

## 1.2 Advice basis

### 1.2.1 General context of ICES advice

ICES advises competent authorities on marine policy and management issues related to the impacts of human activities on marine ecosystems and the sustainable use of living marine resources.

An important part of ICES advice regards *the management of the exploitation of living marine resources*. The context for this part of ICES advice is set by several international agreements and policies:

- United Nations Convention on the Law of the Sea (UN, 1982 (known as UNCLOS)), which includes a call for a maximum sustainable yield (MSY) approach to managing fisheries;
- United Nations Conference on Environment and Development (UN, 1992a (known as UNCED)), including Chapter 17 of Agenda 21 which highlights a precautionary approach;
- United Nations Straddling Fish Stocks Agreement of 1995 (UN, 1995 (known as the UN Fish Stocks Agreement or UNFSA)) and the FAO Code of Conduct for Responsible Fisheries (FAO, 1995), both of which call for a precautionary approach;
- Convention on Biological Diversity (UN, 1992b (known as CBD)), which calls for conservation of biological diversity through an ecosystem approach;
- Johannesburg Declaration of the World Summit on Sustainable Development (UN, 2002 (known as WSSD)), which calls for an ecosystem approach and rebuilding fisheries to maximum sustainable yield.

In addition, ICES advice responds to the policy and legal needs of ICES Member Countries and multinational and intergovernmental organizations that use the advice as the scientific basis to manage human activities that affect, and are affected by, marine ecosystems. Some applicable policy and legal instruments are:

- The Common Fisheries Policy of the European Union (EU, 2013).
- The Marine Strategy Framework Directive (EC, 2008).
- Norwegian Marine Resources Act (Lovdata, 2008 (Lov om forvaltning av vilt levende marine ressursar)).
- Russian Federal Law on Fisheries and conservation of biological resources in the waters. N 166-P3 20/12/2004 (Anon., 2004).
- Icelandic Fisheries Management Act (No. 38, 15 May 1990) (Anon., 1990).
- The Act on the Management of Marine Resources. (Anon., 2017).

### 1.2.2 Advisory products and ICES advisory process

The advisory products provided by ICES can be classified in two categories:

- **Advice** which is adopted by ICES Advisory Committee (ACOM); and
- **Services** provided by the ACOM Leadership and/or the Secretariat under the oversight of ACOM.

#### Advice:

The majority of the advice is provided in response to standing requests (recurring advice) from ICES Clients (the European Commission, the North Atlantic Salmon Conservation Organization (NASCO), the North East Atlantic Fisheries Commission (NEAFC) and Norway). In addition to the recurring advice ICES also provides advice in response to special requests from the Commissions mentioned above and from the Helsinki Commission (HELCOM), the OSPAR Commission (OSPAR) and ICES Member Countries.

ICES aims at producing advice based on the best available science that is characterized by quality assurance, developed in a transparent process, unbiased, independent, and is recognized by all parties as being relevant to management.

The advisory process is illustrated in Figure 1.2.1. The scientific basis for the advice is developed by expert groups. An advice drafting group prepares the advice based on the findings of the expert groups. The advice prepared by the advice drafting group is finalized and adopted by ICES Advisory Committee (ACOM).

In accordance with ICES quality policy, ICES operates a peer-review system. The scientific basis for responses to non-recurring requests for advice is subject to a peer-review process, before or in conjunction with the advice drafting group. For recurring advice on fishing opportunities ICES has implemented a benchmark process in which the methods, including the dataseries to be used by the Expert Groups in addressing the requests, are developed. The results from the benchmarks are subjected to a peer-review process similar to the process for non-recurring requests.

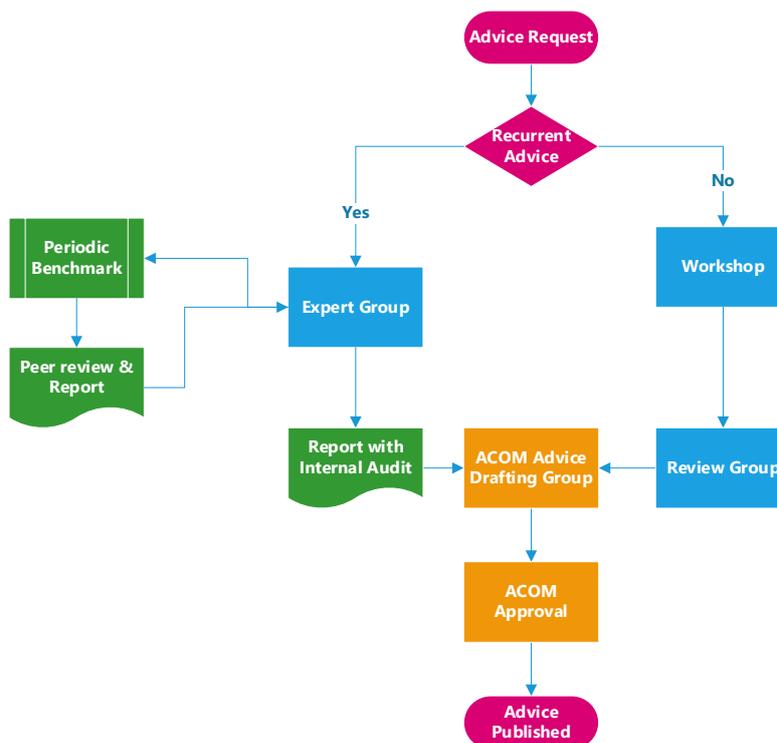


Figure 1.2.1 Overview of the ICES advisory process for recurrent advice.

