2022 Mini-Symposium Copenhagen November 2022. Optimizing sustainable fishing on rebuilt fish stocks

The MSE project

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“MSE-project”

2020-2023: 0.5 million Euros – EU, Danish Ministry

…a follow up on the “Fmsy”-project

2016-2019: 0.5 million Euros - EU, Danish Ministry, Norwegian Ministry, Nordic Council of Ministers

Problem

Fmsy is the fishing pressure that gives the maximum sustantiable yield and is the basis on which TACs are determined.

"**Currently used Fmsy values are underestimates due to missing 3 out of 4 density dependent factors – this led to underfishing"**

Solution

Use another type of models (Surplus Production Models) for calculating Fmsy.

Density dependence is important when fish stocks rebuilt...

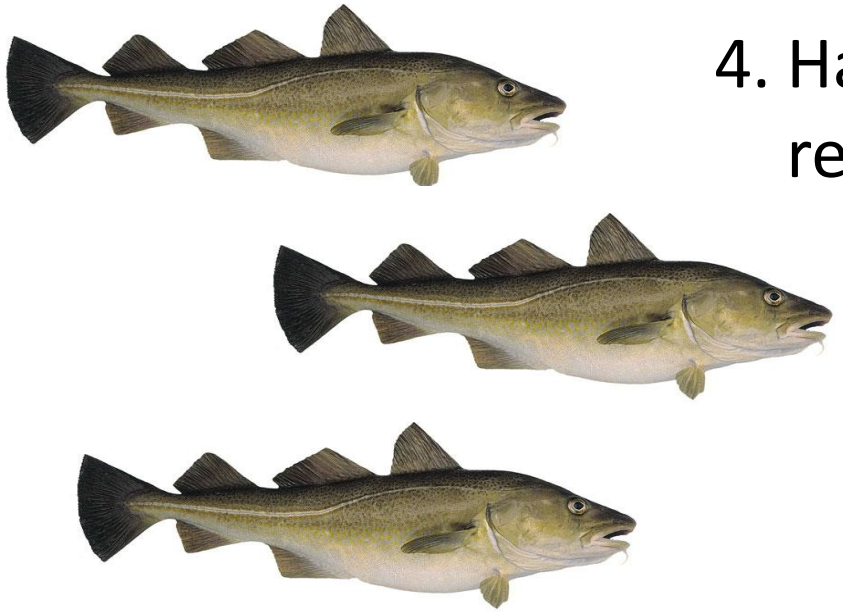
Like thinning the radish....

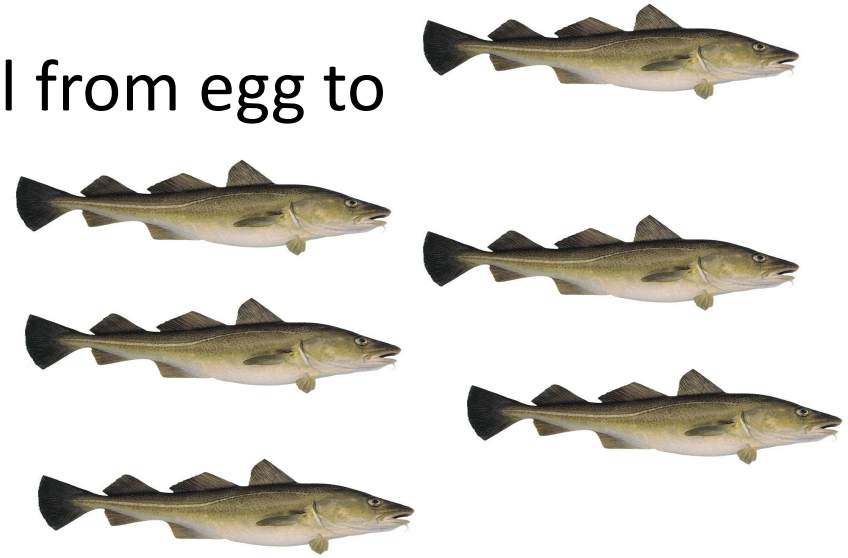
…you get a higher yield by having fewer radish/fish in the population

Density dependence is how ecosystems work. It is the reason we can have sustainable fishing.

