ICES DLS Guidance Report 2012

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# ICES Implementation of Advice for Data-limited Stocks in 2012 in its 2012 Advice

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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## Contents

# 1 Introduction

Of the more than 200 stocks for which ICES provides advice, ICES (2013a) determined that 122 do not have population estimates from which catch options can be derived using the existing MSY framework. These cases have been labelled as "data-limited". Up to and including 2011, ICES provided qualitative advice regarding the future exploitation of such stocks for which there is either limited knowledge of their biology or lack of data on their exploitation. Advice recipients have, however, expressed a strong interest in ICES developing quantitative advice based on the information available. In 2012, ICES has therefore developed a framework for quantitative advice regarding such stocks. This framework will, as other advice approaches, be refined in future.

The principles underlying this framework are that the available information should be used, that the advice to the extent possible should be based on the same principles as applied for stocks with analytical assessments and catch forecasts, and that a precautionary approach should be followed. The latter implies that as information becomes increasingly limited more conservative reference points should be used and a further margin of precaution should be adopted when the stock status is poorly known. The margin of risk tolerance is a management prerogative, but in the absence of any proposal by managers ICES has applied values which are given later in this document.

The ICES approach to data-limited fishery analysis calls for a determination of the status of exploitation relative to $F_{MSY}$ (overfishing or no overfishing) and consideration of the stock trend. In cases where data allow an assessment of current exploitation (e.g. trends-based assessment, catch curve analysis), proxies for $F_{MSY}$ based on, for example, yield-per-recruit (YPR) analysis such as $F_{max}$, $F_{0.1}$, M, and $F_{20\text{-}40\%SPR}$, can be used to give advice in relation to sustainable exploitation. Recent understanding of life-history relationships have demonstrated that the required parameters for a YPR analysis can be calculated on the basis of very limited life-history information on a case-by-case stock basis.

Such information is not available for stocks where only landings are available or for stocks caught in minor amounts as bycatch. In such cases the history of landings is the only reference and quantitative advice on that basis then needs to be applied on a precautionary basis.

The majority of the data-limited stocks have more information available than merely either catch or landings. The starting point for this analysis is therefore a categorization of the stocks according to the data and analyses that are available. The categorization of stocks is intended to reflect the decreasing availability of data, and thus the conclusions on the fishing pressure and state of the stock are likely to be less certain as one goes down the categories.

WKLIFE categorized the stocks according to the data and analyses that are available. The categorization of stocks is intended to reflect the decreasing availability of data, and thus the conclusions on the fishing pressure and state of the stock are likely to be less certain as one goes down the categories. As a consequence, a precautionary approach framework implies that exploitation rates advised for stocks below the data-rich stocks (DRS) (Category 1) will be more conservative than $F_{MSY}$.

Building on the categorization made by WKLIFE, RGLIFE (ICES 2013b) re-categorized stocks based on an ordered sequence of the amount of information and data available. Based on guidelines set forth by RGLIFE, WKLIFE, and WKFRAME III (ICES 2012), which were not intended to be prescriptive, the ICES Secretariat worked with ACOM and the Expert Groups to: (1) categorize data-limited stocks according to the WKLIFE and RGLIFE approaches; and (2) based on this categorization, and in the context of the precautionary approach, apply a methodology that provides quantitative advice for the stocks given the information available. Some of the methods have been tested by simulation, others require further simulation work, and some are based on common sense. As this work is ongoing, the ICES DLS Methods Guidance document is likely to be updated and modified as the methods evolve in the EGs and beyond. ICES recognizes that there are alternative approaches to many of the methods proposed, and EGs are encouraged to explore the most appropriate approach, checking for consistency among the responses. If the EG determines that a type of data or information is not available or is not relevant to the stock/species, their reasoning behind this determination should be provided in their report and stock annex.

To date, this document reflects the methodologies that have been employed for most data-limited stocks in WGBFAS, WGNSSK, WGCSE, WGDEEP, WGWIDE, WGNEW, WGHMM, NIPAG, WGHANSA, WGEF, and HAWG in 2012 that were included under the EC's MOU with ICES. See Appendix B Table 1 for a full list of stocks with DLS-based advice in 2012.

# 2 ICES data-limited stocks (DLS); description of categories

Traditionally, the stocks for which ICES provides advice were categorized as either data-rich or data-limited. For data-rich stocks full analytical stock assessments are in place. The data-limited stocks were without quantitative assessments and forecasts. The availability of data for these data-poor stocks and possibilities for assessment of the status of the stock vary greatly among stocks. Therefore, the designation of one data-poor category is too general; more categories were needed.

ICES identified six categories of data-limited stocks in 2012. The categories range from data-rich to truly data-poor. The data-rich stock category is not within the remit of the DLS approach and is presented merely for completeness. ICES uses the categorization, described below, for all stocks (see Appendix A Figure 1).The categories reflect the availability of the types of data collected under the EU Data Collection Framework. Various other types of data and information may be relevant to assessing the state and productivity of a stock and the fishery exploiting it, e.g. life-history traits, gear selection parameters, distribution of fishing effort, genetic stock structure. For some species, changes in distribution or abundance are linked to environmental parameters such as salinity or temperature. The recent increase in abundance of anchovy in the North Sea has thus been linked to increases in summer temperature in this area (ICES WKANSARNS Report, 2010). When relevant and informative, such data should also be used in providing the advice.

#### Category 1; data-rich stocks (quantitative assessments)

These are the stocks that are not considered data-limited and this category includes stocks with full analytical assessments and forecasts as well as stocks with quantitative assessments based on production models.

#### Category 2; stocks with analytical assessments and forecasts that are only treated qualitatively

This category includes stocks with quantitative assessments and forecasts which for a variety of reasons are merely indicative of trends in fishing mortality, recruitment, and biomass.

#### Category 3; stocks for which survey-based assessments indicate trends

This category includes stocks for which survey indices (or other indicators of stock size such as reliable fishery-dependant indices; e.g. lpue, cpue, and mean length in the catch) are available that provide reliable indications of trends in stock metrics such as mortality, recruitment, and biomass.

#### Category 4; stocks for which reliable catch data are available

This category includes stocks for which a time-series of catch can be used to approximate MSY.

#### Category 5; data-poor stocks

This category includes stocks for which only landings data are available.

#### Category 6; negligible landings stocks and stocks caught in minor amounts as bycatch

This category includes stocks where landings are negligible compared with discards. It also includes stocks that are part of stock complexes and are primarily caught as bycatch species in other targeted fisheries. The development of indicators may be most appropriate to such stocks.

As a consequence, a precautionary approach implies that exploitation rates advised for stocks below the data-rich stocks (Category 1) will be more conservative than $F_{MSY}$.

For each of these categories, methods have been employed to provide quantitative advice. These methods are generally based on approaches published in the scientific literature and most of the specific, quantitative forecast methods which have been applied have also been subjected to formal testing in simulations. The methods and the associated simulations are presented in ICES (2012b). ICES recognizes that there are alternative approaches to many of the methods proposed and it has in some cases been possible for the experts involved to provide methods which are more adequate for a specific stock while maintaining the same principle of precaution as the general framework.

According to the ICES Data-Limited Stock (DLS) Approach (see draft DLS Guidance that was available during the 2012 advisory season) and ICES (2013b) and using the categories detailed above, ICES provided quantitative catch advice for stocks without analytical forecasts from five ecoregions in 2012. Table 1 provides a summary of the number of stocks, by ecoregion, that utilized each of the DLS categories in 2012, and Appendix A Table 1 provides a detailed view of every stock by DLS category.

**Table 1. Summary of the number of stocks assessed in each data-limited stock (DLS) category for each ecoregion in the 2012 ICES Advice. DLS categories that are not listed were not used in the 2012 ICES Advice.**

| | Ecoregion | | | | | |
|---|---|---|---|---|---|---|
| DLS Category | Baltic Sea<br>n = 7 | Bay of Biscay & Iberian Waters<br>n = 24 | Celtic Sea & West Coast of Ireland<br>n = 34 | North Sea<br>N = 27 | Widely Distributed<br>n = 39 | **Total** |
| 2.1.3 | | | 1 | 1 | 1 | **3** |
| 3.1 | 1 | | | 1 | 0 | **2** |
| 3.1.2 | | | | 1 | 0 | **1** |
| 3.1.4 | | 3 | 1 | | 2 | **6** |
| 3.2 | 6 | 7 | 13 | 6 | 11 | **43** |
| 3.3 | | | | | 4 | **4** |
| 4.1.2 | | | 1 | | 0 | **1** |
| 4.1.3 | | | 2 | | 0 | **2** |
| 4.1.4 | | | 1 | 5 | 0 | **6** |
| 5.2 | | 12 | 6 | 9 | 8 | **35** |
| 5.3 | | 1 | | 1 | 5 | **7** |
| 6.2 | | 1 | 6 | 1 | 4 | **12** |
| 6.3 | | | 3 | 2 | 4 | **9** |

Unlike the classic fishery management problem of estimating maximum sustainable yield (MSY), data-limited fishery analysis must often be content simply to estimate a yield that is likely to be sustainable.

# 3 Future work

## 3.1 Consideration of dynamic and static conditions

MSY indicators and associated reference points refer to an equilibrium or average situation. Fish stocks are, however, dynamic as their biological parameters change due to environmental changes. The environment includes populations of predators and the availability of food which affect natural mortality and growth, and recruitment varies from year to year. The spatial distribution of fish populations varies with abundance and ecosystem changes including climate change impacts.

Basing fisheries management on equilibrium considerations may be sufficient to ensure sustainable fisheries and healthy fish populations in more or less constant circumstances, but there are associated risks of excessive impacts on the marine ecosystems and loss of fisheries yields if applied mechanically in a dynamic situation. It is therefore necessary to supplement equilibrium-based MSY indicators and reference points with safeguards relating to the dynamic features of fish populations such as recruitment, growth and natural mortality.

An example is a population which exhibits spasmodic recruitment. Using an equilibrium-based reference point such as $F_{MSY}$ as the sole basis for fisheries management would imply important increases in TACs at the time a large year class enters the fishable population. However, this may result in excessive exploitation of larger and older fish as a result of fisheries trying to target larger specimens for market reasons and will result in loss of potential yield from that year class as it is fished before it has used its growth potential. Rather than keeping a constant F at or just below the equilibrium reference point in such a situation, one could use an indicator of size composition in the population as a supplementary reference point and as a basis for reducing F initially until the year class has grown and become fully recruited to the fishery and the spawning population.

One set of indicators capturing the dynamic features of fish populations, which may be fairly easily measured, relates to the structure of the population by weight, length, maturity or age. Examples are measures of the mean length in the population or the catch relative to maximum length or mean age relative to age of maturity.

An example of such a supplementary set of indicators relating to equilibrium/MSY and relating to the dynamic structure of the population is the descriptors for commercially exploited fish stocks in the EU Marine Strategy Framework Directive (MSFD) – Descriptor 3. This Descriptor is composed of three elements, two of which relate to MSY and the third relates to stock structure.

