Overview of sustainable fisheries assessment and management

Understanding how fish stocks are assessed and how fisheries are managed for sustainability is essential for professionals across the UK seafood supply chain. It facilitates sustainable sourcing, informs approaches to corporate social responsibility, and enables businesses to respond to consumer preferences for sustainability.

This is a brief overview of sustainable fisheries assessment and summarises more detailed Guides on fisheries management, stock assessment and sustainable harvesting and how stocks with limited data are assessed. Each is written to enable understanding without the need for previous training or expertise in fisheries science.

Fisheries Management

Sustainable management is key to maintaining healthy fish stocks long term. Wild stocks are often shared between States (as they migrate across national boundaries), so international agreement on management measures is needed. Management approaches are diverse and define where can be fished, how much can be fished, and what gear can be used.

Many fish stocks are a common resource, shared or competed for between different States. This means that an important challenge is obtaining agreement on the management measures (for example, the Total Allowable Catch, TAC) and deciding what the share (quota) of the TAC for each State and stock should be.

The framework used for joint management of stocks that cross national boundaries or into the high seas is derived from UNCLOS[1] and the United Nations Fish Stocks Agreement (UNFSA). Under these agreements States should seek to reach agreement on management of these stocks to maintain their right to fish for them under international law. The main European fisheries are managed under the Common Fisheries Policy (CFP), where EU Member States pool their EEZs. On leaving the EU the UK has become an independent Coastal State enabling it to manage fisheries in its own waters. Many of the major stocks are now shared between the UK, EU and Norway in the case of North Sea stocks. Under the agreements cited above parties should seek agreement on management. The basis of this co-operation is laid out in the UK-EU trade and co-operation agreement Article 404.

Globally, 30% of assessed stocks are considered overfished, according to FAO data. While we can't control fish stocks, we can regulate how humans exploit them. This process is called 'fisheries management'. Better, forward-looking fisheries

[1] United Nations Convention on the Law of the Sea

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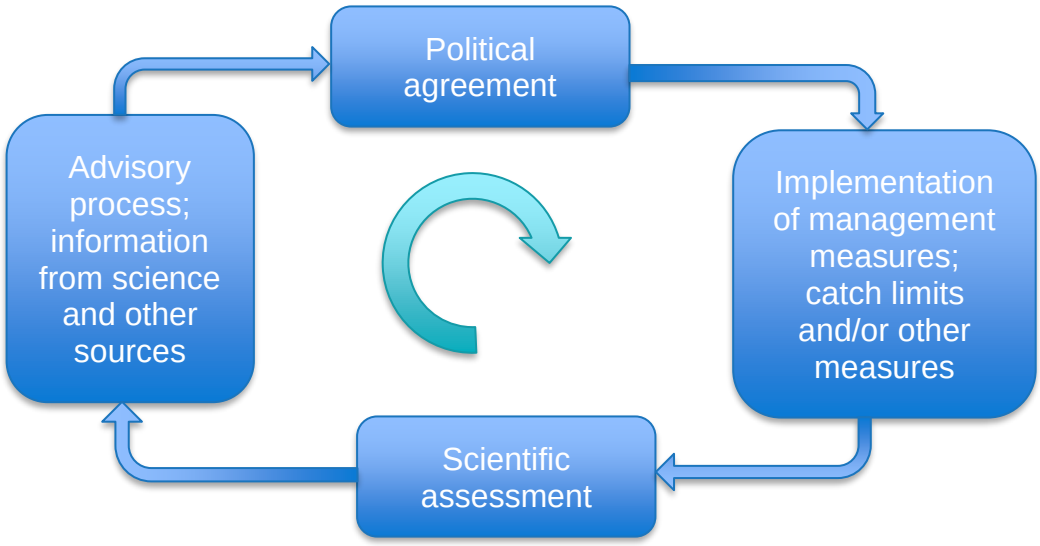
management is needed to sustain stocks into the future and reduce the number of stocks that are overfished. There is a consensus that stocks should be managed to produce 'Maximum Sustainable Yield (MSY)'.

Box 1 The fishery management cycle

Scientific assessment, advice and political agreement are required for fisheries management. Fisheries management is implemented on a cyclical basis.



Whilst scientific assessment and advice is a major element in the advisory process, management bodies also draw on advice from stakeholders. Timescales can vary, with many major stocks being assessed annually. The cycle can be longer for other stocks, such as tuna, which are generally assessed and managed on a longer cycle (up to three years).

