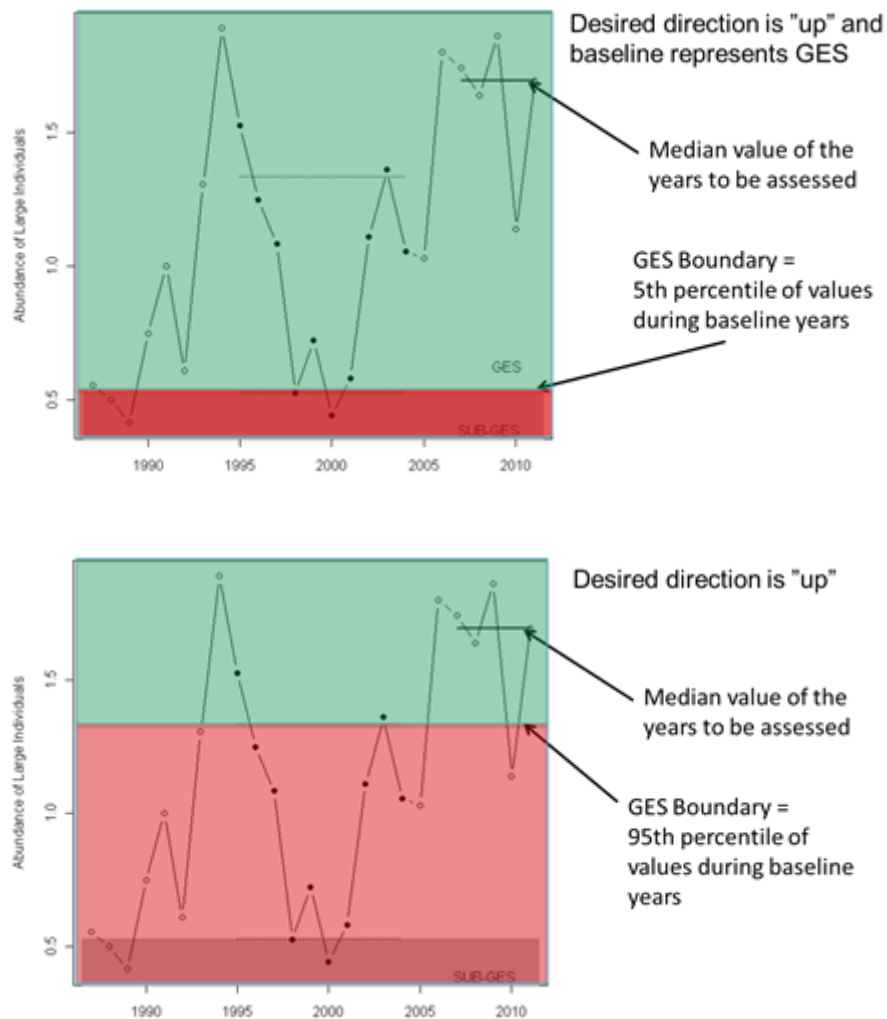
Figure 5.4.2.1. Outline of how the baseline is defined in the dataseries in the approach applied by HELCOM for coastal fish. Upper picture: situation when the desired direction is "up" and the initial condition represents GES. Lower picture: situation when the desired direction is "up" and the initial condition represents subGES. The baseline is identified based on information from the years 1995–2004 in this example (Applied e.g. in HELCOM, 2015).

5.4.3 Conclusions

Methods for time-series based assessments (TSBA) are readily available and could be applied for secondary indicators within D3 (Probst and Stelzenmüller, 2015; Bergström *et al.*, 2016). Nevertheless, TSBA can only track change in relation to the observed past and thus cannot inform on the achievement of GES with regards to MSY-related reference points. However, TSBA may be made compatible with precautionary reference points such as B_{Pa}, which are also based on past observations.

6   ToR3: Exemplary assessments outcomes

6.1   Example of integration of criteria within stocks

Many participants of WKGESFish felt that the one-out-all-out principle (OOAO) may be a reasonable way to integrate two (or three) criteria within a stock (see also WKD1Agg ICES, 2016). When comparing OOAO to an unweighted averaging approach, it is evident that the OOAO provides a lower percentage of stocks at GES than the averaging method (Table 6.1.1). The examples of northern hake (hke-nrtn) also demonstrates how the averaging approach is masking the non-GES status of Criterion 3.1 by an overachievement of Criterion 3.2 (same for spurdog 'dgs-nea' with C3.1 achieving GES, C3.2 failing). The example of northern hake clearly demonstrates an unwanted property of the averaging approach i.e. that a stock failing one criterion may still get a very high score on the integrated assessment across criteria.