## 3.2 Short-lived species

The DLS methods were mostly applied to long-lived species. Further work may be required to develop specific methods for short-lived species which have limited data. In 2012, however, this only applied to one stock, Anchovy IXa where the future size of this short-lived stock is very sensitive to recruitment.

The ICES MSY framework for short-lived, data-rich stocks is aimed at achieving a target escapement (MSY $B_{escapement}$, the amount of biomass left to spawn), which is robust against low SSB and recruitment failure if recruitment is uncertain. The catch corresponds to the stock biomass in excess of the target escapement. No catch should be allowed unless this escapement target can be achieved or quantifiable (ICES Introduction). For short-lived data-limited stocks, where biomass and recruitment estimates for the current year are unknown, no fishing opportunities were calculated.

## 3.3 Productivity and susceptibility analysis (PSA)

A PSA should be considered in situations where there is a need to examine the relative level of risk to stocks and biodiversity rather than quantitative advice for a specific catch. A PSA will not directly derive catch advice, but it will suggest when more conservative proxies should be considered for the derivation of catch advice. The application of PSA in the formation of catch advice is still under development and will be considered in future workshops.

## 3.4 Uncertainty in survey indices

Uncertainty in survey indices is another factor that makes use of short-term trends in formulation of advice questionable and where supplementary information regarding stock structure is useful. If the measurement error of an abundance index is lognormally distributed with CV of sigma the ratio is lognormally distributed with CV of sigma*sqrt(2). Taking ratio of averages improves the situation, however, how great the improvement is depends, among other factors, on the autocorrelation of the measurement error. Distinguishing between real increase and noise is often difficult.

Indices from surveys should always be accompanied by an estimate of uncertainty, i.e. the part that can be improved by increasing the number of stations. Sudden increase in index is often characterized by high uncertainty, which could be used to give the index less weight (inverse variance weighting).

Looking at abundance of different size categories in a survey can often be of help. Increase in the amount of large fish that has been above minimum landing size for many years indicates decrease in fishing mortality, and increase of small fish can indicate increased recruitment. For many stocks useful recruitment signals are difficult to get and what information can be obtained by looking at different size categories varies from one stock to another.

In summary, it is suggested that the ICES advice regarding data-limited stocks (and in effect also for category 1 stocks) should be based on such supplementary sets of indicators, with the main indicator being associated with MSY considerations supplemented with safeguard indicators relating to stock structure, mainly length, age or maturity. Specific examples of such supplementary stock structure indicators are suggested for some of the categories below.

# 4 Methods

The methods accepted and implemented by ICES in 2012 for each category are detailed below.

## 4.1 Definition of common terms and methods

***$C_{y-1}$.*** In all DLS methods, the value used for Catch$_{y-1}$ ($C_{y-1}$) can be derived with one of two main approaches: the $C_{y-1}$ can be the most recent year of reliable landings (or catch) data, a three year average value can be used for $C_{y-1}$, or longer (e.g. ten years for long-lived animals such as elasmobranchs). For example, if there is a decreasing trend in the landings and the catch advice is for an increase, to be precautionary use the last year of landings (or catch) data for $C_{y-1}$. Alternatively, when the last year of data is thought to be preliminary and there is no trend in the landings, the average of the last three years of landings (or catch) for $C_{y-1}$ should be used. When these approaches are not considered appropriate, the data used to calculate $C_{y-1}$ should be clearly stated in the Advice Sheet and their use should be strongly supported in the Advice Sheet/Supporting Information. In all cases, the data used to derive $C_{y-1}$ and all other parameters should be clearly explained in the Advice.

***Uncertainty Cap.*** Note that in the Introduction to the ICES Advice this is referred to as the "change limit" (ICES 2013c, Section 1.2.2.3). A change limit of ±20% has been applied in the advice. This change limit is relative to the reference on which it is based and may be, e.g. recent average catches or a projection of a trend. Apply this cap to the catch advice to address uncertainty or noise in the data and its potential influence on the catch advice. If $C_{y+1}$ is 20% greater or less than $C_{y-1}$, then apply a cap of 20% change in $C_{y+1}$.

***Precautionary Buffer.*** Note that in the Introduction to the ICES Advice (ICES 2013c, Section 1.2.2.3) this is referred to as the "precautionary margin". A precautionary margin of -20% has been applied for those cases when the stock status relative to candidate reference points for stock size or exploitation is unknown. Exceptions to this rule have been made in cases where expert judgement determines that the stock is not reproductively impaired, and where there is evidence that the stock size is increasing or that exploitation has reduced significantly; for instance, on basis of survey indices or a reduction in fishing effort in the main fishery if the stock is taken as a bycatch species. Apply this buffer of a 20% reduction to catch advice ($C_{y+1}$) when reference points are unknown; however, if substantial increases in abundance indices or other stock indices are consistently observed (i.e. not due largely to noise in the data), or there are substantial reductions in fishing mortality (or effort) in the target fishery, this precautionary buffer may not apply to catch advice. For example, if abundance indices ($I$) increase by 50% or more, so that:

$$\left(\frac{\sum_{i=y-2}^{y-1} I_i/2}{\sum_{i=y-5}^{y-3} I_i/3}\right) \geq 1.5$$

then the Precautionary Buffer may not apply to catch advice. In addition, if there is substantial effort decreases in the target fishery, for stocks that are caught mainly as bycatch, the Precautionary Buffer may not apply.

This approach is intended to move in the direction of sustainable exploitation, having due regard for the species' biological characteristics and uncertainty in the information. This implies that advice is applicable to a time frame which is compatible with a measurable response in the metrics used as the basis for the advice; i.e. in the simplest case, and where the least information is available, this would imply a multi-annual constant catch advice. Where least information is available, including cases where the 20% precautionary margin has been applied, ICES therefore considers that the advice is not expected to be changed for a fixed and determined period such as, for example, three years, unless important new knowledge emerges regarding a stock which may justify a revision of the advice.

## 4.2 Category 1: Data-rich stocks (quantitative assessments)

These are the stocks that are not considered data-limited and this category includes stocks with full analytical assessments and forecasts as well as stocks with quantitative assessments based on production models.

### Situation to address

None; all information is available to apply the ICES MSY framework.

### Method 1.1 [1]

This is the current ICES methodology for quantitative assessments, and it is presented here as a comparison for the other categories. Stocks in this category should proceed with the quantitative assessment as defined in their stock annex.

#### Method 1.1.1. If estimated stock biomass in the intermediate year is greater than MSY $B_{trigger}$

Catch advice is based on $F_{MSY}$ and a stepping rule for overexploited stocks. $F_{MSY}$ should be estimated directly, including its uncertainty interval:

1 ) Calculate the fishing mortality ($F$) to be used for catch advice in year $y + 1$:

From ICES Advisory Report 2012 Section 1.2: If an estimate or a proxy of $F_{MSY}$ was available, the transition began in 2011 and F is reduced in five equal steps. Consequently, the catch option for 2013 will be:

$F_{MSY\text{-}HCR\text{-}transition}$ (2013) = Min{0.4 • F (2010) + 0.6 • $F_{MSY\text{-}HCR}$ (2013); $F_{pa}$}.

2 ) Using the Baranov catch equation, determine the advised catch ($C$) for year $y + 1$ as follows:

$$C_{y+1} = \sum_a \frac{s_a F_{y+1}}{s_a F_{y+1} + M_a} N_{a,y+1} w_a [1 - \exp(-s_a F_{y+1} - M_a)]$$

Where $s_a$ is selectivity-at-age, $M_a$ is natural mortality-at-age, $N_a$ is abundance-at-age, and $w_a$ is weight-at-age.

#### Method 1.1.2. If estimated stock biomass in the intermediate year is less than MSY $B_{trigger}$

Catch advice is based on the ICES MSY control rule, in which $F<F_{MSY}$ as a linear function of biomass relative to MSY $B_{trigger}$:

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[1] Background for the method is the ICES MSY Framework.

$F_{MSY\text{-}HCR\text{-}transition}(2013) = \text{Min}\{0.4 \bullet F(2010) + 0.6 \bullet F_{MSY\text{-}HCR}(2013); F_{pa}\}$.

$$F_{MSY-HCR}(2013) = F_{MSY}\left(\frac{B_{2013}}{MSYB_{trigger}}\right)$$

**Method 1.1.3. In situations where a gradual transition is not appropriate because stock size is low (e.g. below $B_{lim}$) and the outlook is for a further decline (e.g. as a result of low recruitment) unless fishing mortality is reduced more rapidly**

ICES may advise on a more rapid transition or application of $F_{MSY\text{-}HCR}$ as soon as possible.

### Method 1.2. For extremely low biomass

A recovery plan and possibly zero catch are advised.

## 4.3 Category 2: Stocks with analytical assessments and forecasts that are only treated qualitatively

This category includes stocks with quantitative assessments and forecasts which for a variety of reasons are merely indicative of trends in fishing mortality, recruitment, and biomass.

### Situation to address

A quantitative assessment is available, but for a variety of reasons is being treated as merely indicative of trends in fishing mortality, recruitment, biomass and future catches, rather than as an analytical assessment with catch forecast. To date, such quantitative assessments are presented without y-axis values. See Appendix A Figure 2 for a decision tree describing the data and methods available to stocks with trends-only assessments.

### Assumptions

The assessment estimates, their forecasts and status relative to reference points are consistent with each other (although not necessarily on the correct scale) and can therefore be used to provide relative management advice on the direction and relative scale of the changes required to achieve targets (see Harvest Control Rule (HCR) Methodology below).

### Data and information needed to apply the methods

- The forecast and an explanation of current year assumptions (basis of forecast);
- Trends information and estimates of potential reference points for each stock (e.g. $F_{0.1}$ and MSY $B_{trigger}$). $F_{0.1}$ should be estimated to be consistent with the quantitative assessment. MSY $B_{trigger}$ should represent a stock size below which more conservative catch advice is needed to avoid impaired productivity (e.g. $B_{loss}$, 25th percentile of estimated biomass).

### Course of action

1) Assemble the data and information described above and provide in the EG's report;

2 ) $F_{0.1}$ or other conservative proxies of $F_{MSY}$ and define the MSY $B_{trigger}$;

3 ) Treat the trends-only assessment as a full analytical assessment:

3.1 ) Conduct a short-term forecast and provide the basis for the forecast;

3.2 ) Derive reference points from the assessment (e.g. $F_{0.1}$) to provide a stepped approach towards the target F (e.g. aiming for exploitation at $F_{0.1}$ by 2015).

### *Method 2.1.*[2] Harvest Control Rule

#### Detailed methodology[3]

See Harvest Control Rule method below, which is used to calculate the *F* to be used to determine the advised Catch (C) for year + 1 ($C_{y+1}$).

#### Purpose

To calculate the *F* to be used to determine the catch advice for the forecast for stocks with assessments that have been used as indicative of trends only (Category 2).

#### Assumptions

$y$ - 1 = final year of data;

$y$ = intermediate year;

$y$ + 1 = year for which advice is given;

$n$ = number of years for $F_{SQ}$ to $F_{MSY}$-proxy transition, starting in year y + 1.

