



# SEAS AT RISK

## MSY - Maximum Sustainable Yield

Hearing in the European Parliament, 23 February 2015

### Why is it important to know about maximum sustainable yield (MSY)?

To manage human take from the wild, one needs to know how much can be safely taken without depleting the resource one wants to take from. Fishing is no exception. As scientists and managers have discussed how much fish can be safely taken out of the sea one concept has become a key tool for fisheries management: maximum sustainable yield (MSY). In order to participate in the debate about fishing limits, one needs to have an understanding of the basics of the MSY concept. This briefing aims to provide this.

### What is MSY?

In population ecology and economics, MSY is the largest average yield (catch) that can theoretically be taken from a species' stock over an indefinite period under constant environmental conditions. It is usually measured in tonnes. To have a viable and thriving fishing sector, the size of fish stocks must be above levels where they can produce the maximum sustainable yield over an indefinite timeframe.

### B, Y, F: The alphabet soup of abbreviations for understanding MSY

When discussing fishing limits it is important to differentiate between stock biomass, fishing yield and fishing rates which are all important in determining how much fish can safely be caught over a given period of time for a specific fishery:

- B:** Biomass is simply the body-weight of all the fish of one specific stock in the water. B does not differentiate age, gender etc. It is measured in tonnes.
- Y:** Yield is the catch, i.e. the fish taken out of the water through fishing. It is measured in tonnes.
- MSY:** Maximum sustainable yield is, theoretically, the largest yield (catch) that can be taken from a specific fish stock over an indefinite period under constant environmental conditions. It is measured in tonnes.
- F:** F is the fishing mortality rate i.e. the catch relative to the size of the stock (the proportion of fish caught and removed by fishing).

**B<sub>MSY</sub>:** B<sub>MSY</sub> is the biomass that enables a fish stock to deliver the maximum sustainable yield. In theory, B<sub>MSY</sub> is the population size at the point of maximum growth rate. The surplus biomass that is produced by the population at B<sub>MSY</sub> is the maximum sustainable yield that can be harvested without reducing the population.

**F<sub>MSY</sub>:** F<sub>MSY</sub> is the maximum rate of fishing mortality (the proportion of a fish stock caught and removed by fishing) resulting eventually, usually a very long time frame, in a population size of B<sub>MSY</sub>. F<sub>MSY</sub> is a constant and can be applied to any stock that is not impaired in its reproductive capacity.

**MEY:** The maximum economic yield (MEY) is the value of the largest positive difference between total revenues and total costs of fishing (including the cost of labour and capital). MEY is typically achieved at catches that are 10-20% smaller than MSY.

**F<sub>MEY</sub>:** F<sub>MEY</sub> is the fishing mortality (the proportion of fish caught and removed by fishing) resulting in MEY. F<sub>MEY</sub> is typically 10-20% smaller than F<sub>MSY</sub>.

MSY, B<sub>MSY</sub> and F<sub>MSY</sub>, as well as MEY, B<sub>MEY</sub> and, F<sub>MEY</sub> are reference points which are expected to remain fixed unless the environment changes or better data become available. Conversely B, Y and F may change every year, and in the EU context are also corrected retroactively (backwards in time) by the International Council for the Exploration of the Seas (ICES).

## When is a fish stock overfished, and what is overfishing?

The European Commission considers a fish stock to be overfished when its biomass is below B<sub>MSY</sub>. In that situation, it is unable to produce the maximum sustainable yield. Overfishing occurs when more than the sustainable share is taken out of a given fish stock, i.e. when the fishing rate is above F<sub>MSY</sub>. The biomass of the stock will then diminish. Overfishing can occur whether a stock is above B<sub>MSY</sub> or not.

## How can an overfished stock be brought to a level where it can produce the maximum sustainable yield?

In order to allow an overfished stock to rebuild to B<sub>MSY</sub>, the fishing rate F has to be set at F<sub>MSY</sub> or below. The lower F, the faster a stock can recover and the sooner it will be possible to take the maximum sustainable yield. As the stock grows, fishers will be rewarded with higher and more stable yields than were previously attainable.

## How can overfishing be stopped?

It is simple to stop overfishing, but not necessarily easy: for a fish stock that is already at or above B<sub>MSY</sub>, fishing pressure should not exceed F<sub>MSY</sub>. To stop overfishing of an overfished stock, the same applies. However, to bring the stock back to B<sub>MSY</sub> or above, in a defined timeframe, fishing pressure needs to be reduced even further below F<sub>MSY</sub> (there is even a formula how to calculate F depending on the desired timeframe). It is simple to do this as fishing pressure is a human intervention and as such manageable. It is not necessarily easy, as for stocks that are currently being overfished the fishing limits will have to be reduced by quite a substantial amount. This will impact the sector, with less fish allowed to be caught. However, depending on the fishery, the time needed until catches first regain and then exceed previous levels can be only a few years. Without action to stop overfishing, a stock could collapse, with deeper and longer-term impacts on both the fishing sector and the marine environment.