When the stock is small, individual fish:

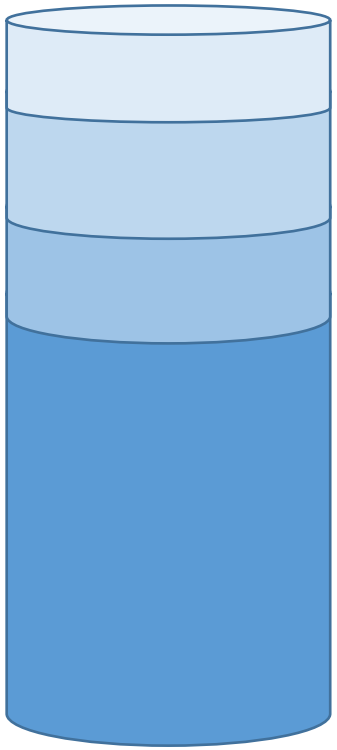
1. Grow better
2. Have reduced natural mortality
3. Produce more eggs
4. Have better survival from egg to recruitment





- In the “Fmsy-project” we calculated new Fmsy values for 53 data-rich fish stocks in the Northeast Atlantic.
- These were 50% higher than the currently used values.
- They can be used directly – here and now – in the fisheries management – just use another row in the ICES Advice short-term forecast table to get another TAC.

Contributions to the Fmsy value – with no DD, Fmsy is zero.



	Contributions to Fmsy
DD in Maturity	0.39
DD in Growth	0.35 (guestimate)
DD in Natural mortality	0.31 (guestimate)
DD in Recruitment	0.26
No DD	0.00

Example: blue whiting - A sustainable gain can be obtained already in 2023 – new Fmsy = 0.44

ICES Advice on fishing opportunities, catch, and effort
whb.27.1-91214

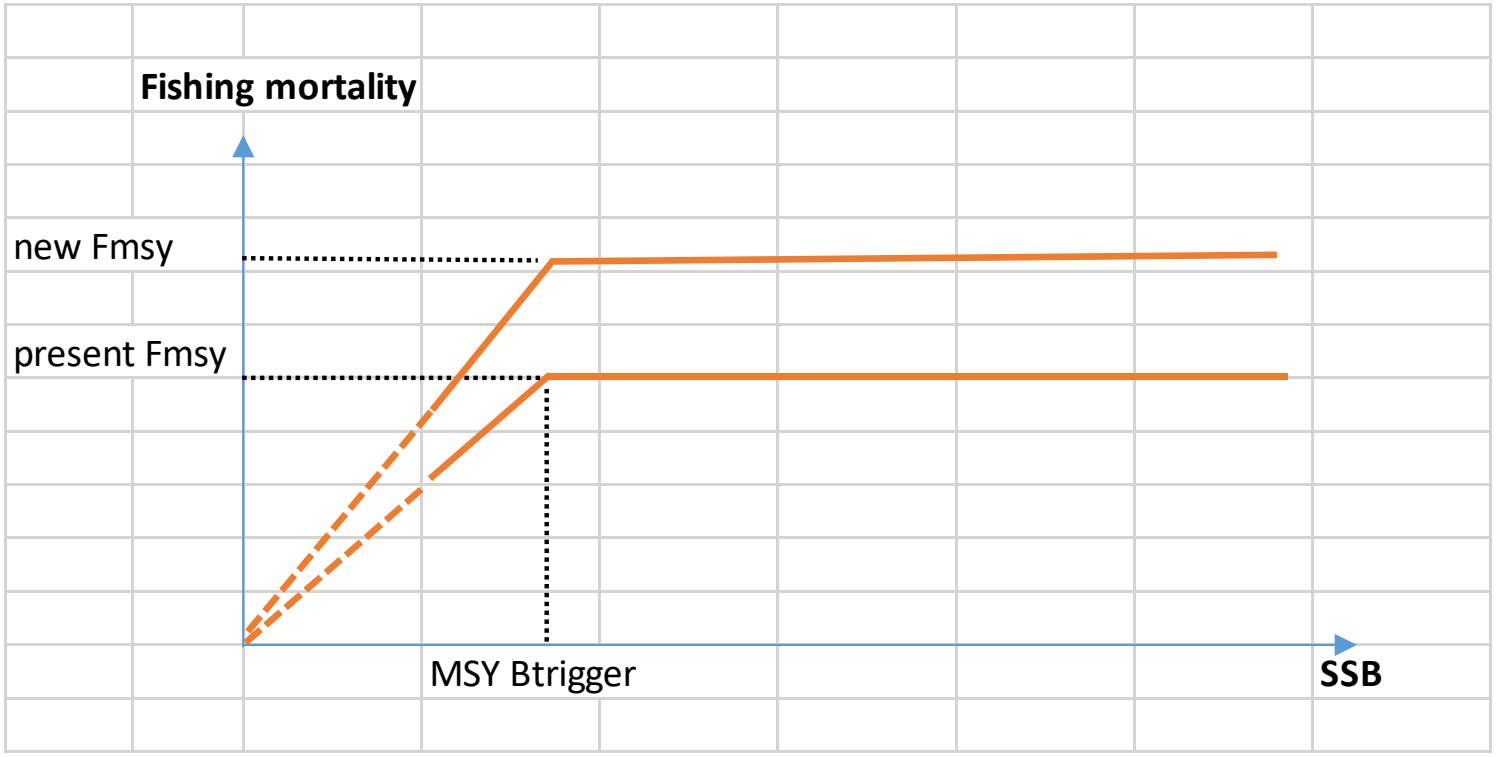
Published 30 September 2022
From ICES advice 2022