A full assessment is conducted in the intermediate year ($y$) based on both catch-at-age data and age-based tuning-series up to the final year of data ($y$ - 1), a short-term forecast (with the usual assumptions of three year means and recruitment based on GM or other rationale) is performed through the intermediate year ($y$) assuming that the TAC previously set is not over-taken and a catch for the year for which advice is given($y$ + 1) is calculated using $F_{MSY}$-proxy (based on the first assessment conducted in year y, which need not be updated on an annual basis), with a transition towards it from $F_{SQ}$ for the first $n$ years.

Because this is a stock with a trends-based assessment it is usually based on a yield-per-recruit (YPR) analysis with candidates such as $F_{0.1}$ and other conservative proxies

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[2] For background on this method, see the simulations in the WKLIFE Report (ICES 2013a; De Oliveira *et al.*, 2012a) that revealed that correct scaling is an important issue for the HCR method for stocks with qualitative assessments and forecasts only (Category 2). Three examples are provided in RGLIFE Appendix A (ICES 2013b) to illustrate how the harvest control rule performs for a 'cod-like' stock, with and without scaling problems.

[3] This HCR is a modification of (De Oliveira, J.A.A. *et al.*, 2010 and ICES, 2010). The general approach is to apply $F_{0.1}$ as a robust and generally precautionary proxy for $F_{MSY}$ to account for the additional uncertainty associated with an assessment that cannot reliably estimate scale.

of $F_{MSY}$. Appropriate assumptions are required regarding mean weight-at-age, selection pattern, and natural mortality for this method.

**Method 2.1.1. Note that this method was available in 2012, but it was not used. If estimated biomass is greater than MSY $B_{trigger}$**

1 ) Conduct an assessment in year $y$ using data up to year $y$ -1;
2 ) Derive an $F_{MSY}$-proxy on the basis of the assessment;
3 ) Derive the estimates required to conduct a short-term forecast. These typically involve calculating averages for the final three years from assessment inputs and outputs such as mean weights-at-age and selection pattern, and setting an appropriate time period for calculating geometric mean recruitment;
4 ) Conduct a short-term forecast, projecting final-year numbers-at-age from the assessment through the intermediate year ($y$) to the beginning of the TAC year ($y$ + 1), using the estimates and geometric mean recruitment from step 3, and assuming the previously set TAC corresponding to the intermediate year will be fully taken. Set recruitment at the beginning of year $y$ + 1 to geometric mean recruitment;
5 ) Calculate the F to be used to advice on the catch (C) for year $y$ + 1 as follows: See above for Category 1 stocks;
6 ) Using the Baranov catch equation and the quantities derived in steps 4 and 5, determine the advised catch ($C$) for year $y$ + 1 as follows:

$$C_{y+1} = \sum_a \frac{s_a F_{y+1}}{s_a F_{y+1} + M_a} N_{a,y+1} w_a \left[1 - \exp\left(-s_a F_{y+1} - M_a\right)\right]$$

Where $s_a$ is selectivity-at-age, $M_a$ is natural mortality-at-age, $N_a$ is abundance-at-age, and $w_a$ is weight-at-age.

7 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

**Method 2.1.2. Note that this method was available in 2012, but it was not used. If estimated stock biomass is less than MSY $B_{trigger}$**

Catch advice is based on the ICES MSY control rule, in which F<$F_{MSY}$ as a linear function of biomass relative to MSY $B_{trigger}$:

$F_{MSY\text{-}HCR\text{-}transition}$ (2013) = Min{0.4 • F (2010) + 0.6 • $F_{MSY\text{-}HCR}$ (2013); $F_{pa}$}

$$F_{MSY-HCR}(2013) = F_{0.1}\left(\frac{B_{2013}}{MSYB_{trigger}}\right)$$

1 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

**Method 2.1.3. For extremely low biomass, a recovery plan and possibly zero catch is advised**

## 4.4 Category 3: Stocks for which survey-based assessments indicate trends

This category includes stocks for which survey indices (or other indicators of stock size such as reliable fishery-dependant indices; e.g. lpue, cpue, and mean length in the catch) are available that provide reliable indications of trends in stock metrics such as mortality, recruitment, and biomass.

### Situation to address

Surveys or other relative abundance or biomass indices are available for these stocks and they provide reliable indications of trends in total mortality, recruitment and abundance or biomass, but no quantitative, analytic assessment is available for the stock (e.g. Irish Sea haddock). See Appendix A Figure 3 for a decision tree describing the data and methods available to stocks with survey-only assessments.

### Assumptions

The general concept of survey-based catch advice is based on Russell's (1931) non-equilibrium definition of overfishing, in which catch exceeds biological production and causes a reduction in the stock. Therefore, decreasing surveys suggest catch should be incrementally decreased and vice versa.

### Data and information needed to apply the methods

- The time-series of the biomass index (or abundance) that should be used to determine the status of the stock and provide catch advice as methods are developed needs to be identified;
- When a biomass index is available, it should be used rather than an abundance index;
- Determination of whether or not the resource is over exploited:
  - Agreed upon stock-specific life-history traits (Le Quesne and Jennings, 2012) (e.g. $L_{MAX}$ values, r, k, M) and the corresponding proxies for sustainable fishing mortalities. Any other information that the EG deems relevant to categorizing the stock or providing an analytical assessment;
  - Approximations of current exploitation rate or fishing mortality based on size structure of fully exploited or mature sizes are needed to determine if overfishing is occurring (e.g. size based estimates of total mortality, equilibrium size distribution of the population);
  - Ideally, this method requires a quantification of current fishing mortality and $F_{0.1}$, but this determination may be based on expert opinion.
- A survey-based proxy for MSY $B_{trigger}$ should be estimated to represent a survey index below which more conservative catch advice is needed to avoid impaired productivity (e.g. lowest observed survey index or 25th percentile of survey indices). Ideally this would be an index of exploitable biomass;
- Survey-adjusted *status quo* catch should be applied only when the stock does not appear to be overfished and is at an appropriate stock size. To

address this concern, the recommended method for advised catch includes a biomass trigger and a determination of overfishing;

- Situations in which catch is less than TAC because of uptake issues should also be considered because this method may not be appropriate to those situations.

**Method 3.1. If a reliable biomass/abundance index is available, apply the biomass/abundance index adjusted, *status quo* catch (a harvest control rule)**

The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data:

$$C_{y+1} = C_{y-1}\left(\frac{\sum_{i=y-x}^{y-1} I_i/x}{\sum_{i=y-z}^{y-x-1} I_i/(z-x)}\right)$$

Where $I$ is the survey index, $x$ is the number of years in the survey average, and $z > x$. For example, $x = 2$ would be a two year survey average, and $x = 2$ $z = 5$, which is analogous to the five steps in the ICES MSY transition from 2010 to 2015 (ICES Introduction Section 1.2).The number of years to average should account for interannual variability of surveys. The precision of the survey's annual abundance/biomass estimates should be taken into account when comparing the two averages in the above equation, where available.

**Method 3.1.0. If a reliable abundance index is available, apply the abundance index-adjusted, status-quo catch (a harvest control rule). If, in addition, the current value of F ($F_{SQ}$), with respect to an $F_{MSY}$ proxy ($F_{MSY\text{-}proxy}$) is known, then**

The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data.

1) Determine catch advice from the survey- and $F_{MSY}$-transition adjusted *status quo* catch

$$C_{y+1} = C_{y-1}\left(\frac{\sum_{i=y-x}^{y-1} I_i/x}{\sum_{i=y-z}^{y-x-1} I_i/(z-x)}\right)\left(\frac{F_{y+1}}{F_{SQ}}\right)$$

where

$$F_{y+1} = (1-\omega)F_{SQ} + \omega F_{MSY-proxy}$$

and $\omega$ is 0.6 for 2013, 0.8 for 2014, and 1.0 for 2015 according to the 2010 ICES MSY approach for fisheries advice where a stepwise transition is used to reach $F_{MSY}$ by 2015.

In cases where $F_{SQ}$ is close to $F_{MSY\text{-}proxy}$: go to $F_{MSY}$ at once $F_{y+1} = F_{MSY\text{-}proxy}$. Note that this was not used in the 2012 advice, but it should be applied going forward.

2) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

**Method 3.1.1. Note that this method was available in 2012, but it was not applied. If the recent survey index is greater than MSY $B_{trigger}$ and $F_{SQ}$ is greater than $F_{0.1}$**

Calculate the fishing mortality ($F$) to be used for catch advice ($C$) in year $y+1$:

$$F_{y+1} = (1-\omega)F_{SQ} + \omega F_{0.1}$$

where the ω is 0.6 for 2013, 0.8 for 2014, and 1.0 for 2015 according to the 2010 ICES MSY approach for fisheries advice where a stepwise transition is used to reach $F_{MSY}$ by 2015.

$$C_{y+1} = C_{y-1}\left(\frac{F_{y+1}}{F_{SQ}}\right)$$

1 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

**Method 3.1.2. If the recent survey index is greater than the survey-based proxy for MSY $B_{trigger}$ and $F_{SQ}$ is less than or equal to $F_{0.1}$**

Then determine catch advice from the survey adjusted *status quo* catch:

$$C_{y+1} = C_{y-1}\left(\frac{\sum_{i=y-x}^{y-1} I_i/x}{\sum_{i=y-z}^{y-x-1} I_i/(z-x)}\right)$$

1 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

**Method 3.1.3. This method was available, but it was not applied in 2012. If the recent survey index is less than the survey-based proxy for MSY $B_{trigger}$**

Then catch advice is based on the ICES MSY control rule, in which $F_{y+1}<F_{0.1}$ as a linear function of the current survey index relative to the survey-based proxy for MSY $B_{trigger}$ (*MSY $I_{trigger}$*):

$$F_{y+1} = (1-\omega)F_{SQ} + \omega F_{0.1}\left(\frac{I_{y-1}}{MSYI_{trigger}}\right)$$

1 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

2 ) Then apply the Precautionary Buffer to the catch advice (see above Methods; Definition of common terms and methods).

**Method 3.1.4. For extremely low biomass, a recovery plan and possibly zero catch is advised**

### Method 3.2. If there are survey data on abundance (e.g. cpue over time), but there is no survey-based proxy for MSY $B_{trigger}$ and F values or proxies are not known

1 ) Determine catch advice from the survey adjusted *status quo* catch:

$$C_{y+1} = C_{y-1}\left(\frac{\sum_{i=y-x}^{y-1} I_i/x}{\sum_{i=y-z}^{y-x-1} I_i/(z-x)}\right)$$

2 ) Where $I$ is the survey index, $x$ is the number of years in the survey average, and $z > x$. For example, $x = 2$ would be a two year survey average, and $x = 2$ $z = 5$, which is analogous to the five steps in the ICES MSY transition from 2010 to 2015 (ICES Introduction 1.2);

3 ) $C_{y-1}$ should be the last three years unless there are justified reasons for using a longer or different time period. For example, long-lived species such as sharks and rays used ten years of data;

4 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods;- Definition of common terms and methods);

5 ) Then apply the Precautionary Buffer to the catch advice (see above Methods; Definition of common terms and methods).