The benchmarking groups, advice drafting groups, and the final ACOM approval of the advice are open to stakeholders who have observer status within ICES. ICES clients can attend the entire advisory process as an observer.

**Services:**

A Service is the provision of scientific information or a process that produces scientific information asked for by policy-makers. The service may include recommendations made by individual or groups of scientists, but it does not include a recommendation on behalf of ICES (except to reiterate a recommendation previously agreed by ACOM).

While Services are not ICES approved advice, they share the same characteristics of quality assurance and developed in a transparent process that is unbiased and politically neutral.

These Services fall into four categories:

1. **Technical Services:** This service is the provision of factual information with no or minimal interpretation, e.g. provision of data and research results.
2. **Clarification of Advice:** This service helps users understand advice previously provided by ICES.

3. **Process Services:** This service facilitates delivery of, e.g. a report of best scientific understanding of an issue, in cases where ICES is not requested to offer advice but is asked to provide scientific integrity to a process.
4. **Review Services:** This service covers peer review of scientific activity (including research proposals, survey or sampling designs, or research results conducted outside ICES). In provision of the service, ICES is responsible for selecting qualified experts without a vested interest to provide reviews. The review will be produced by the reviewers, and ICES does not comment or interpret the reviews.

### 1.2.3 Ecosystem and precautionary approaches

ICES considers ecosystem-based management (EBM) as the primary way of managing human activities affecting marine ecosystems with ecosystem-based fisheries management (EBFM) specifically addressing the fishing sector. These approaches have been defined in various ways but mainly emphasize a management regime that maintains the health of the ecosystem while allowing appropriate human uses of the environment for the benefit of current and future generations.

EBM is expected to contribute to achieve long-term sustainability of the use of marine resources, including the fisheries sector, and serves multiple objectives, involves strong stakeholder participation, and focuses on human behaviour as the central management dimension. A more detailed description of ICES approach to ecosystem-based management can be found at ICES website (<http://www.ices.dk/explore-us/Documents/ICES%20and%20EBM.pdf>).

### 1.2.4 ICES advice on topics other than fishing opportunities

ICES has developed a comprehensive framework including a set of advice rules to be applied when addressing requests for advice on fishing opportunities (see Section 1.2.5 below). The requests for advice on other topics than fishing opportunities cover a very wide range of subjects and ICES is in the process of developing frameworks for advice provided in response to these requests. In the meantime, ICES aims at ensuring that any advice on these topics is making use of the best available scientific information while taking into account the ecosystem approach as well as applying the precautionary approach.

To address requests for advice ICES is dependent on the clients having clearly defined the question(s) to be addressed along with the objectives and criteria to be considered so that the advice is appropriately developed. An important element of the advisory process is therefore the dialogue with the clients to achieve a common understanding on how to interpret the requests, the type of advice the clients expect, and what ICES can deliver.

### 1.2.5 ICES advice on fishing opportunities

The ICES approach to advice on fishing opportunities integrates ecosystem-based management with the objective of achieving maximum sustainable yield (MSY). The aim is, in accordance with the aggregate of international guidelines, to inform policies for high long-term yields while maintaining productive fish stocks within healthy marine ecosystems.

Annex 2 of the UN Fish Stocks Agreement (UN, 1995) contains guidelines for applying a precautionary approach within an MSY framework. In accordance with a precautionary approach, populations need to be maintained within safe biological limits to make MSY possible. However, within safe biological limits, an MSY approach is necessary to achieve MSY. A precautionary approach is a necessary, but not a sufficient condition for MSY.

Maximum sustainable yield is a broad conceptual objective, aimed at achieving the highest yield over the long term. It is non-specific with respect to: (a) the biological unit to which it is applied; (b) the models used to provide scientific advice; (c) the definition of yields; and (d) the management methods used to achieve MSY. The MSY concept can be applied to an entire ecosystem, a fish community, or a single stock. ICES applies the MSY concept to single stocks as well as to groups of stocks in the context mixed fisheries, where stocks are caught together in a fishery. ICES interpretation of MSY is maximizing the average long-term yield from a given stock while maintaining productive fish stocks within healthy marine ecosystems.

In relation to MSY, ICES defines yield to be maximised as the wanted part of the catch measured in weight, i.e. the part of the catch that is landed and above any agreed minimum conservation/reference size.

Many of the models (mathematical and conceptual) used to estimate MSY and associated parameters typically assume that factors not explicitly included in the models remain constant or vary around a historical long-term mean. However, marine ecosystems are dynamic and fish stocks will change not only in response to the fisheries, but also to changes in fishing patterns and fishing pressures on their prey or their predators as well as climate changes. ICES therefore considers MSY reference points to be valid only in the medium term and to be subject to regular reviews.

To support the stock by stock management system, ICES provides advice on fishing opportunities and stock status for individual stocks. In addition to the single stock advice, ICES also provide mixed fisheries considerations, fisheries and ecosystem overviews, which encapsulate the technical and biological interactions between stocks at an ecoregion scale.

