Oral presentation to European Parliament

Presentation to the
Committee on Fisheries
of the European Parliament,
on *23 February 2015*

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Public hearing on
Maximum Sustainable Yield in Fisheries Management

1. I am addressing the matter of escaping from the doctrine, the **stranglehold**, of strict *MSY*-related targets.

2. Parliament and Council have adopted Parliament's **historic proposal** of January 2013 that the overall target should be to regulate the fishing mortality rate so that it is less than would be required to obtain *MSY*.

3. The agreed text **does not say 'How much less'.** That makes a practical problem for the Commission's scientific, technical and economic advisers.

4. **Another formulation** was that fishing **intensity** should be such that the stock **biomass** is always greater than needed to generate *MSY*.

5. That raises another and different type of problem because the biomass changes with next year's recruitment, which is highly **variable** and practically **unpredictable**.

6. It is generally better to **monitor** – and to **control** - systems (like cars, trucks and trains and machinery) by dealing with the human **input** of energy, if necessary limiting it with a throttle, rather than by simply controlling the **output** – with a brake.

7. Regulation by fishing effort input geatly improves the **stability** of the industry. Regulation by output adds to natural **instability**.

8. Some experts argue that keeping the stock size above the MSY-generating level is a **precautionary measure**, so avoiding the possibility of inadvertently reducing the stock below MSY level and so causing what we call *growth over-fishing*.

7. True, but **avoiding waste** of excessive fishing effort and costs is practically far more important in practice. We can live with less catch than the maximum, but if there is no profit fishing must either cease or be massively subsidized.

8. The EU's revised policy should ensure that future catches are sustainable, slightly less than a theoretical maximum but obtained with much less wasteful fishing effort, and so at far less cost.

9. MSY is the main management target in the UNCLOS. UNCLOS also says it is OK to deviate from that target for social and economic reasons.

10. There is no unique MSY. *msy lcal v*aries with selectivity. Selectivity does not depend only, or even mainly, on gear type (mesh, hook size).

11. Graph is for a particular selectivity (capture begins before maturity) and dynamics driver (M/K=1.5 – mackerels). Recruitment not density dependent.

12. Reduction of sustained catch - a '**sacrifice'** – of only 10% would result from a fishing effort - and therefore at a cost - of about 50% of what is needed to obtain *MSY*.

13. That is because models providing curves of sustainable catch against fishing mortality rate are always rather **flat-topped**. The reason for this is that the pattern in the mid-range of the curve is determined almost entirely by the interaction between

the natural mortality rate in one direction and the growth rate – increase of body weight – in the other direction

14. **Potential economic benefits of holding the fishing intensity to less than is need to take MSY are enormous.**

15. This is **not some new idea**.

A G. Huntsman, told the first UN Conference on Conservation and Utilization of Resources, in 1949:
"The take should be increased only as long as the extra cost is offset by the added revenue from sales."

16. A R. A.Nesbit †, in giving evidence, in 1943, to a hearing about management) told a US fishey Commission,

"the Commission should adopt a policy that will protect the fishermen as well as the fish. …such a program will be easier to develop than a conventional program based on a policy of imposed inefficiency."

17. In 1974, a series of international workshops involving 100 scientists, economists and managers, agreed that while MSY had been a useful educational tool it was quite inadequate as a proper target for management.

18. We have known for many years that the **profit** from sustainable fishing – *i.e*. the difference between the market value of the catch and the cost of taking it – has a maximum. We call that ***MSEY,*** **Maximum Sustainable Economic Yield**. It is somewhere between the *MSY* level and a much lower fishing intensity.

19. It is not difficult to calculate if we know just a few things, especially what is the **break-even** catch rate – the minimum catch per unit effort by a fishing unit that makes continued fishing worthwhile.

20. **It is commonly assumed that fishing at MSY level will be profitable, but that is by no means necessarily so.**

21. I am not suggesting that ***MSEY*** – which some researchers have called 'the optimum' - should be the policy target, any more than *MSY* should be. There are other good reasons for not seeking that particular 'optimum'. But the biologically and economically desirable target should be somewhere between *MSEY* and *MSY.*

22. The scientific and economic advisers to the Commission should be asked by Parliament to look at such options. Their efforts should be addressed not merely to the dynamics of the fish stocks, but to the dynamics of the fishing operations and other features of the industry.