#### Method 3.3. If the biomass index is increasing or stable over a representative period of time

Then an $F_{proxy}$ can be calculated as the average of a time-series of total catch divided by survey biomass to derive catch advice.

1 ) Multiply the $F_{proxy}$ by $I_{y-1}$ as defined in Common terms and methods;

2 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods;- Definition of common terms and methods);

3 ) Then apply the Precautionary Buffer to the catch advice (see above Methods; Definition of common terms and methods).

The advice for Northeast Atlantic Boarfish in 2012 was a variant of this method, where an $F_{msyproxy}$ (derived from YPR analysis) was expressed as a harvest rate and applied to the 2012 biomass estimate from an acoustic survey. No PA Buffer was applied as there was expert judgement to evaluate $F_{current} << F_{MSYproxy}$, and the uncertainty Cap did not apply as there was (by coincidence) no change to the advised catch.

## 4.5 Category 4: Stocks for which reliable catch data are available

This category includes stocks for which a time-series of catch can be used to approximate MSY.

#### Situation to be addressed

When only catch or landings data are available, and the data may not be continuous or consistent over time for a variety of reasons. See Appendix A Figure 4 for a decision tree describing the data and methods available to stocks with only catch (or landings) data.

#### Assumptions

The average catch has been sustainable if abundance has not changed. Depletion Corrected Average Catch is an approximation of MSY. However, a catch advice based on MSY is only appropriate to stocks near $B_{MSY}$. For situations in which DCAC is much greater than recent catch, stock size may be less than $B_{MSY}$ and catch advice should increase slowly toward DCAC.

### Data and information needed to apply the methods

- The time-series and data used should be recorded and justified;
- The Depletion Corrected Average Catch (DCAC) method requires cumulative total catch over several years, while Catch Curve Analysis requires age or possibly length disaggregated catch numbers;
- Auxiliary information, such as historical survey information, may also be helpful, although it should be noted that if survey information is available, then the possibility of "upgrading" the stock to another category (e.g. Category 3) should also be considered.

### Method 4.1. When a sufficient catch history is available, which need not be continuous, to determine a suitable exploitation rate

1 ) Apply the Depletion-Corrected Average Catch (DCAC)[4] model;

2 ) Use a stepped approach to catch advice to slowly increase advised catch toward Depletion-Corrected Average Catch, or to quickly reduce advised catch toward Depletion-Corrected Average Catch;

3 ) If catch is less than TAC because of uptake issues, this method of deriving catch advice may not be appropriate.

DCAC is calculated as:

$$\text{DCAC} = \frac{\sum C_t}{n + \Delta\left[B_{peak}\left(F_{msy}/M\right)M\right]^{-1}}$$

Where

$C_t$ is the catch during year $t$;

$n$ is the length of catch time-series in years;

$\Delta$ is the decline in the relative stock status;

$B_{peak}$ is the biomass that corresponds to maximum sustainable yield relative to carrying capacity ($B_{msy}/K$);

$M$ is the instantaneous rate of natural mortality; and

$F_{msy}/M$ is the ratio between the fishing mortality rate that corresponds to $B_{peak}$ and $M$.

4 ) Catch advice ($C_{y+1}$) should be a derived using a stepped approach;

5 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

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[4] Methodology available on the NOAA Toolbox and in the RGLIFE Draft Report. The model is available for download from the NOAA Toolbox at http:\\ntf.nefsc.noaa.gov/. Further information is also available in the RGLIFE report Appendix B (ICES 2013b) and from sources including Anon (2011); Wetzel and Punt (2011), and MacCall (2009).

**Method 4.1.1. If recent catch is greater than DCAC**

$$C_{y+1} = (1-\omega)C_{SQ} + \omega DCAC$$

Where the $\omega$ is 0.6 for 2013, 0.8 for 2014, and 1.0 for 2015 according to the 2010 ICES MSY approach for fisheries advice where a stepwise transition is used to reach $F_{MSY}$ by 2015.

1 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

Note that while this method was available, it was not applied in 2012.

**Method 4.1.2. If recent catch is less than DCAC, advised catch should be based on a slower step increase**

$$C_{y+1} = (1+\delta)C_{SQ}$$

Where $\delta$ reflects the desired rate of increasing catch to DCAC (e.g. 0.1). This 'slow up-fast down' approach is designed to account for stocks that may be at relatively low biomass that cannot support MSY.

1 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods; Definition of common terms and methods).

**Method 4.1.3. Catch Curves. If a sufficient catch history is available to determine a suitable exploitation rate ($F_{MSY}$) and $F_{SQ}$ is available**

Use catch curve analysis (use $F/F_{MSY}$ as an indicator) to determine the catch advice ($C_{y+1}$) from $C_{y-1}$ as relatively proportional to the current F to $F_{MSY}$.

1 ) If F is highly variable (e.g. many variations in F although landings remain stable), take a three year average F value to estimate the $F_{SQ}$, which is $F_{(2009–2011)}$.

  1.1 ) For example, given the uncertainty of the total mortality (Z) estimates from the catch curves analyses, quantify the $F_{SQ}$ as the three years' average F over the period 2009–2011. The $F_{SQ}$ (equal to 0.66 in this example) must be decreased by 64% to reach the $F_{MSY\text{-}proxy}$ of 0.24;

  1.2 ) This reduction is then applied to the average of the last three years' landings ($C_{y-1}$) to provide the catch advice ($C_{y+1}$).

$$C_{y+1} = C_{y-1}\left(\frac{F_{y+1}}{F_{SQ}}\right)$$

2 ) If using the MSY Transition,

$$F_{y+1} = (1-\omega)F_{SQ} + \omega F_{MSY-proxy}$$

where $\omega$ is 0.6 for 2013, 0.8 for 2014, and 1.0 for 2015 according to the 2010 ICES MSY approach for fisheries advice where a stepwise transition is used to reach $F_{MSY}$ by 2015.

3 ) Apply the 20% Uncertainty Cap to the catch advice (see above Methods;- Definition of common terms and methods).
4 ) Then apply the Precautionary Buffer to the catch advice (see above Methods;- Definition of common terms and methods). In 2012, the PA buffer was applied because the SSB level was unknown.

#### Method 4.1.4. Data borrowing for sedentary species[5]

This approach can be used for sedentary species such as *Nephrops* and scallops where there are reasonable scientific grounds to use life-history information and density information from neighbouring areas to frame where current fishing effort levels lie within the MSY framework, e.g. *Nephrops* units lacking formal TV surveys.

The minimum data required that are specific to the Data-limited Stocks are the spatial areas occupied by the stocks and the landings. In addition to this, estimates of absolute density, mean weight in the landings and discard rate are required but these can be drawn from other areas as deemed fit. Obviously it is desirable to use as many stock-specific parameters as possible.

1 ) If the medium-term (~ten year) average F or Harvest Rate is below reasonable $F_{MSY}$ estimates from neighbouring areas with similar environmental characteristics, and there is no indication of declining catch rates then the stock is likely to be well above MSY $B_{trigger}$. The advised landings should be no greater than the medium term (~ten year) average landings, but the Uncertainty Cap was not applied in 2012 but should be applied in future;
2 ) If the medium term (~ten year) average F or Harvest Rate is not below reasonable $F_{MSY}$ estimates from neighbouring areas with similar environmental characteristics, a 20% precautionary reduction should be applied to the medium term (~ten year) average landings;
3 ) Where there is concern that fishing practice and/or life-history characteristics may have significantly changed within the medium term (~ten year) history, a 20% Precautionary Buffer on the short-term (~three year) average landings should be advised.

### Method 4.2. If catches have declined significantly over a period of time and this is considered to be representative of a substantial reduction in biomass, a recovery plan and possibly zero catch is advised

Note that this method was available, but it was not applied in 2012.

## 4.6 Category 5: Data-poor stocks

This category includes stocks for which only landings data are available.

### Situation to address

In the rare situation that only landings (or catch) data are available and no relevant fishery information can be gleaned from similar stocks or species in the ecoregion or beyond, the situation to address here is biodiversity rather than yield. See Appendix

[5] Note that the use of the uncertainty cap in Method 4.1.4, used for some *Nephrops*, should be reconsidered in 2013.

A Figure 5 for a decision tree describing the data and methods available to stocks in this category, where very little information is available.

#### Method 5.1. Productivity and Susceptibility Analysis (PSA) risk assessment

This method was proposed, but not made available for implementation for the 2012 ICES Advice. The application of PSA in the formation of catch advice is still under development and will be considered in future workshops.

1 ) Conduct a Productivity and Susceptibility Analysis (PSA) risk assessment to determine if reductions in catch are necessary:
    1.1 ) The WKLIFE Report (ICES 2013a, Section 6.2.2) and the RGLIFE Report (ICES 2013b) discuss the potential for PSA to be appropriate where there is a need to examine the relative level of risk to stocks. The application of PSA in the formation of catch advice is still under development and will be considered in future workshops.

#### Method 5.2.[6] If there is no indication of where F is relative to proxies and no marked positive trends in stock indicators

1 ) Calculate the catch advice ($C_{y+1}$) as $C_{y-1}$.
2 ) Apply the Precautionary Buffer to the catch advice (see above Methods; Definition of common terms and methods).

#### Method 5.3. If catches have declined significantly over a period of time and this is considered to be representative of a substantial reduction in biomass, a recovery plan and possibly zero catch is advised

## 4.7 Category 6: Negligible landings stocks and stocks caught in minor amounts as bycatch

This category includes stocks where landings are negligible compared with discards. It also includes stocks that are part of stock complexes and are primarily caught as bycatch species in other targeted fisheries. The development of indicators may be most appropriate to such stocks.

#### Situation to address

There are cases when few fish are caught and recorded, either because their abundance is low or because they are simply discarded at sea, that ICES has not traditionally provided catch advice, and such advice may not be appropriate. These stocks may be caught incidentally as bycatch in targeted fisheries with harvest control rules or TACs. Information may or may not be collected by some fleets encountering these stocks, and advice on reducing the catch of these stocks may be irrelevant as they are simply discarded or not landed in large quantities. See Appendix A Figure 5 for a decision tree describing the data and methods available to stocks in this category, where very little information is available.

[6] The Uncertainty Cap does not apply to this method.

### Method 6.1. Productivity and Susceptibility Analysis (PSA) risk assessment

This method was proposed, but not made available for implementation for the 2012 ICES Advice. The application of PSA in the formation of catch advice is still under development and will be considered in future workshops.

1 ) Conduct a Productivity and Susceptibility Analysis (PSA) risk assessment to determine if reductions in catch are necessary:

   1.1 ) The WKLIFE Report (ICES 2013a, Section 6.2.2) and the RGLIFE Report (ICES 2013b) discuss the potential for PSA to be appropriate where there is a need to examine the relative level of risk to stocks. The application of PSA in the formation of catch advice is still under development and will be considered in future workshops.

### Method 6.2.[7] If there is no indication of where F is relative to proxies and no marked positive trends in stock indicators

1 ) Calculate the catch advice ($C_{y+1}$) as $C_{y-1}$.