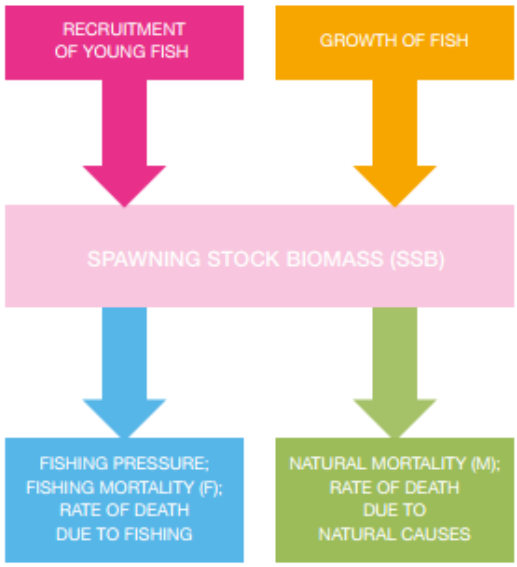
Maximum Sustainable Yield (MSY)

Fishing at MSY levels aims to catch the maximum quantity of fish that can safely be removed from the stock while maintaining its capacity to produce sustainable yields in the long term. This requires that the addition of new fish (through growth and reproduction) is balanced against the fish removed (by fishing or predation).

A 'fish stock' is a population of fish that has distinct biological characteristics, occupies a limited area, and has limited mixing with other stocks of the same species. 'Stock assessment' uses real-world data to build a picture of a stock's population in order to offer management advice (Box 2).

Box 2 Stock assessment models

In stock assessment, scientists use data from both the fishery and research surveys, to construct a mathematical model of the stock. The aim is to create a model of the fish biomass entering and leaving the stock, as shown below:



The key requirement is to ensure that there is a sufficient spawning stock biomass to enable the stock to reproduce and support a fishery. Stocks in this condition are termed inside 'safe biological limits.' To keep the stock within safe biological limits and optimise exploitation for MSY, scientific advice is given to modify fishing pressure.

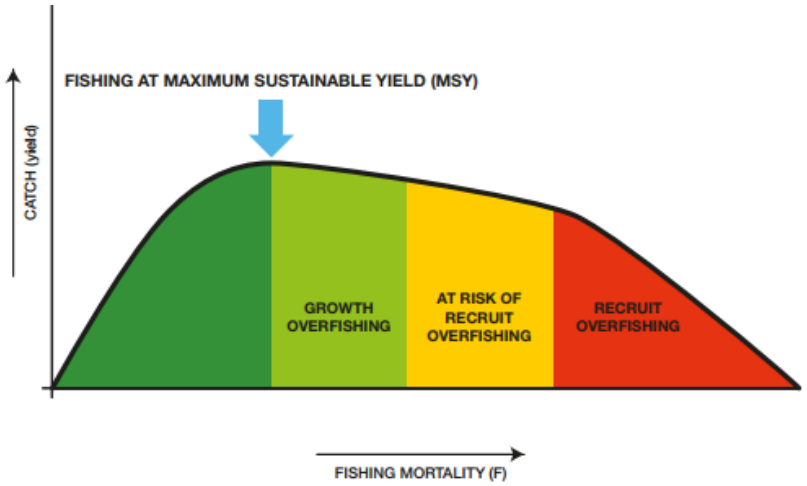
Reference points are designed to guide managers in making effective decisions for fish stock conservation and management. 'Target', 'trigger' and 'limit' reference points indicate a stock's health and are used to assess its status:

- **Target reference points** – levels that managers are aiming for (e.g. MSY).
- **Trigger reference points** – levels at which action should be taken to bring the stock back towards the target.
- **Limit reference points** – the 'Safe Biological Limits' for the stock.

Scientists calculate the status of the stock in relation to the biological reference points, then advise on the levels of catch for the fishery. Box 3 outlines the relationship between fishing pressure and yield (catch).

Box 3 ICES[2] Precautionary and MSY approaches

This schematic shows the impact of fishing pressure (or mortality) on catch at equilibrium. The peak of the curve represents optimal fishing pressure at MSY and is used as a target reference point.



Growth overfishing (light green) is when fishing pressure causes too many small fish to be caught, so the production of the stock (due to growth of individual fish) is not fully realised.

Recruit overfishing (red) is when the fishing pressure is at very high levels and the stock's reproductive capacity may be impaired. A stock in this condition may not be able to sustain a fishery, so it is regarded as 'outside safe biological limits', that is beyond the limit reference point. The stock is 'at risk' that is below the trigger level for action to prevent recruit overfishing in the yellow section of the graph.