The advice rule applied by ICES in developing the advice on fishing possibilities depends on management strategies agreed by relevant management bodies and the information and knowledge available for the concerned stocks.

If the relevant management authorities have agreed on a management plan or strategy and the plan/strategy has been evaluated by ICES to be consistent with the precautionary approach, ICES will provide advice in accordance with the plan/strategy.

If no management plan/strategy has been agreed by all relevant management parties or the agreed plan/strategy has been evaluated by ICES not to be consistent with the precautionary approach, ICES will provide advice applying the ICES MSY advice rule if possible or the precautionary approach if the information on the stocks is insufficient to support the MSY rule.

ICES MSY advice rule requires a relative high level of data and knowledge on the dynamics of the stocks concerned. If the data and knowledge requirements are not fulfilled ICES cannot provide advice consistent with MSY; instead ICES applies an advice rule that is only based on precautionary considerations.

For the purposes of identifying the advice rule to be applied when giving advice on fishing possibilities, ICES classifies the stocks into six main categories on the basis of available knowledge.

**Category 1** – *stocks with quantitative assessments*. Includes the 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*. Includes stocks with quantitative assessments and forecasts which for a variety of reasons are considered indicative of trends in fishing mortality, recruitment, and biomass.

**Category 3** – *stocks for which survey-based assessments indicate trends*. Includes stocks for which survey or other indices are available that provide reliable indications of trends in stock metrics, such as total mortality, recruitment, and biomass.

**Category 4** – *stocks for which only reliable catch data are available*. Includes stocks for which a time-series of catch can be used to approximate MSY.

**Category 5** – *landings only stocks*. Includes stocks for which only landings data are available.

**Category 6** – *negligible landings stocks and stocks caught in minor amounts as bycatch*. Includes stocks where landings are negligible in comparison to discards and stocks that are primarily caught as bycatch species in other targeted fisheries.

For category 1 and 2 stocks ICES provides advice in accordance with agreed management plans/strategies evaluated to be consistent with the precautionary approach. If such plans/strategies are not agreed or have been evaluated by ICES not to be precautionary, ICES will give advice on the basis of the ICES MSY approach.

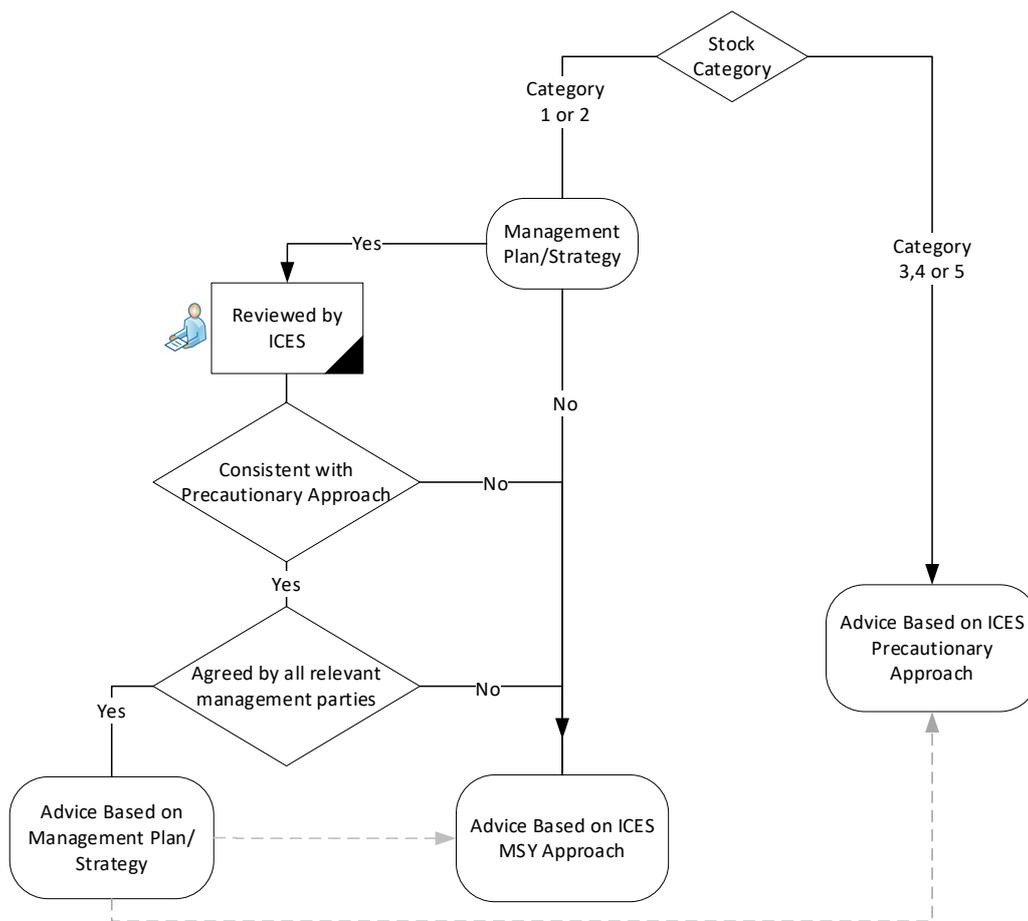


Figure 1.2.2 Flow diagram showing the basis of the ICES advice. The grey broken lines indicate that sometimes the advice in management plans is consistent with the ICES MSY approach or the Precautionary Approach.