2 ) Then apply the Precautionary Buffer to the catch advice (see above Methods; Definition of common terms and methods).

### Method 6.3. If catches have declined significantly over a period of time and this is considered to be representative of a substantial reduction in biomass, a recovery plan and possibly zero catch is advised

[7] The Uncertainty Cap does not apply to this method.

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## Appendix A

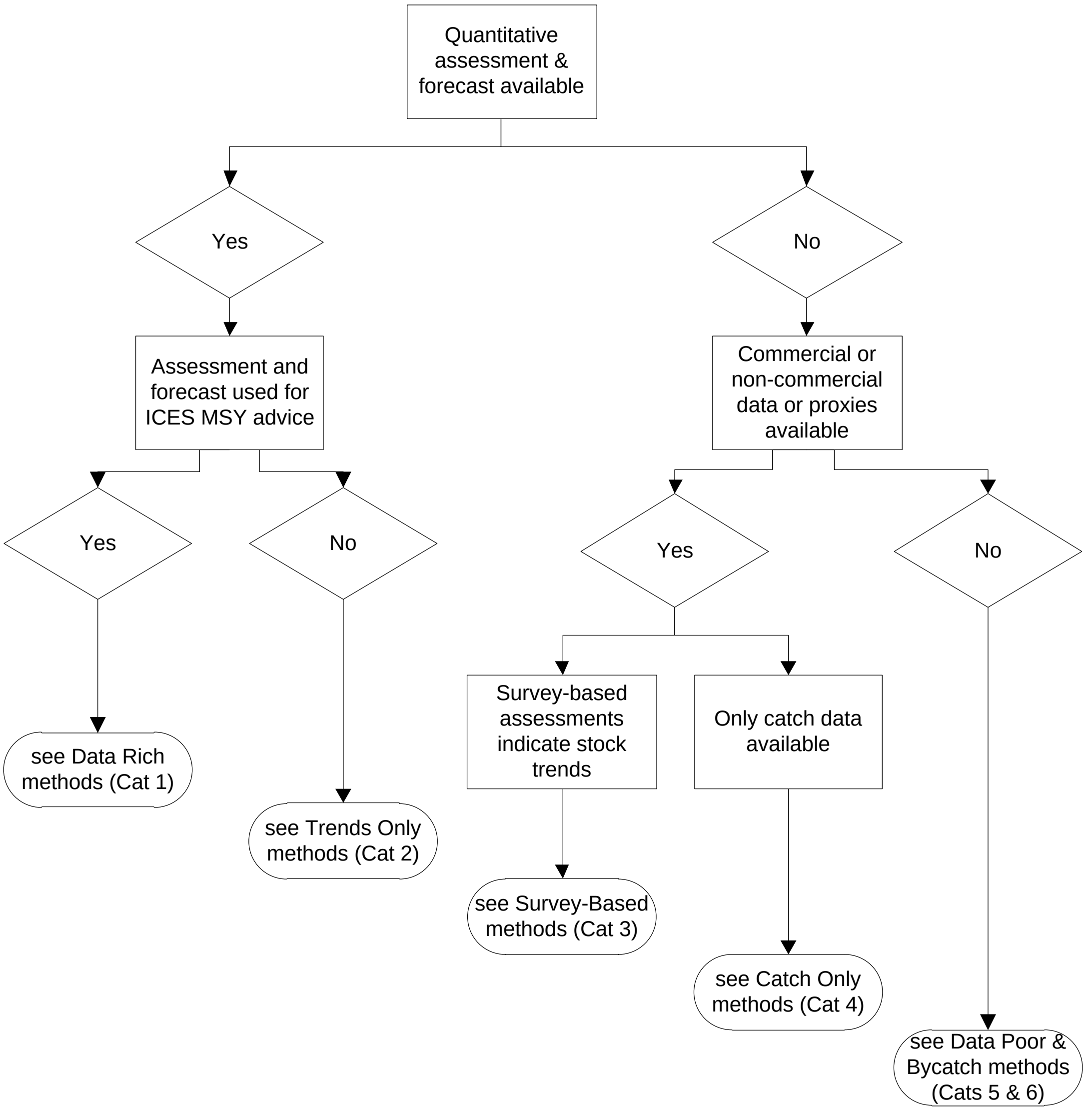


**Figure 1. Overview of categories of ICES assessment types for data-rich (Category 1) and the data-limited stocks (DLS) (Categories 2–6). The availability of high quality data and proxies for the assessments decreases and the precautionary approach increases from left to right.**

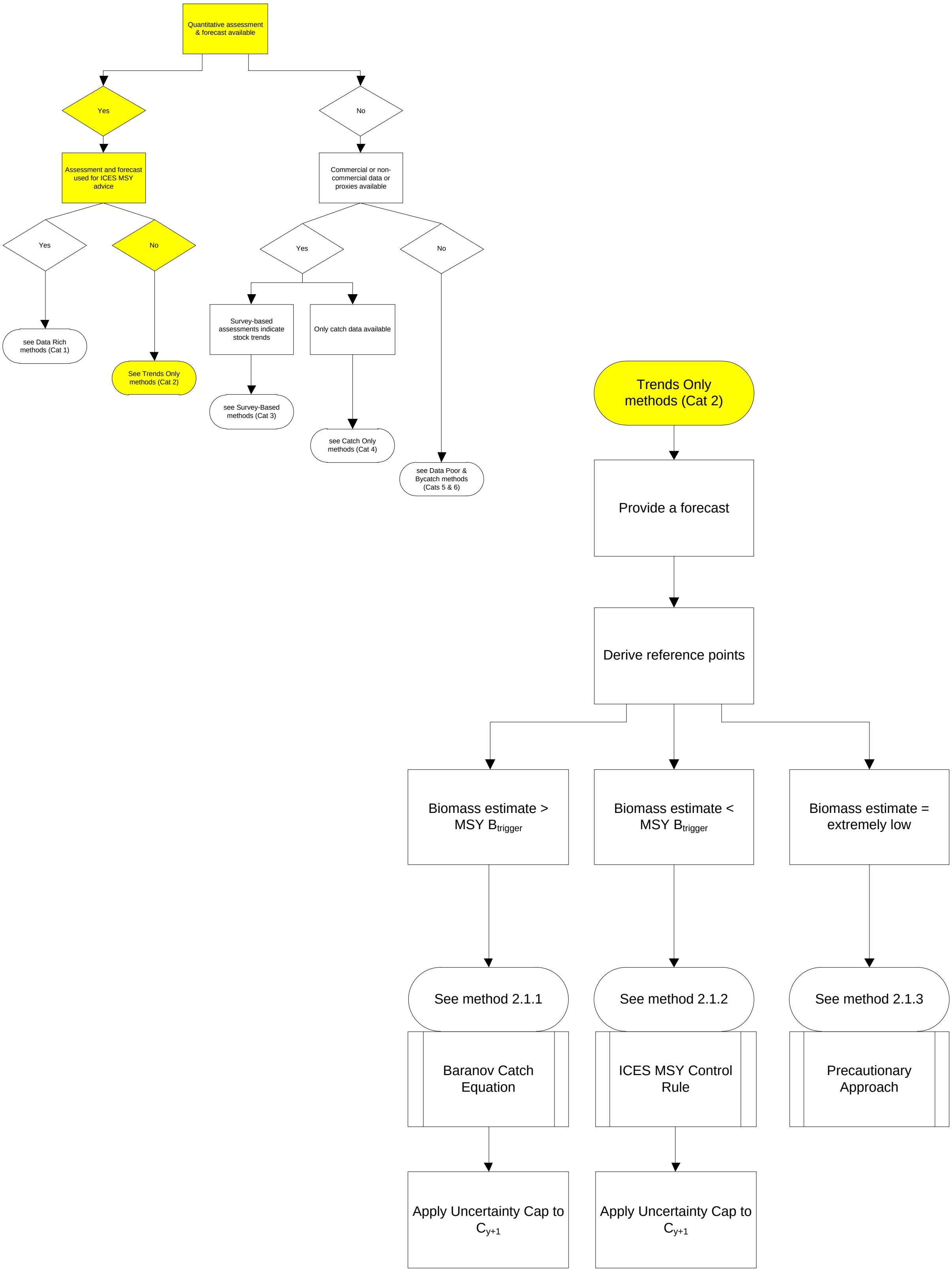


**Figure 2. Decision tree for implementing the ICES Data-limited Stock (DLS) methods for stocks with quantitative assessments that are considered indicative of trends only (Category 2).**

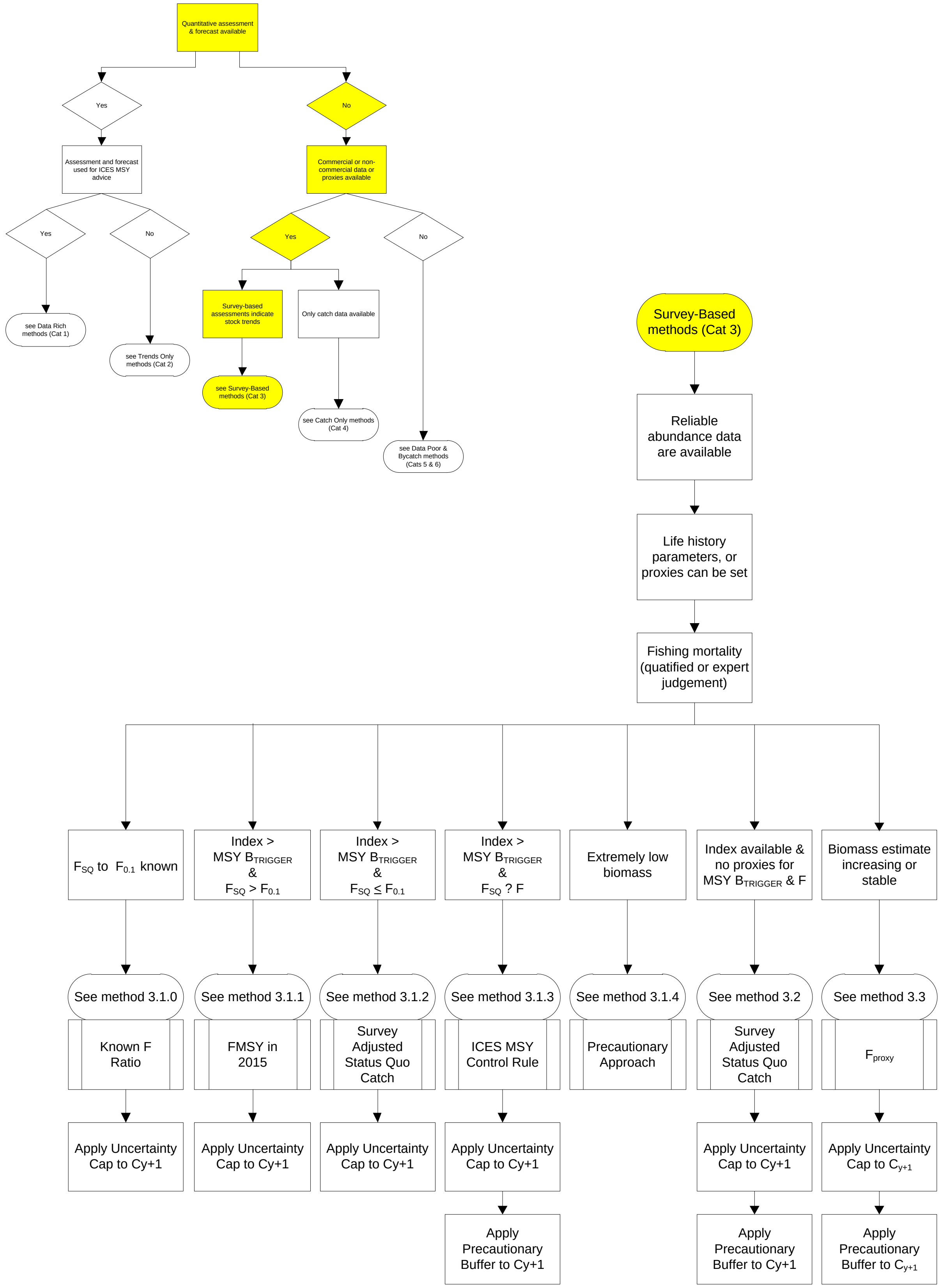


**Figure 3. Decision tree for implementing the ICES Data-limited Stock (DLS) methods for stocks with survey data and proxies, or other relative abundance indices(Category 3), which provide reliable indications of trends in mortality, recruitment, and abundance.**