Table 6.1.1. Comparison of the one-out-all-out approach vs. arithmetic averaging. The assessment benchmark for GES were $F_{Ref}/F>1$ (Criterion 3.1) and $SSB/SSB_{Ref} >1$ (Criterion 3.2). For the averaging approach the integrated GES-assessment target was a value ≥1. Note that probabilistic methods were not considered here, as it may be equal to the OOAO for a small number of aggregated elements (Probst, personal communication).

	C3.1	C3.2	INTEGRATION METHOD	
STOCK	FRef/F	SSB/SSBRef	OOAO	Average (arithmetic mean)
cod-2224	0.31	0.49	No	0.40
cod-347d	0.84	0.79	No	0.82
dgs-nea	2.07	0.25	No	1.16
her-47d3	1.33	2.36	Yes	1.85
hke-nrtn	0.79	4.72	No	2.76
ple-nsea	1.06	3.42	Yes	2.24
rng-5b67	2.58	1.30	Yes	1.94
% stocks at GES			42.86	71.43

6.2   Example for a pan-European Assessment

Using the stock assessment database from the last calculation of the European Environment Agency (EEA) indicator for the "Status on marine (shell)fish in European Seas" we compared the results of two approaches:

Approach 1: This approach is based on the initial assessment by the EEA (EEA, 2015), where information availability is presented and status is assessed for those categories:

a) 'F only': Status assessed based on Fishing mortality (F) and F_{MSY} where GES requires: $F \leq F_{MSY.}$

b) 'SSB only': Status assessed based on Spawning–Stock Biomass (SSB) and SSB_{MSY} (or some proxy e.g. MSY $B_{trigger}$) where GES requires $SSB > SSB_{MSY}$ (or above its proxy).

c) 'F & SSB': Status assessed based on both the F and SSB criteria and where GES thus requires $F \leq F_{MSY}$ and $SSB > SSB_{MSY}$.

Note that F & SSB effectively implies an integration within stocks.

Approach 2: An alternative assessment where the information is aggregated per criterion, i.e. 'All F' (combining all stocks with information on F from 'Only F' and 'F & SSB') and 'All SSB' (combining all stocks with information on SSB from 'Only SSB' and 'F & SSB'). Note that 'F all' and 'SSB all' effectively implies an aggregation within criteria.

Table 6.2.1 gives an overview of the number of stocks per region fulfilling each one or both of the criteria. The consequences for each approach are given below:

1) Approach 1 shows that from a pan-European perspective there are 36 stocks with information for F only, 20 stocks with information on SSB only and 23 of a total of 186 (10.8%) stocks with information on both criteria. Furthermore, there are considerable regional differences between the availability of information. Notably in the Mediterranean and Black Sea there are no stocks that can be included for the GES assessment.

2) Approach 2 allows to assess F against 36+23=59 (31.7%) stocks and SSB against 20+23=43 (23.1%) stocks.

Table 6.2.1. Number of stocks per region with information on one or both of the criteria, i.e. $F \leq F_{MSY}$ and SSB > SSB_{MSY} (or above proxy e.g. MSY $B_{trigger}$). Note that F and SSB effectively implies an integration within stocks (Approach 1) contrasting to an aggregation within criteria represented by 'F all' and 'SSB all' (Approach 2).