For category 3–6 stocks, the available knowledge is insufficient to apply the ICES MSY approach and the advice rule is therefore based on the precautionary approach. However, ICES has developed an approach to determine proxies for MSY reference points for some stocks in categories 3 and 4. Based on these proxies, ICES will assess the state of the stocks and their exploitation relative to MSY criteria.

Limitations on fisheries may be required to achieve environmental objectives, especially regarding biodiversity, habitat integrity, and foodwebs. This will not affect the catch that can be taken from a stock in accordance with the objectives of MSY and the precautionary approach and will therefore not affect ICES advice on fishing possibilities. However, the limitations may affect the possibilities for the fisheries to fully utilize the advised fishing possibilities. ICES may, if requested, advise on the likely impact of such limitations on the catch but will, as explained, not include such considerations in the advice on fishing opportunities.

Most of the fish and shellfish stocks fished in ICES areas are subject to discard bans or landing obligations. This means that catches may be split into three categories, reported landings at or above minimum conservation/catching size, reported landings below minimum size (BMS), and discards. . The discards may be split in dead discards and live discards on the basis of information on survival rates. ICES discard estimates are normally based on data from observer schemes and may include discards, which in accordance to the landing obligations/discard bans should be landed.

If the current fishing pattern and the discarding practices are likely to remain unchanged in the forecast period, ICES may split the advised catch and other catch scenarios into the three categories above (four if a fraction of discards is assumed to survive).

If the fishing pattern and ratio between landings and discards may change in the forecast period for example because of change in compliance of the landing obligation/discard ban, ICES will not distinguish between landings below minimum

conservation/catching size and discards in the catch scenarios but add the two components into one: unwanted catch. The landing above minimum conservation/catching size may, in these cases, be termed wanted catch as illustrated in Figure 1.2.3.



Figure 1.2.3 Catch categories used by ICES in stock assessments and forecasts. For explanation see text above.

### 1.2.5.1 ICES MSY advice rule

Fisheries directly affect fish stocks through catches. The fishing mortality (F) is a measure for fishing pressure, it is a rate derived from the proportion in numbers of fish in a year class taken by fisheries during one year. The fishing mortality referred to in ICES advice is estimated as the average overages that dominate in the catches. For some stocks, such as Icelandic cod, saithe and most *Nephrops* stocks, ICES uses harvest rates (HR) instead of fishing mortality. The harvest rate is defined as the fraction of a reference biomass or abundance that is caught by the fishery during a year.

The production in a fish stock can be highly variable. It is related to recruitment, stock size (often expressed as spawning-stock biomass, SSB) and the size structure in the stock, which in turn depend also on the fishing mortality and fishing pattern.

Surplus production of a stock is the catch that can be harvested without changing the average production in the long term. For a given fishing pattern there is a level of fishing mortality that in the long term will generate the highest surplus production. This peak of the surplus production (above minimum conservation/reference size) is the MSY, and the fishing mortality generating this peak is  $F_{MSY}$ .

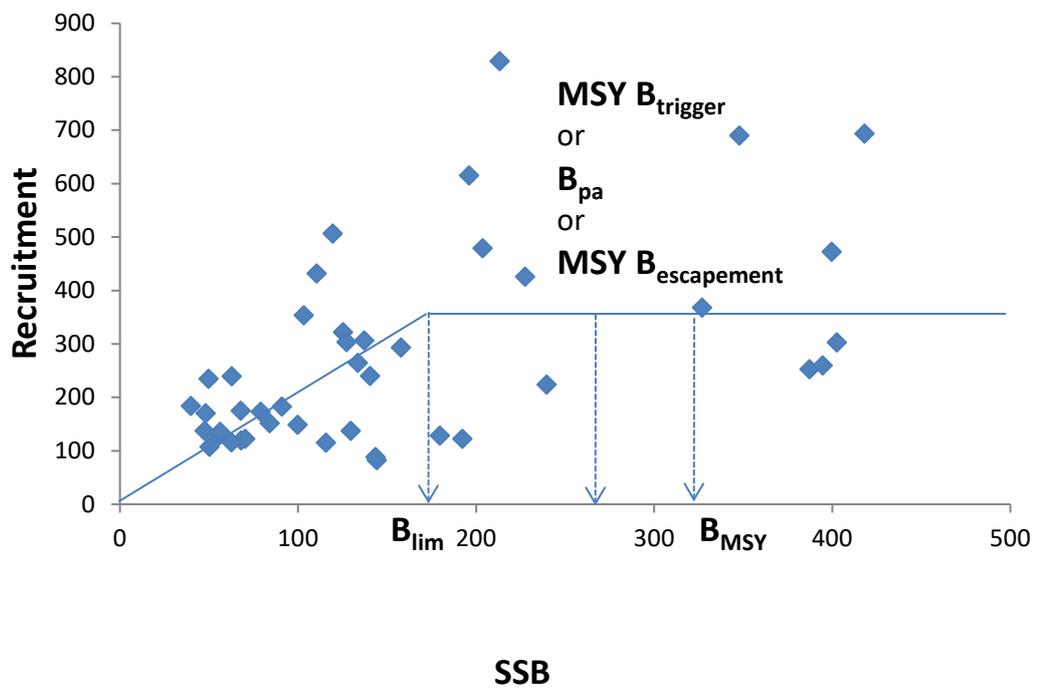
Fishing mortality is the only variable that can be directly controlled by fisheries management. Fisheries management cannot directly control the stock size, it can only influence it through the fishing mortality. Stock size is also subject to natural variability that on a year-to-year basis can overwhelm the influence of fishing. MSY is a long-term average. A management strategy that harvests variable yields in response to the natural variability in stock size will, on average, give yields closer to the long-term MSY than a strategy operating with the maximum constant yield that could be taken sustainably.