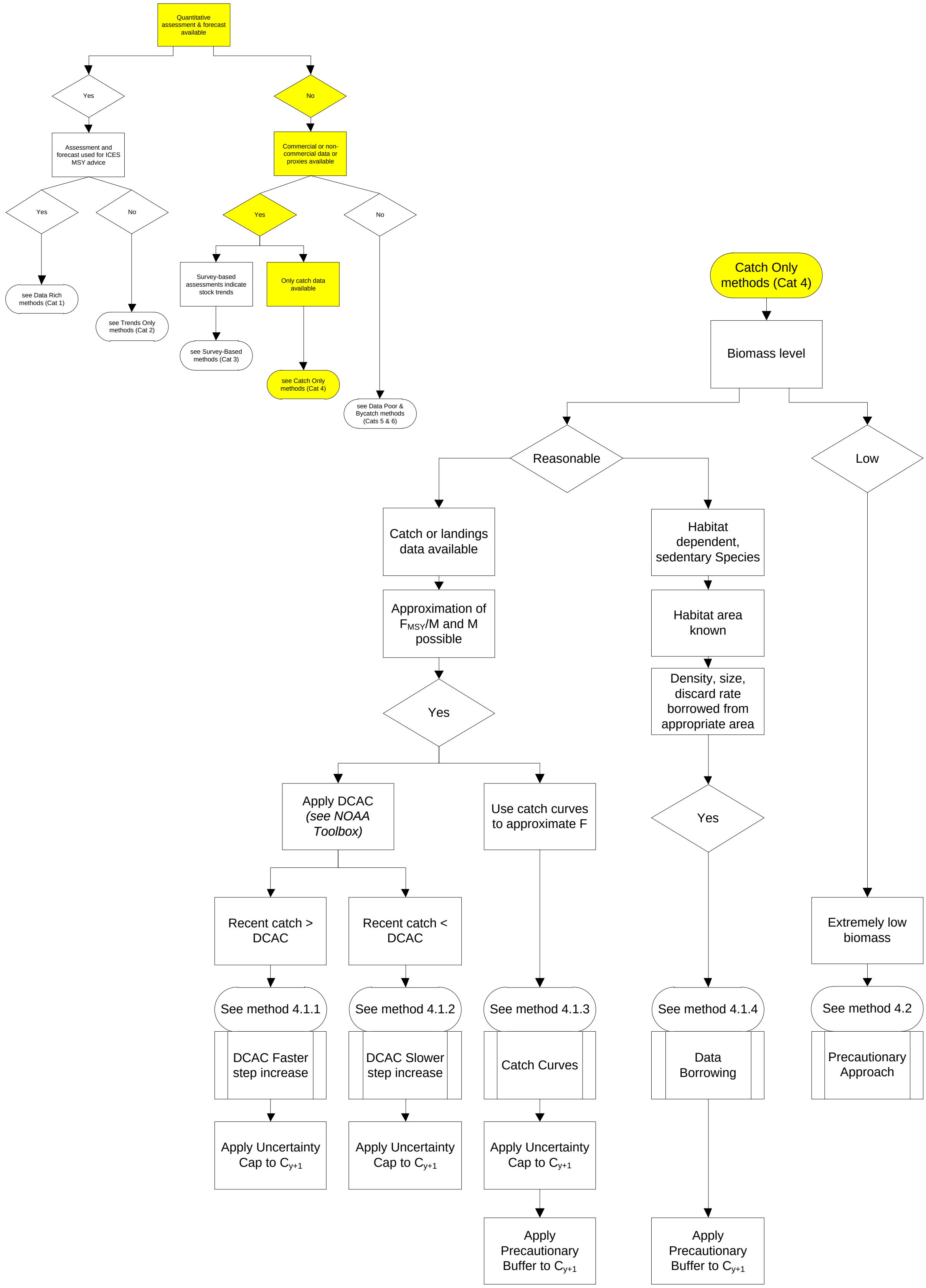


**Figure 4. Decision tree for implementing the ICES Data-limited Stock (DLS) methods for stocks with only catch or landings data available (Category 4), which may not be continuous or consistent over time.**

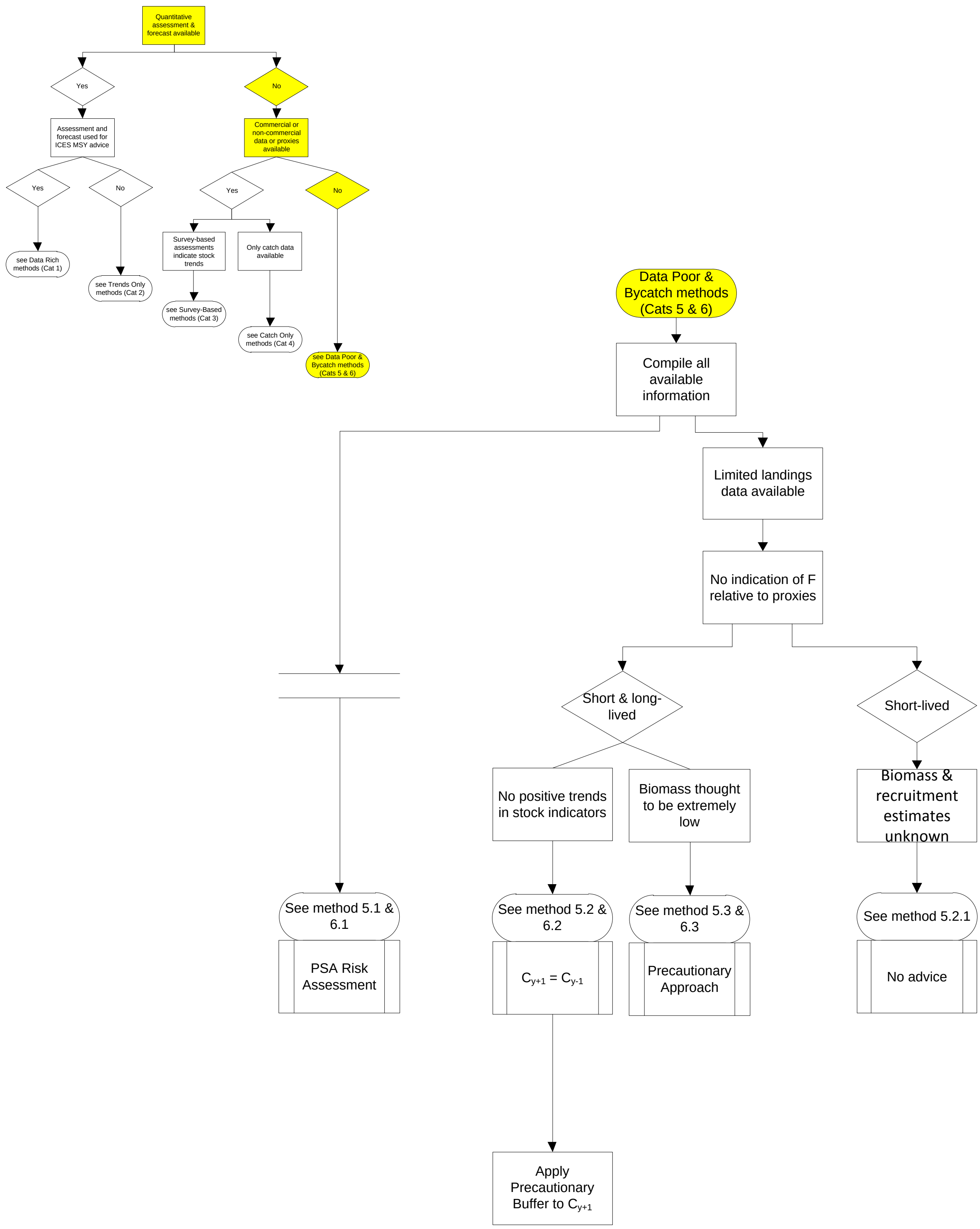


**Figure 5. Decision tree for implementing the ICES Data-limited Stock (DLS) methods for stocks with very few available data, such as only landings, and no other relevant information can be inferred from other similar stocks (Category 5), or (Category 6) for which so few fish are landed because their abundance is low and they are rarely caught or they are largely a bycatch species and rarely landed. There is a break in the depicted method for PSA (5.1 and 6.1) because these methods are not yet detailed by ICES.**

## Appendix B

**Table 1. A complete list of all ICES stocks assessed with the ICES data-limited stock methods in 2012, the category of methods they were assessed with, and the application of the Uncertainty Cap and Precautionary Buffer for each stock. Note that "NA" is used to denote when the cap/buffer does not apply to the method; "no" is used when the cap/buffer can apply to the method, but it was not applied based on the rules of the method (e.g. change <20%) and/or expert judgement (e.g. fishing effort in the target fishery has declined substantially, stock abundance has increased >50%); and "yes" denotes that he cap/buffer can apply to the method, and it was applied based on the rules of the method (e.g. change >20%) and/or expert judgement (e.g. exploitation rate is unknown).**