Table 2 Blue whiting in subareas 1–9, 12, and 14. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2023)	F (2023)	SSB (2024)	% SSB change*	% catch change**	% advice change***
ICES advice basis						
MSY approach: F_{MSY}	1359629	0.32	7781444	17.5	23	81
Other scenarios						
Long-term management strategy $F = F_{MSY}$	1359629	0.32	7781444	17.5	23	81
F = 0	0	0	9039585	37	−100	−100
F_{pa}	1359629	0.32	7781444	17.5	23	81
F_{lim}	3146002	0.88	6157129	−7	184	318
$SSB_{2024} = B_{lim}$^	8696303	6.503	1499996	−77	685	1055
$SSB_{2024} = B_{pa}$^	7715688	4.401	2249993	−66	597	925
SSB_{2024} = MSY $B_{trigger}$^	7715688	4.401	2249993	−66	597	925
$F = F_{2022}$	1550784	0.371	7605942	14.9	40	106
$SSB_{2024} = SSB_{2023}$	2631402	0.698	6621196	0	138	250
$Catch_{2023} = catch_{2022}$ ^	1107553	0.255	8013430	21	0	47
$Catch_{2023} = catch_{2022}$ −20%	886105	0.2	8217731	24	−20	17.7
$Catch_{2023} = catch_{2022}$ +25%	1384385	0.327	7758694	17.2	25	84
$Catch_{2023} = advice_{2022}$ −20%	602183	0.133	8480325	28	−46	−20
$Catch_{2023} = advice_{2022}$ +25%	940871	0.214	8167163	23	−15.0	25
New F msy value	1796604	0.44	7380863			

This means a 437000 t higher TAC in 2023 than based on the current Fmsy

Harvest Control Rule still very important and will take care of the ”precautionary approach”



ICES type HCR

Why the MSE-project

- Only the standard HCR can be used with the new Fmsy values - because the analysis of alternative HCRs (MSEs) done hitherto also ignores 3 out of 4 DD factors.

- Thus we need to have MSE models that include all 4 DD factors– <u>the MSE-project have developed them,</u> using the so-called Surplus Production Models which by design, include all 4 DD factors.

Now, all kinds of management strategies can be evaluated appropriately, thanks to the MSE-project

- We have done it for 6 high profile stocks in the Northeast Atlantic

Ecosystem approach to fisheries management

- Everybody say they will do it
- The fact is: scientific bodies giving advice to managers still use the old fashioned single species approach with DD only in recruitment
- Including all 4 density dependent factors in single species approach get close to “an ecosystem approach”