Due to the variability in stock size there may be situations where the spawning-stock is so low that reproduction is at significant risk of being impaired. A precautionary approach implies that fisheries management in such situations should be more cautious. For stocks where quantitative information is available, a reference point  $B_{lim}$  may be identified as the stock size below which there is a high risk of reduced recruitment. A precautionary safety margin incorporating the uncertainty in ICES stock estimates leads to a precautionary reference point  $B_{pa}$ , which is a biomass reference point designed to have a low probability of being below  $B_{lim}$ . When the spawning-stock size is estimated to be above  $B_{pa}$ , the probability of impaired recruitment is expected to be low.

For short-lived species, for which the recruitment is highly variable, the biomass can fluctuate wildly between years. A precautionary approach in this situation implies that a minimum stock size,  $B_{escapement}$ , should remain in the sea every year after fishing to ensure future recruitment.

$F_{lim}$  is the fishing mortality which in the long term will result in an average stock size at  $B_{lim}$ . Fishing at levels above  $F_{lim}$  will result in a decline in the stock to levels below  $B_{lim}$ . Again, to account for the uncertainty in the assessment, ICES applies a precautionary buffer  $F_{pa}$  to avoid that *true* fishing mortality is above  $F_{lim}$ .

### Biomass Reference Points



**Figure 1.2.2** Illustration of biomass-based biological reference points.  $B_{lim}$  and  $B_{pa}$  are precautionary reference points related to the risk of impaired reproductive capacity, while  $MSY B_{escapement}$  (often equal to  $B_{pa}$ ) is used in the advice framework for short-lived species.  $MSY B_{trigger}$  is the parameter in the ICES MSY framework which triggers advice on a reduced fishing mortality relative to  $F_{MSY}$ .  $B_{MSY}$  is the expected average biomass if the stock is exploited at  $F_{MSY}$ . Diamonds show the variable recruitment versus SSB that have been observed over the years. Recruitment can be seen to be generally lower when SSB is below  $B_{lim}$ .

Some fish eat other fish, which means growth for the predator and mortality for the prey; fish populations also compete for food or habitat. This means that the size and productivity of a fish stock may depend on the state of other stocks as well as on its own abundance. It also means that as a population of fish increases one cannot expect that growth and mortality for that species remains constant as there will be increasing competition for food and habitat within that population.

ICES incorporates such species interaction considerations into the single-species framework in the Baltic, the Barents Sea, and the North Sea, by applying natural mortality and growth rates derived from models of species interactions, using size, age, and stomach data for several species. ICES routinely incorporates short-term changes in growth and maturation in short-term projections to account for competition and food supply. ICES also expects to update MSY reference points (typically as part of the benchmark process) to ensure they reflect current dynamics.

#### 1.2.5.2 Long-lived category 1 and 2 stocks

For long-lived category 1 and 2 stocks, ICES bases its MSY approach on attaining a fishing mortality rate of no more than  $F_{MSY}$  while maintaining the stock above  $B_{lim}$  with at least 95% probability.

In this approach, ICES uses the fishing mortality and biomass reference points  $F_{MSY}$  and  $MSY B_{trigger}$ .  $F_{MSY}$  is estimated as the fishing mortality with a given fishing pattern and current environmental conditions that gives the long-term maximum yield. To ensure that fishing at  $F_{MSY}$  is sustainable,  $F_{MSY}$  is not allowed to be above  $F_{pa}$ . This is appropriate since a precautionary approach is a necessary boundary to ensure sustainability, even though it is in itself not a sufficient condition for achieving the maximum sustainable yield implied by the MSY framework.

$MSY B_{trigger}$  is considered the lower bound of spawning–stock biomass fluctuation when fished at  $F_{MSY}$  and is used in ICES advice rule to trigger a cautious response. The cautious response, in cases where the spawning–stock falls below  $MSY B_{trigger}$ , is to reduce fishing mortality to allow a stock to rebuild to levels capable of producing MSY. The reduction in fishing mortality is proportional to the ratio between the size of the spawning–stock and  $MSY B_{trigger}$ .

The advice rule leads to catch advice corresponding to a fishing mortality of:

1.  $F = F_{MSY}$  when the spawning–stock biomass is at or above  $MSY B_{trigger}$ ; and
2.  $F = F_{MSY} \times \text{spawning–stock biomass} / MSY B_{trigger}$  when the stock is below  $MSY B_{trigger}$  and above  $B_{lim}$ ;
3. If the  $F$  following from applying rule 2 is insufficient to bring the stock above  $B_{lim}$  in the short term ICES advice will be based on bringing the stock above  $B_{lim}$  in the short term. This may result in advice of zero catch.

Conceptually, spawning–stock biomass in the advice rule is the estimated spawning–stock size at the beginning of the year to which the advice applies (advice year) or at spawning time, the year before the advice year. For example, for an assessment performed in 2018 using data through 2017, the reference spawning–stock size will for most stocks be the projected size at the beginning of 2019.