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| cod-kat | Cod in Division IIIa East (Kattegat) | North Sea | WGBFAS | 2.1.3 | NA | NA |
| whg-iris | Whiting in Division VIIa (Irish Sea) | Celtic Sea & West of Scotland | WGCSE | 2.1.3 | NA | NA |
| bsf-oth | Black scabbardfish (*Aphanopus carbo*) in other areas (Subareas I, II, IV, X, XIV, and Divisions IIIa and Va) | Wide | WGDEEP | 2.1.3 | NA | NA |
| ple-2123 | Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound) | Baltic Sea | WGNSSK | 3.1 | no | NA |
| ple-eche | Plaice in Division VIId (Eastern Channel) | North Sea | WGNSSK | 3.1 | yes | NA |
| ple-skag | Plaice in Subdivision 20 (Skagerrak) | North Sea | WGNSSK | 3.1.2 | no | NA |
| rjb-celt | Common skate (*Dipturus batis*) complex (flapper skate (*Dipturus* cf. *flossada*) and blue skate (*Dipturus* cf. *intermedia*)) in Subarea VI and Divisions VIIa–c, e–j | Celtic Sea & West of Scotland | WGEF | 3.1.4 | NA | NA |
| dgs-nea | Spurdog (*Squalus acanthias*) in the Northeast Atlantic | Wide | WGEF | 3.1.4 | NA | NA |
| guq-nea | Leafscale gulper shark (*Centrophorus squamosus*) in the Northeast Atlantic | Wide | WGEF | 3.1.4 | NA | NA |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| nep-25 | *Nephrops* in North Galicia (FU 25) | Bay of Biscay & Atlantic Iberian waters | WGHMM | 3.1.4 | NA | NA |
| nep-2627 | *Nephrops* in West Galicia and North Portugal (FUs 26–27) | Bay of Biscay & Atlantic Iberian waters | WGHMM | 3.1.4 | NA | NA |
| nep-31 | *Nephrops* in the Cantabrian Sea (FU 31) | Bay of Biscay & Atlantic Iberian waters | WGHMM | 3.1.4 | NA | NA |
| bll-2232 | Brill in Subdivisions 22–32 (Baltic Sea) | Baltic Sea | WGBFAS | 3.2 | yes | no |
| dab-2232 | Dab in Subdivisions 22–32 (Baltic Sea) | Baltic Sea | WGBFAS | 3.2 | yes | no |
| fle-2232 | Flounder in Subdivisions 22–32 (Baltic Sea) | Baltic Sea | WGBFAS | 3.2 | no | no |
| her-31 | Herring in Subdivision 31 (Bothnian Bay) | Baltic Sea | WGBFAS | 3.2 | yes | no |
| ple-2432 | Plaice in Subdivisions 24–32 (Baltic Sea) | Baltic Sea | WGBFAS | 3.2 | yes | no |
| tur-2232 | Turbot in Subdivisions 22–32 (Baltic Sea) | Baltic Sea | WGBFAS | 3.2 | no | yes |
| ang-ivvi | Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Division IIIa, and Subareas IV and VI | Celtic Sea & West of Scotland | WGCSE | 3.2 | no | no |
| had-iris | Haddock in Division VIIa (Irish Sea) | Celtic Sea & West of Scotland | WGCSE | 3.2 | no | no |
| meg-rock | Megrim (*Lepidorhombus* spp) in ICES Division VIb (Rockall) | Celtic Sea & West of Scotland | WGCSE | 3.2 | no | no |
| ple-celt | Plaice in Divisions VIIf,g (Celtic Sea) | Celtic Sea & West of Scotland | WGCSE | 3.2 | no | yes |
| ple-iris | Plaice in Division VIIa (Irish Sea) | Celtic Sea & West of Scotland | WGCSE | 3.2 | no | no |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| arg-oth | Greater silver smelt (*Argentina silus*) in Subareas I, II, IV, VI, VII, VIII, IX, X, XII, and XIV, and Divisions IIIa and Vb (other areas) | Wide | WGDEEP | 3.2 | no | yes |
| bsf-89 | Black scabbardfish (*Aphanopus carbo*) in Subareas VIII and IX | Wide | WGDEEP | 3.2 | no | no |
| bsf-nrtn | Black scabbardfish (*Aphanopus carbo*) in Subareas VI, VII, and Divisions Vb and XIIb | Wide | WGDEEP | 3.2 | no | no |
| gfb-comb | Greater forkbeard (*Phycis blennoides*) in the Northeast Atlantic | Wide | WGDEEP | 3.2 | no | yes |
| sbr-x | Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subarea X (Azores region) | Wide | WGDEEP | 3.2 | yes | yes |
| usk-oth | Tusk (*Brosme brosme*) in Divisions IIIa, Vb, VIa, and XIIb, and Subareas IV, VII, VIII, and IX (other areas) | Wide | WGDEEP | 3.2 | yes | no |
| usk-rock | Tusk (*Brosme brosme*) in Division VIb (Rockall) | Wide | WGDEEP | 3.2 | no | yes |
| lin-faro | Ling (*Molva molva*) in Division Vb | Wide | WGDEEP | 3.2[a] | no | yes |
| lin-oth | Ling (*Molva molva*) in Divisions IIIa and IVa, and in Subareas VI, VII, VIII, IX, XII, and XIV (other areas) | Wide | WGDEEP | 3.2[a] | no | yes |
| syc-bisc | Lesser-spotted dogfish (*Scyliorhinus canicula*) in Divisions VIIIa,b,d (Bay of Biscay) | Bay of Biscay & Atlantic Iberian waters | WGEF | 3.2 | yes | no |
| syc-8c9a | Lesser-spotted dogfish (*Scyliorhinus canicula*) in Divisions VIIIc and IXa (Atlantic Iberian waters) | Bay of Biscay & Atlantic Iberian waters | WGEF | 3.2 | no | no |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| rjc-bisc | Thornback ray (*Raja clavata*) in Subarea VIII (Bay of Biscay and Cantabrian Sea) | Bay of Biscay & Atlantic Iberian waters | WGEF | 3.2 | no | no |
| rjn-celt | Cuckoo ray (*Leucoraja naevus*) in Subarea VI and Divisions VIIa–c, e–j | Celtic Sea & West of Scotland | WGEF | 3.2 | yes | yes |
| syc-celt | Lesser-spotted dogfish (*Scyliorhinus canicula*) in Subarea VI and Divisions VIIa–c, e–j (Celtic Sea and west of Scotland) | Celtic Sea & West of Scotland | WGEF | 3.2.0 | yes | no |
| syc-347d | Lesser-spotted dogfish in the North Sea | North Sea | WGEF | 3.2 | yes | no |
| rjr-347d | Starry ray (*Amblyraja radiata*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel) | North Sea | WGEF | 3.2 | yes | yes |
| raj-mar | Rays and skates (mainly thornback ray) in ICES Subareas X, XII, and XIV (Azores and Mid-Atlantic Ridge) | Wide | WGEF | 3.2 | yes | yes |
| trk-nea | Smooth-hounds (*Mustelus* spp.) in the Northeast Atlantic | Wide | WGEF | 3.2 | yes | yes |
| rjn-bisc | Cuckoo ray (*Leucoraja naevus*) in Subarea VIII (Bay of Biscay and Cantabrian Sea) | Bay of Biscay & Atlantic Iberian waters | WGEF | 3.2[a] | no | no |
| rjm-7afg | Spotted ray (*Raja montagui*) in Divisions VIIa, f, g | Celtic Sea & West of Scotland | WGEF | 3.2[a] | yes | no |
| rjm-VI | Spotted ray (*Raja montagui*) in Subarea VI | Celtic Sea & West of Scotland | WGEF | 3.2[a] | no | yes |
| rjc-7afg | Thornback ray (*Raja clavata*) in Divisions VIIa, f, g | Celtic Sea & West of Scotland | WGEF | 3.2[a] | yes | no |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| rjc-VI | Thornback ray (*Raja clavata*) in Subarea VI | Celtic Sea & West of Scotland | WGEF | 3.2[a] | yes | no |
| rjn-347d | Cuckoo ray (*Leucoraja naevus*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel) | North Sea | WGEF | 3.2[a] | yes | no |
| rjm-347d | Spotted ray (*Raja montagui*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel) | North Sea | WGEF | 3.2[a] | yes | no |
| rjc-347de | Thornback ray (*Raja clavata*) in Subarea IV and in Divisions IIIa and VIId, e (North Sea, Skagerrak, Kattegat, and English Channel) | North Sea | WGEF | 3.2[a] | yes | no |
| nep-2324 | *Nephrops* in Division VIIIab (Bay of Biscay, FUs 23–24) | Bay of Biscay & Atlantic Iberian waters | WGHMM | 3.2 | no | yes |
| nep-2829 | *Nephrops* in Southwest and South Portugal (FUs 28–29) | Bay of Biscay & Atlantic Iberian waters | WGHMM | 3.2 | no | no |
| nep-30 | *Nephrops* in the Gulf of Cadiz (FU 30) | Bay of Biscay & Atlantic Iberian waters | WGHMM | 3.2 | yes | no |
| mgw-78 | Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIb–k and VIIIa,b,d | Celtic Sea & West of Scotland | WGHMM | 3.2 | yes | yes |
| ang-78ab | Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Divisions VIIb–k and VIIIa,b,d | Celtic Sea & West of Scotland | WGHMM | 3.2 | *L. pisc* no<br>*L. bud* yes | no |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| pan-sknd | Northern shrimp (*Pandalus borealis*) in Divisions IIIa and IVa East (Skagerrak and Norwegian Deep) | North Sea | WGNIPAG | 3.2 | yes | yes |
| arg-icel | Greater silver smelt (*Argentina silus*) in Division Va | Wide | WGDEEP | 3.3 | no | no |
| bli-5a14 | Blue ling (*Molva dypterygia*) in Division Va and Subarea XIV (Iceland and Reykjanes ridge) | Wide | WGDEEP | 3.3 | no | no |
| lin-icel | Ling (*Molva molva*) in Division Va | Wide | WGDEEP | 3.3 | no | no |
| boc-nea | Boarfish in the Northeast Atlantic | Wide | WGWIDE | 3.3 | no | no |
| pol-celt | Pollack in Subareas VI and VII (Celtic Sea and West of Scotland) | Celtic Sea & West of Scotland | WGNEW | 4.1.2 | no | NA |
| ple-7h-k | Plaice in Divisions VIIh–k (Southwest of Ireland) | Celtic Sea & West of Scotland | WGCSE | 4.1.3 | yes | yes |
| sol-7h-k | Sole in Divisions VIIh–k | Celtic Sea & West of Scotland | WGCSE | 4.1.3 | no | yes |
| nep-2021 | *Nephrops* in the FU 20–21 (Labadie, Baltimore, Jones and Cockburn) | Celtic Sea & West of Scotland | WGCSE | 4.1.4 | NA | no |
| nep-34 | *Nephrops* in Devil's Hole (FU 34) | North Sea | WGNSSK | 4.1.4 | NA | no |
| nep-10 | *Nephrops* in Noup (FU 10) | North Sea | WGNSSK | 4.1.4 | NA | yes |
| nep-32 | *Nephrops* in the Norwegian Deep (FU 32) | North Sea | WGNSSK | 4.1.4 | NA | no |
| nep-33 | *Nephrops* off Horn's Reef (FU 33) | North Sea | WGNSSK | 4.1.4 | NA | no |