## **What did EU member states commit to in 2012?**

In line with the requirements from the United Nations Convention on the Law of the Sea (UNCLOS) and the United Nations Fish Stocks Agreement (UNFSA), EU member states re-committed themselves at the Rio+20 Summit in 2012 to intensify efforts to meet the 2015 target to maintain or restore stocks to levels that can produce maximum sustainable yield on an urgent basis.

## **What does the Basic Regulation of the Common Fisheries Policy state?**

Article 2, paragraph 2, of the Regulation (EU) 1380/2013 on the Common Fisheries Policy, states the following: “The CFP shall apply the precautionary approach to fisheries management, and shall aim to ensure that exploitation of living marine biological resources restores and maintains populations of harvested species above levels which can produce the maximum sustainable yield.

In order to reach the objective of progressively restoring and maintaining populations of fish stocks above biomass levels capable of producing maximum sustainable yield, the maximum sustainable yield exploitation rate shall be achieved by 2015 where possible and, on a progressive, incremental basis at the latest by 2020 for all stocks.”

## **What is required to secure EU fish stocks above a level capable of producing MSY?**

Stocks that are already at or above  $B_{MSY}$  levels should be fished at rates slightly below  $F_{MSY}$ , to account for scientific uncertainty and fluctuations in stock sizes. Fishing below  $F_{MSY}$  would also bring economic benefits (see below “Is maximum economic yield an option?”). In order to restore stocks that are below  $B_{MSY}$  to above levels where they can produce maximum sustainable yield, fishing pressure needs to be further relieved to enable the stocks to recover. The larger the reduction, the faster the recovery.

## **What about data deficient stocks?**

Many of the stocks fished in EU waters are currently assessed as 'data-limited'. However, there are no biological or scientific reasons why fishing pressure from 2015 onwards cannot be at rates below  $F_{MSY}$  or below a proxy for  $F_{MSY}$  in the case of data-limited stocks. Australia, New Zealand and the USA manage their data-limited fish stocks using proxies for MSY and historic catch levels.

## **What about mixed fisheries?**

In mixed fisheries,  $F_{MSY}$  should be set according to the most vulnerable stock. It is possible to have all stocks at the same time above  $B_{MSY}$ , but not exactly at  $B_{MSY}$  levels. However,  $B_{MSY}$  is typically a target set for a single species, so a joint  $B_{MSY}$  target in a multi-species context would mean that some species would be fished below MSY, and some overfished, with the risk that sensitive ones might collapse.

## **What if a stock is in such a bad state that it cannot recover to $B_{MSY}$ by 2020 even if fishing were to stop completely?**

Since 2002, EU member states have been aware that they committed themselves to reaching MSY by 2015. However, action has largely been too slow and too late, so that many EU fish stocks are still in an overfished state, i.e. with a biomass well below  $B_{MSY}$ . For such stocks, fishing pressure must be substantially below  $F_{MSY}$ , with a clear timeline for when each fish stock should reach  $B_{MSY}$ .

## **Is maximum economic yield an option?**

Maximum Economic Yield (MEY) is the value of the largest positive difference between total revenues and total costs of fishing (including the cost of labour and capital). Typically, mortality rate  $F_{MEY}$  is slightly below  $F_{MSY}$ , resulting in marginally less than the maximum sustainable yield. However, much less fishing effort is used, with fewer associated costs, to take the maximum economic yield, and higher biomass levels reduce fluctuations in fishing opportunities. Consequently, it is an economically attractive option, i.e. a cheaper way of ending up with almost the same amount of fish. It is also environmentally more desirable as it reduces environmental pressures such as engine emissions and negative impacts on the wider marine environment.

## **Is there a win-win scenario?**

Clearly, there are many losers if the objectives agreed under the CFP are not implemented. Fish stocks won't recover, and fishers will have even less fish to catch, resulting in more job losses and hardship. According to the European Commission only 9% of stocks are likely to still be in sustainable state by 2022 if the pre-CFP reform status persists. With some short term pain there could be gain for all: for fishers the yield would increase, the marine environment would be in a better state, and European consumers would have a more secure fish supply.

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