23. Three aims:
A Economical
V Sustainable
C Stable.

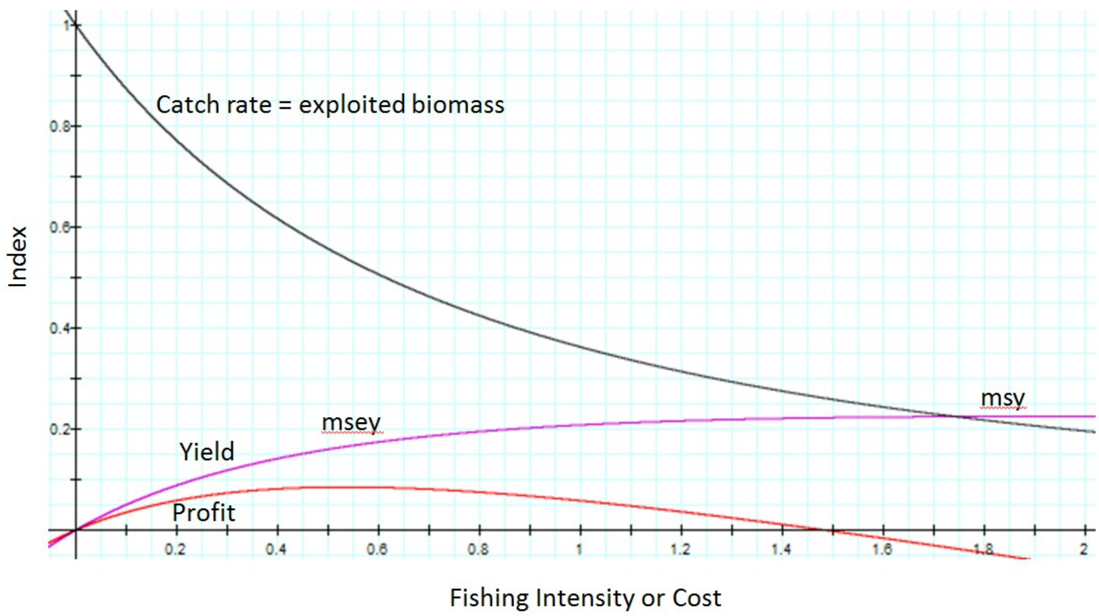
PRIORITIES

24. **Conservative precautionary management, while 'saving' the fish in the process, is supposed to be for *our* benefit, and especially to make fishing a worthy occupation again.**

25. **Some additional precautions are needed.**
One concerns the fear that even a well-managed fishery could lead to an occasional **unintentional depletion** of the stock to a level where there are insufficient mature females alive to guarantee normal recruitment. So a high priority to maintain fishing effort at a level that will have a negligible probability of ever inadvertently causing what we call **recruitment over-fishing,**

26. Attention must be given to devising optimal patterns for **transition** of current stock states to the agreed sustained states. Such optima would balance the desire for the biggest **cumulative catch** in the circumstances against the need for fishing to be worthwhile during the transition.

27. Then, we need to design a **monitoring system** to ensure, when the policy is implemented, that it is performing as expected, and, if it is not, to make appropriate corrections.



Explanation of Graphs
annexed to Presentation to Euro-Parliament

These graphs are for a stock of a typical teleost (bony fish) species with dynamic natural mortality – growth rate driver ***M/K*** = 1.5.

This is near the lower range of this parameter for the bony fishes, from about 1.4 to 2.1. (The characteristic value for numerous species of *scombrids* - *e.g.* mackerels - is 1.6.) The M/K value does not concern the general size of the species, which could be anything between that of a sardine and of a cod.

The curves shown are for a fishery with ***selectivity*** of fish length at first liability to capture of half the maximum length that the fish will attain if it lives long enough (c=0.5) which is equivalent to the weight of a fish about 15% of the average weight of a full-grown fish (w/W=0.15). This means that juvenile fish are not being caught but near-adults are liable to be caught before they are sexually mature, which occurs generally when w/W = 0.3-0.4.

Here I refer to maximum sustainable yields of a fishery with an identified selectivity as ***local msy***s, ***msyl***, symbolized with miniscules. The ***absolute MSY***, when selectivity is at the critical age and size of fish, is unobtainable in practice, as it requires extremely selective fishing at infinite intensity.

Note that if the selectivity were to be increased, one way or another, towards the critical values of ***c*** and ***w/W***, then both the ***local msy*** and the fishing intensity needed to obtain it, also increase. Note, also, that the general range of values of the ratio ***M/K***. Its actual value does not much affect the qualitative conclusions drawn here though it does affect the numerical values cited.