The approach does not use a  $B_{MSY}$  estimate.  $B_{MSY}$  is a notional value around which stock size fluctuates when fishing at  $F_{MSY}$ .  $B_{MSY}$  strongly depends on the interactions between the fish stock and the environment it lives in, including biological interactions between different species. Historical stock size trends may not be informative about  $B_{MSY}$  (e.g. when  $F$  has exceeded  $F_{MSY}$  for many years or when current ecosystem conditions and spatial stock structure are, or could be, substantially different from those in the past).

Determination of  $MSY B_{trigger}$  requires contemporary data with fishing at  $F_{MSY}$  to identify the normal range of fluctuations in biomass when stocks are fished at this fishing mortality rate. If the observation on fluctuation in biomass is insufficient to estimate  $MSY B_{trigger}$ , the reference point is normally set at  $B_{pa}$  (when this reference point is available) When sufficient observations of SSB fluctuations associated with fishing around  $F_{MSY}$  are available, the  $MSY B_{trigger}$  should be re-estimated to correspond to the lower bound of the range of stock sizes associated with MSY.

ICES has, on request from the EU, provided advice on plausible values around  $F_{MSY}$  (range for  $F_{MSY}$ ) for a number of stocks in the Baltic Sea, North Sea and Western EU waters. The  $F_{MSY}$  ranges [ $F_{lower}$ ,  $F_{upper}$ ] provided are derived to deliver no more than a 5% reduction in long-term yield compared with the maximum sustainable yield (MSY). To be consistent with the ICES precautionary approach,  $F_{upper}$  is capped, so that the probability of  $SSB < B_{lim}$  is no more than 5% in any single year.

Most fisheries catch a mixture of species and it is not entirely possible to control which species and how much of each is caught. For stocks exploited by mixed-species fisheries, it may not be possible to achieve the single-stock MSY catch advice for all the stocks simultaneously. Either the advised catches for some stocks will be exceeded in trying to catch the TACs of other stocks, or the TACs for some stocks will not be caught in order to prevent overshooting the TACs of other stocks. ICES has developed a mixed-species fisheries model to address this; for the main demersal stocks in the North Sea, Bay of Biscay and the Celtic Sea ICES provides information on catch composition of different fisheries strategies to illustrate the trade-offs between the strategies.

### 1.2.5.3 Short-lived category 1 and 2 stocks

The future size of a stock of short-lived species is very sensitive to recruitment because of the few age groups in the natural population. Incoming recruitment is often the main or only component of the fishable stock. Therefore, care must be given to ensure that the spawning–stock size is above levels where recruitment is impaired as the future of the stock is highly dependent on annual recruitment.

For most stocks of short-lived species, similar to the long-lived ones, the ICES MSY approach is aimed at providing MSY will ensure that the probability of the stock being below  $B_{lim}$  in any single year is no more than 5%. To do this ICES uses two reference points,  $MSY_{B_{escapement}}$  (see Figure 1.2.2) and  $F_{cap}$ .  $MSY_{B_{escapement}}$  is estimated each year to be robust against low SSB and includes a biomass buffer to account for uncertainty in the assessment and catch advice.  $F_{cap}$  is defined to limit exploitation rates when biomass is high. A large stock is usually estimated with greater uncertainty, i.e. when the catch is taken, the uncertainty in the escapement biomass is greater. By capping the  $F$ , the escapement biomass is increased in proportion to stock size, maintaining a high probability of achieving the minimum amount of biomass left to spawn.

The advised yearly catches correspond to the estimated stock biomass in excess of the  $MSY_{B_{escapement}}$ , but constrained to allow a fishing mortality that is no higher than  $F_{cap}$ .

For some short-lived species, assessments are so sensitive to incoming recruitment that the amount of biomass in excess of the target escapement cannot be reliably estimated until data on the incoming year class are available. For most of the stocks concerned, such data are obtained just before the fishery starts (or during the fishing year). Therefore, the advice on fishing opportunities may be given just prior to the start of the fishing season or after the fisheries has started.

#### 1.2.5.4 Category 3–6 stocks

A substantial part of the stocks for which ICES provides advice do not have population estimates from which catch options can be derived using the MSY framework. ICES has therefore developed a precautionary framework for quantitative advice regarding such stocks.

The overall aim of the approach for these stocks is to ensure that the advised catch is sustainable. The underlying principles of the approach are that (a) all the available information should be used, and (b) 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 there is limited knowledge of the stock status. The margin of risk tolerance is a management prerogative, but in the absence of any proposal by managers ICES applies the values given below.

In order to apply a precautionary approach for categories 3–6 the framework for these stocks includes the following considerations regarding uncertainty and precaution which have been applied in sequence:

1. As the methodologies used to estimate stock status, trends, and forecasts, due to the limited data or knowledge about their biology, are expected to be more susceptible to noise than methods used to produce forecasts for category 1–2 stocks, a change limit of  $\pm 20\%$  (uncertainty cap) 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.
2. A principle of an increasing precautionary margin with decreasing knowledge about the stock status has been applied:
  - The reference points for exploitation used have, when proxies could be identified, been selected on the lower margins of  $F_{MSY}$  – either at the lower range of an interval, as  $F_{0.1}$ , or similar.
  - A precautionary margin of  $-20\%$  (precautionary buffer) has been applied for those cases when it is likely that  $F > F_{MSY}$  or when the stock status relative to candidate reference points for stock size or exploitation is unknown. Exceptions to this latter 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 significantly or exploitation has reduced – for instance, based on survey indices or a reduction in fishing effort in the main fishery if the stock is taken as a bycatch species. Applying or not the pa buffer has to be re-considered every 3 years.