MSFD (sub)region	None	F only	SSB only	F&SSB	F all	SSB all	Total
					APPROACH 2		
Baltic Sea	0	1	2	4	5	6	7
North Sea	6	0	7	5	5	12	18
Barents Sea and Norwegian Sea	0	0	2	2	2	4	4
Iceland and East Greenland	1	1	1	2	3	3	5
Celtic Sea	7	6	6	8	14	14	27
Bay of Biscay and Iberian Sea	2	3	2	1	4	3	8
NEA WD	1	8	0	1	9	1	10
MED WD	4	6	0	0	6	0	10
Western Mediterranean	46	2	0	0	2	0	48
Ionian Sea	19	7	0	0	7	0	26
Adriatic Sea	12	0	0	0	0	0	12
Aegean-Levantine Sea	5	1	0	0	1	0	6
Black Sea	4	1	0	0	1	0	5
Pan-European	107	36	20	23	59	43	186

Figure 6.2.1 shows how much of the landings are covered by stocks with available information on either one or both operational D3-criteria (C3.1 and 3.2). For a pan-European assessment (i.e. across all regions) it shows that a large part of the landings are covered by stocks for which information on both criteria is available.
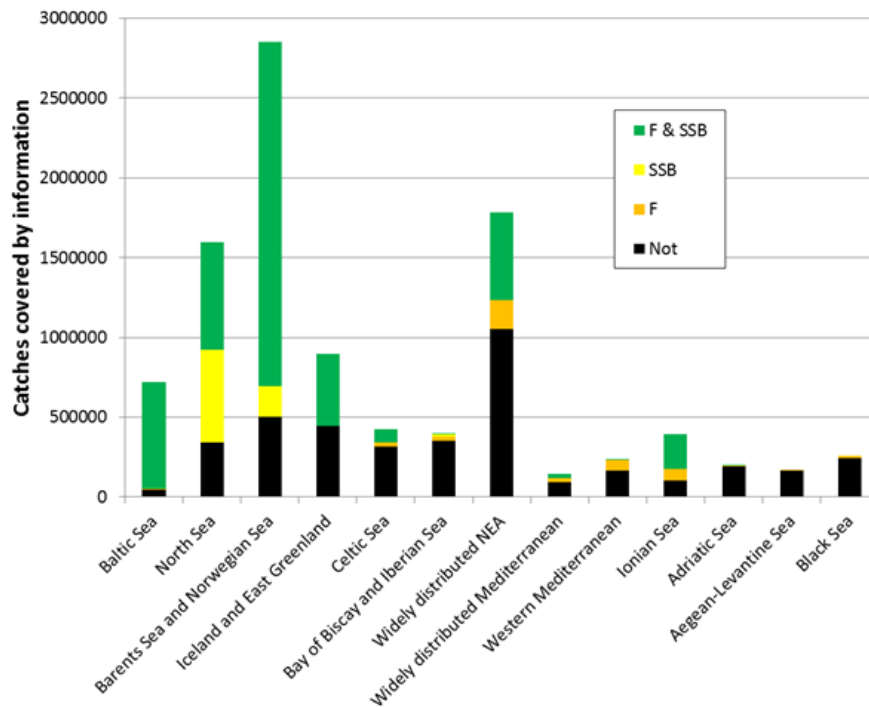
Figure 6.2.1. Proportion (%) of landings which are covered (or not) by stocks with available information on each one and on both criteria of Descriptor 3 (D3), i.e. $F \leq F_{MSY}$ and $SSB > SSB_{MSY}$.