The main, domed graph is an index of average annual sustainable catch plotted against the fishing intensity. The catch index is an index of catch per average annual number of **recruits**, *i.e.* of young fish entering the exploitable population and so theoretically liable to capture. But the value of the catch index depends on the selectivity of the fishing gear and also of the fishing operations (their location, seasonality, depth of capture and so on).

The catch index must be multiplied by W (in *kg*) - the body weight to which all the fish would grow if they lived long enough - and by the average annual number of recruits, ***R***, to give the total catch in *kg*s. For the present purposes the total market value of the catch can be taken to be directly proportional to its weight index and thus to its total weight, although in practice the price of a fish may increase somewhat with its size, and the average size of fish in the catch must decline as fishing intensity increases – this is because the fish will generally be caught when they are younger if the fishing is more intense.

The fishing intensity, on the x-axis, is not the fishing mortality rate ***F***, but the ratio of ***F*** to the natural mortality rate, ***F/M***. So, for example, a value ***F/M***=1.0 means the fishing mortality rate is equal to the natural mortality rate (these rates are not percentages but are logarithmic - *exponential*). Such a rate would cause the number of fish in the exploited stock to be reduced to about half of those originally in the unexploited ('virgin') stock. The biomass of the exploited stock would be reduced to less than half that of the unfished stock because fish are being caught earlier in their growth than would be their average age and size in an unexploited stock.

I use here the index ***F/M*** rather than ***F*** itself to facilitate comparisons between different stocks and species.

To a first approximation we can assume that the index ***F/M*** is directly proportional to the total cost of taking the catch, and the ratio of the catch index to ***F/M*** as proportional to the average catch rate (*catch per unit effort* – ***cpue***) in the fishery.

This graph shows a maximum average sustained catch of index 0.22 being obtained by a fishing intensity of ***F/M*** =1.85.

The graph like a J in reverse is a plot of the ratio of the sustained catch index to the fishing intensity index. This is a measure of the biomass of the exploited phase of the stock, and equally of the catch rate. The biomass is calibrated to that of the stock before it was exploited as unity. The curve therefore shows the ***degree of depletion*** of the exploited phase of the stock as a function of the intensity of fishing. It shows that in this example the stock at *msy* level is depleted to about one fifth of its unexploited biomass. (This contrasts with a common assumption that at MSY the biomass is between 50 and 40% of the 'virgin' size.)

With that degree of depletion it is quite likely that reduction of spawning females has reduced the annual recruitment. In that case the ***F/M*** for *msy* would be less than that indicated here and the *msy* itself would also be lower. If the relation between spawning stock size and recruitment has been determined then these shifts can easily be determined exactly but for this example I assume recruitment has not changed. That will not qualitatively affect the conclusions I draw from the example.

The third, humped curve at the bottom left is a plot of the economic sustainable yield (***msey***) against the fishing intensity index. *sey* is the difference between the value of the catch and the cost of taking it, in this example being, respectively, proportional to the weight of the catch (no allowance being made for dependence of price on size of fish) minus the cost of taking it, assumed to be proportional to the fishing intensity. This curve, naturally, is zero at the origin (no fishing at all) and zero at an ***F/M*** value I call ***break-even***. Break-even is a threshold beyond which continued fishing is not worthwhile to the fishers because their expenses are more than the market value of their catches. This ***sey*** curve, whatever the location, always has a maximum near the middle range but it is not necessarily symmetrical. The peak I call **maximum sustainable economic yield**, ***msey***, taken with a the fishing intensity of ***F-msey***.

The *F/M* value at break-even can be higher or lower than that value which generates *msy*. (That taking *msy* will be profitable cannot, contrary to popular opinion, be taken for granted.) For this example I have assumed that F/M is *slightly* lower than that which generates *msy*, which implies that adjusting intensity to catch *msy* would hardly be worthwhile.

In this example we see that *msey* is taken by a fishing intensity of 0.5. That is just over 20% – of the intensity needed to take *msy*. The sustainable yield index at *msey* is 60% of *msy*. To take it would be profitable, but not very. And to get it we would have to forgo 40% of the potential sustainable catch.

We can do better by aiming at an ***F/M*** value somewhere between the *msey* and *msy* reference points. We can look, for example, at the consequences of forfeiting – sacrificing - 20% of the potential sustainable catch, taking a ***sy*** of index 0.18 instead of 0.22. This reduced yield could be taken with ***F/M***=0.65, which is at 65% less expense than needed to take *msy*. That would be highly profitable, providing a profit of about 80% over cost. With this intensity of fishing the exploited stock would be depleted only to a bit less than half of its unexploited level, so with a much smaller chance of adverse effect on the recruitment rate.