The advice is applicable to a time-frame which is compatible with a measurable response in the metrics used as the basis for the advice. Where the least amount of 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, two years, unless important new knowledge emerges regarding a stock which may justify a revision of the advice.

The advice rule used to provide quantitative advice on fishing possibilities depends on the available information, and ICES has developed separate advice rules for each of the stock categories listed in Section 1.2.5.1.

*Category 3. Stocks for which survey-based assessments indicate trends.* The advice on fishing opportunities for the coming year(s), is based on the recent advised catch (or landings) adjusted to the change in the stock size index for the two most recent values relative to the three preceding values. Other reference years may be used, based on the knowledge of the biology of the stock (e.g. species with a relatively large longevity) or the quality of the data.

*Category 4. Stocks for which reliable catch data are available.* The approach is to use catch information to evaluate whether the stock is fished sustainably or whether a reduction in catch is required to achieve sustainability. Decreases or increases in catch are incremental and slow.

*Categories 5 and 6. Landings only stocks or negligible landings stocks and stocks caught in minor amounts as bycatch.* In situations where only landings data are available, and no relevant life-history or fishery information can be gleaned from similar stocks or species in the ecoregion or beyond, ICES will normally provide advice on the basis of recent catches/landings, applying the precautionary buffer. If catches have declined significantly over a period of time and this could represent a reduction in stock size, ICES may advise zero catch or the implementation of a management strategy.

ICES provides a framework for stock status classification relative to maximum sustainable yield (MSY) proxies for stocks in categories 3 and 4.

A stock is classified on the basis of two MSY proxy indicators: one for exploitation and a second for biomass. Whenever possible, the indicators are designated either green (exploitation is at or below the  $F_{MSY}$  proxy, biomass is at or above the  $MSY_{B_{trigger}}$  proxy) or red (exploitation is above the  $F_{MSY}$  proxy, biomass is below the  $MSY_{B_{trigger}}$  proxy). When no determination can be made they are designated unknown.

Given the uncertainties in data and knowledge for stocks in these categories, ICES is not currently using these methods to provide quantitative estimates of the distance of  $F$  from  $F_{MSY}$  or  $B$  from  $MSY_{B_{trigger}}$ . Whereas the classification of stocks is the best available at this time, revisions may occur as more information becomes available for these stocks and the methods and knowledge are further developed. The framework is expected to evolve over time, as the methods are further developed and validated.

**1.2.5.5 ICES approach to classify exploitation and stock status**

ICES uses pictograms to represent the status of the stocks and their exploitation relative to management objectives as defined by ICES MSY and precautionary approach reference points, and to agreed management strategies where they exist. When reference points are missing, ICES presents a qualitative evaluation if the available information is sufficient to conduct such an evaluation. The structure and the associated symbols and text are given below in Tables 1.2.1 to 1.2.3 for MSY and precautionary approaches:

**Table 1.2.1** Pictograms used by ICES to represent the evaluation of the stock status.

Status relative to reference points	Qualitative evaluation	Description
		Desirable situation, e.g. fishing pressure is below the relevant reference point or stock size is above the relevant reference point.
		Status lies between the precautionary (PA) and limit (lim) reference points.
		Undesirable situation, e.g. fishing pressure is above the relevant reference point or stock size is below the relevant reference point.
		Status of the stock is either <b>Unknown</b> when neither quantitative assessment nor proxy calculation exist, or <b>Undefined</b> when there is an analytical assessment but reference points are undefined.
		Absolute level unknown, but increasing.
		Absolute level unknown, but unchanged.
		Absolute level unknown, but decreasing.

**Table 1.2.2** Fishing pressure (F,  $F_{proxy}$ ,  $F_{MSY}$ , or harvest rate).

Fishing pressure	Explanation	Sign	Text
MSY reference ( $F_{MSY}$ , $F_{MSY_{proxy}}$ )	$F \leq F_{MSY}$	✔	At (if $F = F_{MSY}$ ) Below (if $F < F_{MSY}$ )
	$F \ll F_{MSY}$ ( $F \sim 0$ ), $F \ll F_{MSY_{proxy}}^1$	✔	Below / Below proxy
	$F > F_{MSY}$ , $F > F_{MSY_{proxy}}^1$	✘	Above / Above proxy
	No reference point	?	Undefined
	Stock status unknown	?	Unknown
Precautionary approach ( $F_{PA}$ , $F_{lim}$ )	$F \leq F_{PA}$	✔	Harvested sustainably
	$F_{lim} > F > F_{PA}$	⦿	Increased risk
	$F \geq F_{lim}$	✘	Harvested unsustainably
	No reference point <sup>2</sup>	?	Undefined
	Stock status unknown (even if reference point is defined)	?	Unknown
Management plan ( $F_{MGT}$ )	$F < F_{MGT}$ target <i>or</i> $F < F_{MGT}$ limit	✔	Below
	F within X% of target or within defined range	✔	At target <i>or</i> within the range
	$F > F_{MGT}$ target $F > F_{MGT}$ limit	✘	Above
	No (agreed) management plan	-	Not applicable
Qualitative evaluation <i>[Not applicable for category 1 and 2 stocks]</i>	If the exploitation of the stock can be conceptualized in relation to any possible reference points, a qualification is given:		
	When the fishing pressure indicator is very high (higher than expected to be safe for the stock), e.g. $F >$ any safe limit	✘	<i>[Short qualification]</i>
	When the fishing pressure indicator is very low, e.g. $F <$ possible ref. points	✔	<i>[Short qualification]</i>
	If the stock exploitation cannot be conceptualized in relation to any possible reference points, trends are shown by arrows only:		
	When the fishing pressure indicator increases	↗	Increasing
	When the fishing pressure indicator decreases	↘	Decreasing
	When the fishing pressure indicator is stable	→	Stable