Where the objective is fishing at MSY scientists will advise management on catches which result in MSY. Further action may be advised (including zero catch in some cases) when the stock is in the yellow or red zones.

Data-Limited Stock Assessment

Fish stock assessment helps fisheries managers optimise yields and avoid stock depletion, but 80% of world fish catches do not have a full assessment. Both stock abundance and yield could potentially be increased if these stocks were assessed and managed properly. Full analytical assessments require extensive data on stock age structure, which is time-consuming and expensive to collect. However, existing or relatively easy-to-collect data can be informative if the right methods are used to draw up scientific advice from this less complex data.

Given that there is less information available to inform them, data-limited stock assessments are designed to provide precautionary advice. If stocks are at risk of

[2] International Council for Exploration of the Seas (ICES)

overexploitation, ICES advise a 20% decrease catch (the precautionary buffer) to limit the impact of fishing on the stock. However, ICES' data-limited assessment methods are evolving, and for some stocks, precautionary advice can be given without the need to implement the precautionary buffer.

Approximately 64% stocks assessed by ICES are assessed using data-limited methods, including stocks of commercially important species such as anglerfish, North Sea lemon sole, as well as skates and rays.

Worldwide, there have been considerable efforts to develop methods for assessing stocks with minimal data, with some methods showing good correspondence with conventional analytical techniques. The development and implementation of data-limited stock assessment methods should result in better fisheries management in the long term.

Scientific limitations

While models are vital tools, they also simplify factors affecting stock dynamics. It is therefore important to keep their limitations in mind when using them for management. Limitations include, estimation of 'natural mortality' (mortality by processes other than fishing), in addition to ecological and environmental factors, such as food web dynamics and climate change. For this reason, stock assessment scientists regularly revise assessment models.

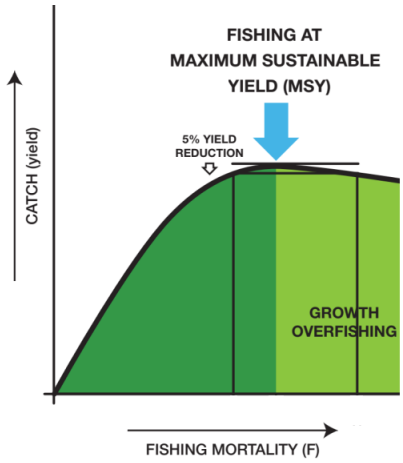
Fisheries implications

Whilst MSY is important, it's not the only factor affecting fish stocks, and the effects of fishing at MSY can, potentially, have implications for other stocks, or for economic and social goals.

Environmental factors can affect recruitment of young fish and fish stock biomass, so fishing to MSY can lead to highly variable catches. When managers are aiming to recover stock biomass to enable stocks to achieve MSY, there has to be a reduction in catches before recovery can take place. In mixed fisheries different stocks may require different management regimes, so keeping all stocks at MSY may not be possible. Mixed fisheries assessment and management is evolving in European fisheries (see Box 4).

Box 4 Mixed fisheries management

Many demersal fisheries, which pursue species close to the seabed result in a mixture of fish species in the catch. These fisheries can be 'choked', when there is limited quota available for a particular species. Mixed fisheries advice presents a range of scenarios enabling the managers to understand the trade-offs between stocks, and identify which stocks are likely to become limiting.



ICES has also defined MSY ranges (schematic above) to allow flexibility when setting TACs. This enables managers to resolve conflicts between stocks by exploiting stocks at levels which are within 5% of MSY in the long term. However, it is not intended that all stocks will be fished in the range above MSY, the aim is for balanced exploitation across all stocks.

Responsible fishing

The FAO 'Code of Conduct for Responsible Fishing' is a set of guidelines for responsible fishing at all levels, and, with other documents, forms the basis of seafood Certification for Eco-labels. The Responsible Fishing Vessel Standard (RFVS) is a voluntary vessel-based programme certifying high standards of crew welfare and responsible catching practices on board fishing vessels.

Further information

Seafish Guides;
Guide to Fisheries Management SR741 ISBN 978-1-911073-47-5

Guide to Fish Stock assessment and ICES reference points SR742 ISBN 978-1-911073-48-2

Guide to Fishing at Maximum Sustainable Yield SR743 ISBN 978-1-911073-49-9

Guide to Data-Limited Stock Assessment SR744 ISBN 978-1-911073-50-5