The outcome of GES assessments is presented in Figure 6.2.2. 'F & SSB' indicates Approach 1. A combination of 'Only F' and 'F & SSB' shows the number of stocks fulfilling the F criterion (i.e. 'F all'), and a combination of 'Only SSB and 'F & SSB' gives the number of stocks fulfilling the SSB criterion (i.e. 'SSB all') (Approach 2). Depending on which approach is used, only 12% of the stocks are in GES (Approach 1), i.e. $F \leq F_{MSY}$ and $SSB > SSB_{MSY}$ (Figure 6.2.2). Using Approach 2 indicates that 32% of the stocks meet their assessment benchmark for the F-criterion (Criterion 3.1) and 23% for the SSB-criterion (Criterion 3.2). The difference in stocks achieving GES becomes especially pronounced in regions where a large proportion of stocks have only information for F or SSB (e.g. Bay of Biscay and Iberian Sea).
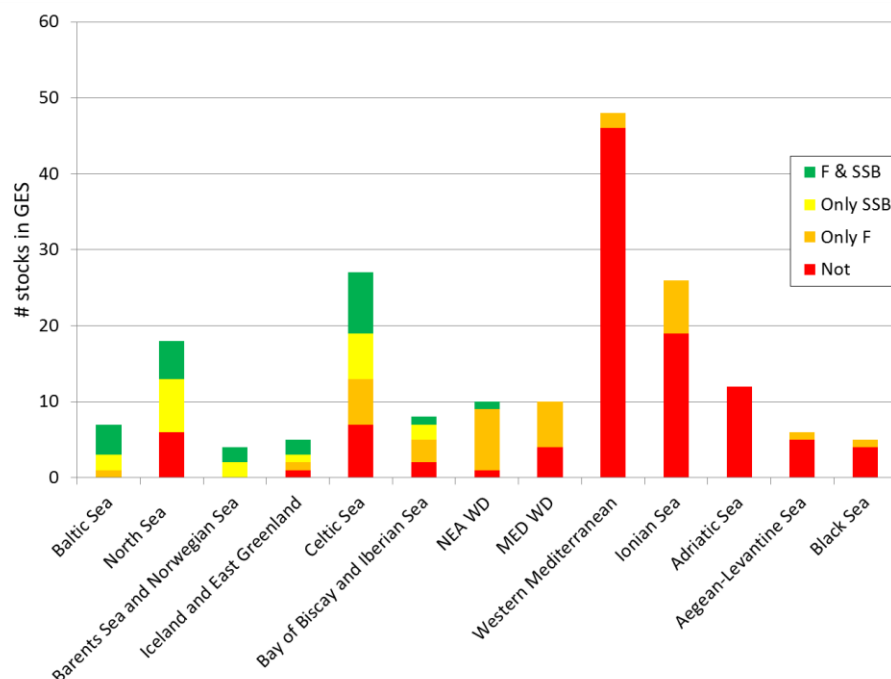
Figure 6.2.2. Number of stocks at GES (or not) for categories 'Only F', 'Only SSB' and 'F & SSB'.

The pan-European assessment shows that in case of an aggregation within criteria (respectively F and SSB), 52% of the landings are assessed by F and 56% by SSB (against the corresponding assessment benchmarks) (Approach 2, Table 6.2.2). By contrast, only 48% of the landings are assessed against F and SSB in case of an integration of criteria within stocks.

Table 6.2.2. Proportion of landings assessed against F ('F all'), SSB ('SSB all') (Approach 2) or F and SSB ('F & SSB', Approach 1). Comparison between an aggregation per criterion i.e. F ≤ F_{MSY} and/or SSB > SSB_{MSY} (or above proxy e.g. MSY $B_{trigger}$), vs. an aggregation per stock.

MSFD (SUB)REGION	PROPORTION OF LANDINGS (%)			PROPORTION OF STOCKS (%)		
	Criterion		Stock	Criterion		Stock
	F all	SSB all	F & SSB	F all	SSB all	F & SSB
Baltic Sea	93	93	93	71	86	57
North Sea	42	79	42	28	67	28
Barents Sea and Norwegian Sea	76	82	76	50	100	50
Iceland and East Greenland	50	50	50	60	60	40
Celtic Sea	25	19	19	52	52	30
Bay of Biscay and Iberian Sea	8	5	1	50	38	13
Widely distributed NEA	41	31	31	90	10	10
Widely distributed Mediterranean	36	18	18	60	0	0
Western Mediterranean	30	0	0	4	0	0
Ionian Sea	74	55	55	27	0	0
Adriatic Sea	4	1	1	0	0	0
Aegean-Levantine Sea	2	0	0	17	0	0
Black Sea	6	0	0	20	0	0
Pan-European	52	56	48	32	23	12

7 A proposal for a two-stage aggregation method

The discussions during WKGESFish on pros and cons of integration of criteria within stocks vs. aggregating stocks within criteria revealed several problems associated with the use of different levels of confidence and the most efficient use of available knowledge (see Chapter 5). To tackle these problems, WKGESFish recommends an aggregation method with two-stage reporting, which aggregates primary and secondary indicators separately within each criterion across all stocks (Table 7.1). The separate aggregation would allow assessment results from the primary and secondary indicators to be displayed separately providing a clear outcome based on all information available.

Table 7.1. Example of assessment aggregation across stocks within Criteria 3.1 and 3.2 of Descriptor 3 using primary (P) and secondary (S) indicators. Red and green table fields represent exemplarily the achievement or failure of good environmental status (GES) respectively, intensity of colouring indicates the use of primary (dark) or secondary (light) criteria.