| nep-5 | *Nephrops* in Botney Gut–Silver Pit (FU 5) | North Sea | WGNSSK | 4.1.4 | NA | no |
| spr-nsea | Sprat in Subarea IV (North Sea) | North Sea | HAWG | 5.2 | NA | no |
| spr-kask | Sprat in Division IIIa (Skagerrak–Kattegat) | North Sea | HAWG | 5.2 | NA | yes |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| bli-5b67 | Blue ling (*Molva dypterygia*) in Division Vb and Subareas VI and VII | Wide | WGDEEP | 5.2 | NA | no |
| lin-arct | Ling (*Molva molva*) in Subareas I and II | Wide | WGDEEP | 5.2 | NA | yes |
| rng-1012 | Roundnose grenadier (*Coryphaenoides rupestris*) on the Mid-Atlantic Ridge (Divisions Xb and XIIc, and Subdivisions Va$_1$, XIIa$_1$, and XIVb$_1$) | Wide | WGDEEP | 5.2 | NA | yes |
| usk-arct | Tusk (*Brosme brosme*) in Subareas I and II (Arctic) | Wide | WGDEEP | 5.2 | NA | yes |
| gag-nea | Tope (*Galeorhinus galeus*) in the Northeast Atlantic | Wide | WGEF | 5.2 | NA | yes |
| rjh-pore | Blonde ray (*Raja brachyuran*) in Division IXa (west of Galicia, Portugal, and Gulf of Cadiz) | Bay of Biscay & Atlantic Iberian waters | WGEF | 5.2[a] | NA | yes |
| rjn-pore | Cuckoo ray (*Leucoraja naevus*) in Division IXa (west of Galicia, Portugal, and Gulf of Cadiz) | Bay of Biscay & Atlantic Iberian waters | WGEF | 5.2[a] | NA | yes |
| raj-89a | Other skates and rays in Subarea VIII and Division IXa (Bay of Biscay and Atlantic Iberian waters) | Bay of Biscay & Atlantic Iberian waters | WGEF | 5.2[a] | NA | yes |
| rjm-pore | Spotted ray (*Raja montagui*) in Division IXa (west of Galicia, Portugal, and Gulf of Cadiz) | Bay of Biscay & Atlantic Iberian waters | WGEF | 5.2[a] | NA | yes |
| rjm-bisc | Spotted ray (*Raja montagui*) in Subarea VIII (Bay of Biscay and Cantabrian Sea) | Bay of Biscay & Atlantic Iberian waters | WGEF | 5.2[a] | NA | yes |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| rjc-pore | Thornback ray (*Raja clavata*) in Division IXa (west of Galicia, Portugal, and Gulf of Cadiz) | Bay of Biscay & Atlantic Iberian waters | WGEF | 5.2[a] | NA | yes |
| rjh-7afg | Blonde ray (*Raja brachyura*) in Divisions VIIa, f, g | Celtic Sea & West of Scotland | WGEF | 5.2[a] | NA | yes |
| rjh-VI | Blonde ray (*Raja brachyura*) in Subarea VI | Celtic Sea & West of Scotland | WGEF | 5.2[a] | NA | yes |
| rji-celt | Sandy ray (*Leucoraja circularis*) in the Celtic Sea ecoregion | Celtic Sea & West of Scotland | WGEF | 5.2[a] | NA | yes |
| rjf-celt | Shagreen ray (*Leucoraja fullonica*) in the Celtic Sea ecoregion | Celtic Sea & West of Scotland | WGEF | 5.2[a] | NA | yes |
| rjh-4c7de | Blonde ray (*Raja brachyuran*) in Divisions IVc and VIId, e (Southern North Sea and English Channel) | North Sea | WGEF | 5.2[a] | NA | yes |
| raj-347d | Other ray and skate species in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat and eastern English Channel) | North Sea | WGEF | 5.2[a] | NA | yes |
| ane-pore | Anchovy in Division IXa | Bay of Biscay & Atlantic Iberian waters | WGHANSA | 5.2 | NA | no |
| ple-89a | Plaice in Subarea VIII and Division IXa | Bay of Biscay & Atlantic Iberian waters | WGHMM | 5.2 | NA | yes |
| sol-8c9a | Sole in Divisions VIIIc and IXa | Bay of Biscay & Atlantic Iberian waters | WGHMM | 5.2 | NA | yes |
| whg-89a | Whiting in Subarea VIII and Division IXa | Bay of Biscay & Atlantic Iberian waters | WGHMM | 5.2 | NA | yes |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| pol-89a | Pollack (*Pollachius pollachius*) in Subarea VIII and Division IXa | Bay of Biscay & Atlantic Iberian waters | WGNEW | 5.2 | NA | yes |
| mut-347d | Striped red mullet in Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat) | North Sea | WGNEW | 5.2 | NA | no |
| bss-comb | European sea bass in the Northeast Atlantic | Wide | WGNEW | 5.2 | NA | yes |
| mut-west | Striped red mullet in Subarea VI, VIII and Divisions VIIa-c, e–k and IXa (Western area) | Wide | WGNEW | 5.2 | NA | yes |
| gug-347d | Grey gurnard in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak–Kattegat) | North Sea | WGNEW | 5.2[a] | NA | no |
| czs-comb | Red gurnard in the Northeast Atlantic | Wide | WGNEW | 5.2[a] | NA | yes |
| pol-nsea | Pollack in Subarea IV and Division IIIa | North Sea | WGNSSK | 5.2 | NA | yes |
| whg-kask | Whiting in Division IIIa (Skagerrak–Kattegat) | North Sea | WGNSSK | 5.2 | NA | yes |
| hom-nsea | Horse mackerel (*Trachurus trachurus*) in Divisions IIIa, IVb,c, and VIId (North Sea stock) | North Sea | WGWIDE | 5.2 | NA | yes |
| spr-celt | Sprat in Subarea VI and Divisions VIIa–c and f–k (Celtic Sea and West of Scotland) | Celtic Sea & West of Scotland | HAWG | 5.2 | NA | yes |
| spr-ech | Sprat in Divisions VIId,e | Celtic Sea & West of Scotland | HAWG | 5.2 | NA | yes |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| jaa-10 | Blue jack mackerel (*Trachurus picturatus*) in Subdivision Xa2 (Azores) | Bay of Biscay & Atlantic Iberian waters | WGHANSA | 5.2 | NA | no |
| bli-oth | Blue ling (*Molva dypterygia*) in Divisions IIIa and Iva, and Subareas I, II, VIII, IX, and XII | Wide | WGDEEP | 5.3 | NA | NA |
| rjb-89a | Common skate (*Dipturus batis*) complex (flapper skate (*Dipturus* cf. *flossada*) and blue skate (*Dipturus* cf. *intermedia*)) in Subarea VIII and Division IXa (Bay of Biscay and Atlantic Iberian waters) | Bay of Biscay & Atlantic Iberian waters | WGEF | 5.3 | NA | NA |
| agn-nea | Angel shark (*Squatina squatina*) in the Northeast Atlantic | Wide | WGEF | 5.3 | NA | NA |
| bsk-nea | Basking shark (*Cetorhinus maximus*) in the Northeast Atlantic | Wide | WGEF | 5.3 | NA | NA |
| sck-nea | Kitefin shark (*Dalatias licha*) in the Northeast Atlantic | Wide | WGEF | 5.3 | NA | NA |
| por-nea | Porbeagle (*Lamna nasus*) in the Northeast Atlantic | Wide | WGEF | 5.3 | NA | NA |
| pan-flad | Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground) | North Sea | WGNIPAG | 5.3 | NA | NA |
| cod-rock | Cod in Division VIb (Rockall) | Celtic Sea & West of Scotland | WGCSE | 6.2 | NA | yes |
| ple-7b-c | Plaice in Divisions VIIb,c (West of Ireland) | Celtic Sea & West of Scotland | WGCSE | 6.2 | NA | yes |
| san-scow | Sandeel in Division Via | Celtic Sea & West of Scotland | WGCSE | 6.2 | NA | no |
| sol-7b-c | Sole in Divisions VIIb,c (West of Ireland) | Celtic Sea & West of Scotland | WGCSE | 6.2 | NA | yes |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| whg-rock | Whiting in Division VIb (Rockall) | Celtic Sea & West of Scotland | WGCSE | 6.2 | NA | yes |
| alf-comb | Alfonsinos/Golden eye perch (*Beryx* spp.) in the Northeast Atlantic | Wide | WGDEEP | 6.2 | NA | yes |
| rng-oth | Roundnose grenadier (*Coryphaenoides rupestris*) in all other areas (Subareas I, II, IV, VIII, and IX, Division XIVa and Subdivisions Va2 and XIVb2) | Wide | WGDEEP | 6.2 | NA | no |
| sbr-ix | Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subarea IX | Wide | WGDEEP | 6.2 | NA | yes |
| raj-ech | Small-eyed ray (*Raja microocellata*) in Divisions VIId,e (English Channel) | North Sea | WGEF | 6.2[a] | NA | yes |
| gug-celt | Grey gurnard in Subarea VI and Divisions VIIa–c and e–k (Celtic Sea and West of Scotland) | Celtic Sea & West of Scotland | WGNEW | 6.2 | NA | yes |
| gug-89a | Grey gurnard in Subarea VIII and Division IXa | Bay of Biscay & Atlantic Iberian waters | WGNEW | 6.2[a] | NA | yes |
| sbr-678 | Red (=blackspot) sea bream (*Pagellus bogaraveo*) in Subareas VI, VII and VIII | Wide | WGDEEP | 6.3 | NA | NA |
| ory-comb | Orange roughy (*Hoplostethus atlanticus*) in the Northeast Atlantic | Wide | WGDEEP | 6.3 | NA | NA |
| rng-kask | Roundnose grenadier (*Coryphaenoides rupestris*) in Division IIIa | Wide | WGDEEP | 6.3 | NA | NA |
| usk-mar | Tusk (*Brosme brosme*) in Subarea XII, excluding Division XIIb (Mid-Atlantic Ridge) | Wide | WGDEEP | 6.3 | NA | NA |

| Stock code | Stock name | EcoRegion | Expert Group | 2012 DLS Category | Uncertainty Cap | Precautionary Buffer |
|---|---|---|---|---|---|---|
| raj-celt | Other ray and skate species in Subarea VI and Divisions VIIa–c, e–j | Celtic Sea & West of Scotland | WGEF | 6.3 | NA | NA |
| rju-7j | Undulate ray (*Raja undulata*) in Division VIIj | Celtic Sea & West of Scotland | WGEF | 6.3 | NA | NA |
| rjb-347d | Common skate (*Dipturus batis*) complex (*Dipturus* cf. *flossada* and *Dipturus* cf. *intermedia*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat and eastern English Channel) | North Sea | WGEF | 6.3 | NA | NA |
| rju-ech | Undulate ray (*Raja undulata*) in Divisions VIId, e (English Channel) | North Sea | WGEF | 6.3 | NA | NA |
| cyo-nea | Portuguese dogfish (*Centroscymnus coelolepis*) in the Northeast Atlantic | Wide | WGEF | 6.3 | NA | NA |
| nop-scow | Norway pout in Division Via | Celtic Sea & West of Scotland | WGNSSK | 6.3 | NA | NA |

[a] **Qualitative advice based on the ICES data-limited stock approach.**