<sup>1</sup> The evaluation of the proxies should only concern the year of the evaluation, i.e. when the estimation of MSY proxies uses data up to year Y the tick marks (✘✔) are only included in the year Y. In the remaining years a ? is used, except when information is conclusive that the stock status will remain the same for the other years.

<sup>2</sup> For stocks with defined MSY reference point(s) or MSY proxies, but NO defined PA reference point(s):

- if a ✔ is used for the MSY reference point, a ✔ should also be used for the PA reference point.
- if a ✘ is used for the MSY reference point, a ? should be used for the PA reference point.

However, the text should be adapted to specify that PA reference point values are not defined (i.e. “above/below candidate reference points”). In such cases, the terms “Harvested sustainably” and “Full reproductive capacity”, provided for cases when PA reference points are defined, should not be used.

**Table 1.2.3 Stock size (SSB, total biomass,  $B/B_{MSY}$ , or abundance/biomass indices)**

Stock size	Explanation	Sign	Text
MSY ( $B_{trigger}$ , $B_{trigger proxy}$ )	$SSB \geq MSY B_{trigger}$ $SSB \geq MSY B_{trigger proxy}^1$		At trigger / Above trigger /At proxy / Above proxy
	$SSB \geq MSY B_{escapement}$ <i>[applicable for short-lived stocks with an MSY <math>B_{escapement}</math>]</i>		Above escapement
	$SSB < MSY B_{trigger}$ $SSB < MSY B_{trigger proxy}^1$		Below trigger / Below proxy
	$SSB < MSY B_{escapement}$		Below escapement
	No reference point		Undefined
	Stock status unknown		Unknown
Precautionary approach ( $B_{PA}$ , $B_{lim}$ )	$SSB \geq B_{PA}$		Full reproductive capacity
	$B_{lim} < SSB < B_{PA}$		Increased risk
	$SSB \leq B_{lim}$		Reduced reproductive capacity
	No reference point <sup>2</sup>		Undefined
	Stock status unknown (even if no reference point is defined)		Unknown
Management plan ( $SSB_{MGT}$ )	$SSB \geq B_{MGT}$ plan target, limit or trigger biomass		Above or At target
	$SSB$ within X% of target or within defined range		within the range
	$SSB < B_{MGT}$ plan target, limit or trigger biomass		Below
	No (agreed) management plan	-	Not applicable
Qualitative evaluation	If the state of the stock can be conceptualized in relation to any possible reference points, a qualification is given:		
	When the stock size indicator is very low (lower than expected to be safe for the stock), e.g. $SSB <$ any safe limit		<i>[Short qualification]</i>
	When the stock size indicator is very high, e.g. $SSB >$ possible reference points		<i>[Short qualification]</i>
	If the state of the stock cannot be conceptualized in relation to any possible reference points, trends are shown by arrows only:		
	When the stock size indicator increases		Increasing
	When the stock size indicator decreases		Decreasing
	When the stock size indicator is stable		Stable

**1.2.6 Fisheries management strategy evaluations**

Multiannual management plans and strategies have been agreed for a number of fish stocks or fisheries within the ICES area, and new plans are being proposed. Before using a plan/strategy as basis for the advice, ICES evaluates them relative to their compliance with a precautionary approach regarding risks to maintenance of reproductive capacity, and according to the likelihood that high yields will be produced in the long term. The evaluations also address issues raised by

stakeholders and authorities that are contained in a specific management plan, such as stability of yield and risks under specific recruitment regimes.

ICES has adopted a precautionary criterion for long-lived stocks and a second similar criterion for short-lived stocks.

- **Long-lived stocks**

- a) The management plan/strategy is precautionary if, over the simulated period, the *maximum* probability that SSB is below  $B_{lim}$  is  $\leq 5\%$ , where the maximum (of the annual probabilities) is taken over all years in the plan/strategy (i.e. short and long term).

- **Short-lived stocks**

- a) If, under natural conditions of no fishing, the long-term annual probability of SSB being below  $B_{lim} \leq 5\%$ , then the same criteria as for long-lived stocks is used.
- b) If, under natural conditions of no fishing, the long-term annual probability of SSB being below  $B_{lim} > 5\%$ , then the management plan/strategy is precautionary if the maximum probability that SSB is below  $B_{lim}$  is  $\leq 5\%$  (after the fishery) in any year when a fishery takes place. In all other years the fishery should be closed.

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