STOCK	INDICATOR TYPE C3.1	CRITERION 3.1 ASSESSMENT	INDICATOR TYPE C3.2	CRITERION 3.2 ASSESSMENT
A	P		P	
B	P		P	
C	P		S	
D	S		S	
E	S		S	
F	S		S	
G	S		S	
NGES / N (%) at GES with prim. Indicators (F or SSB, respectively)		$1/3$ (33%)		$1/2$ (50%)
NGES / N (%) at GES with sec. indicators (Catch ratio or survey abundance/biomass, respectively)		$2/4$ (50%)		$3/5$ (60%)

The two-stage approach of aggregating across stocks within criteria is associated with several advantages:

- Data from data-limited stocks with new methods estimating F and F-benchmarks can be used (e.g. from WKLIFE).
- Stocks with information on only one criterion can be included, thereby best use of all information is made.
- The evidence base of the aggregated GES-assessment is communicated in a transparent manner.

- Percentage limits or probabilistic methods could be used to determine the number of stocks that should be in GES (ICES, 2016).

However, disadvantages should also be noted:

- Aggregation within criteria may not be consistent with assessment of species under D1 if these follow the approach of integrating criteria within species (consistent with Habitats Directive).
- Stock-specific assessments in D3 and species-specific assessments in D1 may cause compatibility issues if assessments from both descriptors will be combined. To date it is not yet clear, if this will be required and which implications the combination of assessments at the stock- and species-level might have.

8   Recommendations

RECOMMENDATION	ADRESSED TO
1. For regional assessments the DCF-list of exploited species should be considered (2008/949/EC & 2010/93/EU). For national assessments the list of species/stocks from national DCF programmes should be used.	Regional Sea Conventions (OSPAR, HELCOM), ICES, European Environment Agency, Member States, EU-Commission
2. When integrating across criteria of Descriptor 3 within a stock, either a two-step One-Out-All-Out (OOAO) or an averaging approach could be used. For the integration of criteria within stocks WKGESFish therefore recommends a modified, two-step OOAO approach, which assesses secondary indicators of a criterion only, if at least one other criterion is primary and achieves GES. Under both scenarios stocks with information on only onecriterion can not be included into the assessment.	Member States, EU-Commission
3. WKGESFish recommends to aggregate D3 indicator assessments across stocks within each criterion using a two-stage reporting approach. The aggregation of primary and secondary indicators should be reported seperately within each criterion to ensure transparancy in the use of evidence base while making best use of all availbale information.	Regional Sea Conventions (OSPAR, HELCOM), ICES, European Environment Agency, Member States, EU-Commission

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Annex 2: Agenda

18.03.2016 (Decide and apply aggregation methods)

09.00–10.00 Plenary:

- Introduction to the workshop objectives;
- Discussion on aggregation methods to be used (OOAO, averaging, weighted averaging, others?)

10.30–13.00 Subgroups on aggregation methods

13.00–14.00 Lunch break

14.00–16.00 Subgroups on evidence base

16.00–16.30 Coffee break

16.30–17.30 Sub–groups on selection of stocks

17.30–18.30 Plenary

19.03.2016 (Decide on advice)

09.00–12.00 Split-up into subgroups:

- Strength and weaknesses of aggregation methods
- Operationalisation of secondary indicators
- Combination of primary and secondary indicators

12.00–13.00 Plenary: Report of subgroups

13.00–14.00 Lunch break

14.00–16.00 Worktime for report

16.00 Closing of meeting

Annex 3:   WKGESFish terms of references

2015/X/ACOMXX **Workshop on guidance on the practical methodology for delivering an MSFD GES assessment on D3 for an MSFD region/subregion** (WKGESFish), chaired by Nikolaus Probst, Germany, will meet in Copenhagen, Denmark, 18–19 March 2016 to:

a) Draft recommendations for the assessment of GES for Descriptor D3 at stock level. Building on previous work of ICES (on MSFD-D3 and D3+) and ICES advice 2015, and the outcomes of the WKIND3.3i, draft a guidance document to:

i) Define the criteria or procedure to select the list of assessed commercial exploited fish and shellfish stocks.

ii) Define the criteria for the assessment of these stocks in relation to GES for Descriptor 3.

iii) Conduct the assessment of criterion 3.1, 3.2 and 3.3, to evaluate the GES status of selected stocks (as examples).

b) ICES shall make efforts to coordinate closely with activities in the framework of Regional Fisheries Management Organizations (RFMOs) and to include in the preparatory work experts covering the four marine regions of MSFD (Baltic Sea, Northeast Atlantic Ocean, Mediterranean and Black Sea).

Priority	High, in response to a special request from GDENV on the Common Implementation (CIS) of the MSFD. The advice will feed into ongoing efforts to provide guidance on the operational implementation of the MSFD.
Scientific justification	The EC is seeking clarification of appropriate methods for determining GES for commercial fish and shellfish stocks in a region/subregion. This can then be used to provide guidance to member states, RSCs and RFMOs for their GES assessments of commercial fish and shellfish in the MSFD. This approach will build on existing knowledge already provided through the CFP (DCF and stock assessments) and rather than duplicate that provision.
	Based on the previous MSFD-D3 workshops, the guidance will form a recipe book on how to carry out a D3 GES assessment for individual stocks. It should also address the definition of commercial fish and shellfish stocks and aggregation issues such as if the assessment should focus on populations, stocks or species within a region/subregion and how to treat transboundaries stocks within the assessments.
	The outcomes from this technical workshop will lead to ICES Advice with a release in late May.
Resource requirements	ICES secretariat and advice process.
Participants	Workshop with researchers and RSCs investigators
Secretariat facilities	Yes.
Financial	Covered by DGENV special request.

Linkages to advisory committees	Run through ACOM.
Linkages to other committees or groups	Links to CSGMSFD and SCICOM.
Linkages to other organizations	Links to RSCs and EC.

Annex 4: Technical minutes from the Review Group of Practical methodology for delivering and MSFD GES assessment on D3

- RGFISH
- Deadline: 14 April 2016
- Participants: Alain Biseau (Chair), José De Oliveira, Samuel Shephard and Sasa Raicevich. Inigo Martinez and Michala Ovens for ICES Secretariat.
- Review of WKGESFish

Overall the report is clear. However the organization of the text and the inconsistent use of the terms (e.g. "aggregation" and "integration" (which are at the basis of the report structure) or "secondary" vs. "primary") reduce the clarity of the report in some sections. The text should be carefully revised to ensure consistency in the use of the terms and clearness in the message, especially in relation to proposed methodologies for GES assessment.

The report addresses most of the requests of the ToRs (and related scientific justification). However, the ToRs asked for the drafting of a guidance document, which is not, as such, in the report. Furthermore, the following ToRs items appear to be little developed/not considered within the report:

1) Selection of stocks: no mention of transboundaries stocks;

2) Aggregation issues in relation to whether the assessment should be carried out at population, stocks or species within a region/subregion. The topic is presented only in the executive summary (few sentences) while a full discussion of this topic is missing in the full text;

3) How to treat transboundaries stocks within the assessments. This issue is not discussed in the report.

The RG agrees that:

- Following WKIND3.3I conclusion, WKGESFish did not considered criterion 3.3 which may be included into the assessment of GES in future. However, Section 5.4 seems to deal with a possible use of these C3.3 indicators (wrongly called 'secondary indicators'); although it could be relevant to consider C3.3 indicators only when C3.1 and C3.2 achieve GES; this is inconsistent.
- OOAO is considered an appropriate method for integration. It is not fully clear if it covers both aggregation (one criterion among stocks) and integration (one stock among criteria).
- Aggregation should be done for stocks with primary and secondary indicators separately.

Given the uncertainty around most indicators, the RG suggests that two different assessment regimes could be carried out considering in one group the stocks in very poor state and in a second the stocks around GES. For the former, the OOAO approach will be applied, and for the latter, a more flexible approach allowing for some bounds around the GES targets.

The RG also considered that the weights that can be used for an averaging is a management issue.

The RG notes that the use of TSBA for assessing the secondary indicators within criteria 3.1 and 3.2 should be used only if the time-series is long enough, and when the early part could be considered as representing GES.

Finally the proposed two stages approach is found to be relevant. The RG suggests that this could be done for two separate groups: target and non-target species, which could help for consistency with D1. However, the way these two stages should be further merged to fulfil the requirement of a GES assessment is missing.