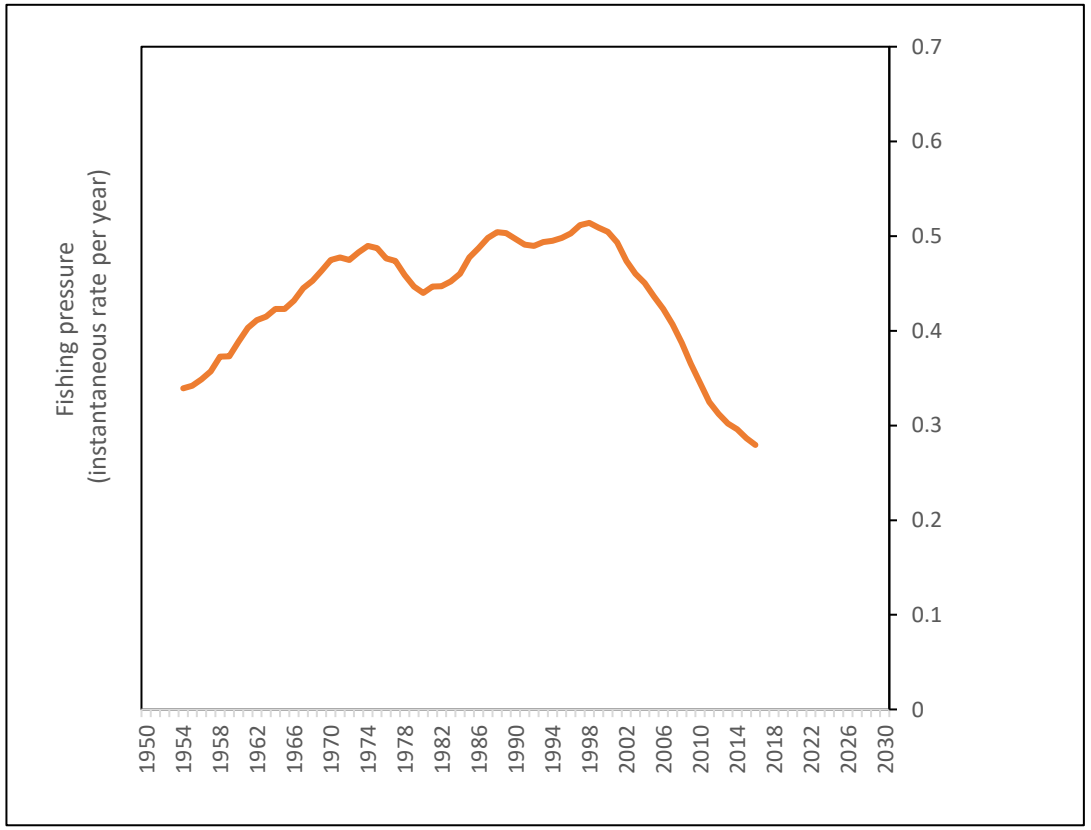
DD not a new “thing” in fisheries science

- Density dependence (DD) in fish population dynamics was included from the beginning of this field of science (Baranov, 1918).
- ICES held a symposium in 1947 only to consider how important DD was when fish stocks were left practically unfished during the WWII (Graham 1948).
- The seminal book by Beverton and Holt (1957) includes many concrete case studies with effects of DD on fish population dynamics.

…but maybe DD has been partly forgotten in the recent decades where overfishing made it less of a problem?

Mean fishing pressure in the Northeast Atlantic (FAO 27) – mean of 53 ICES data rich stocks.

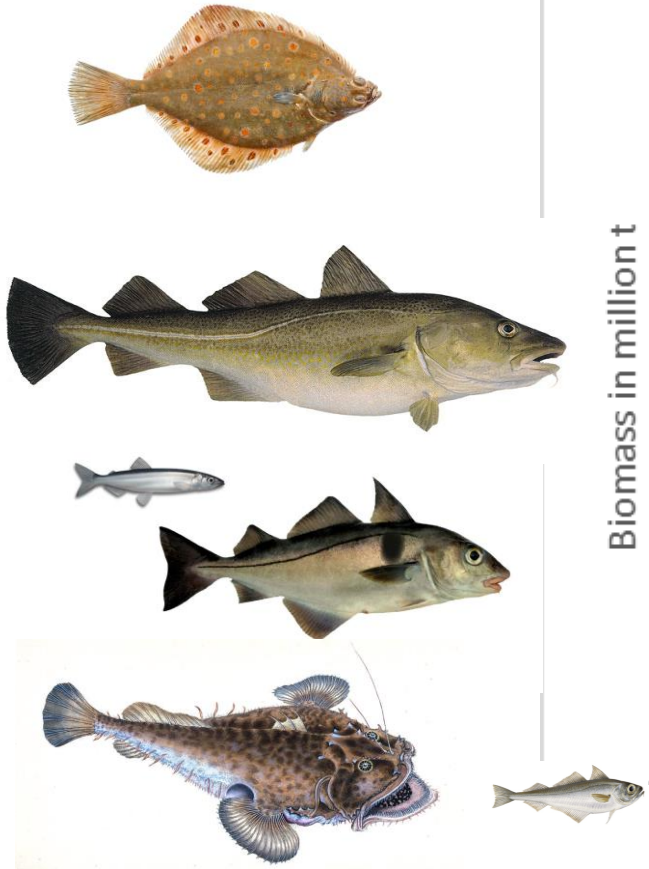
12% of Global catch

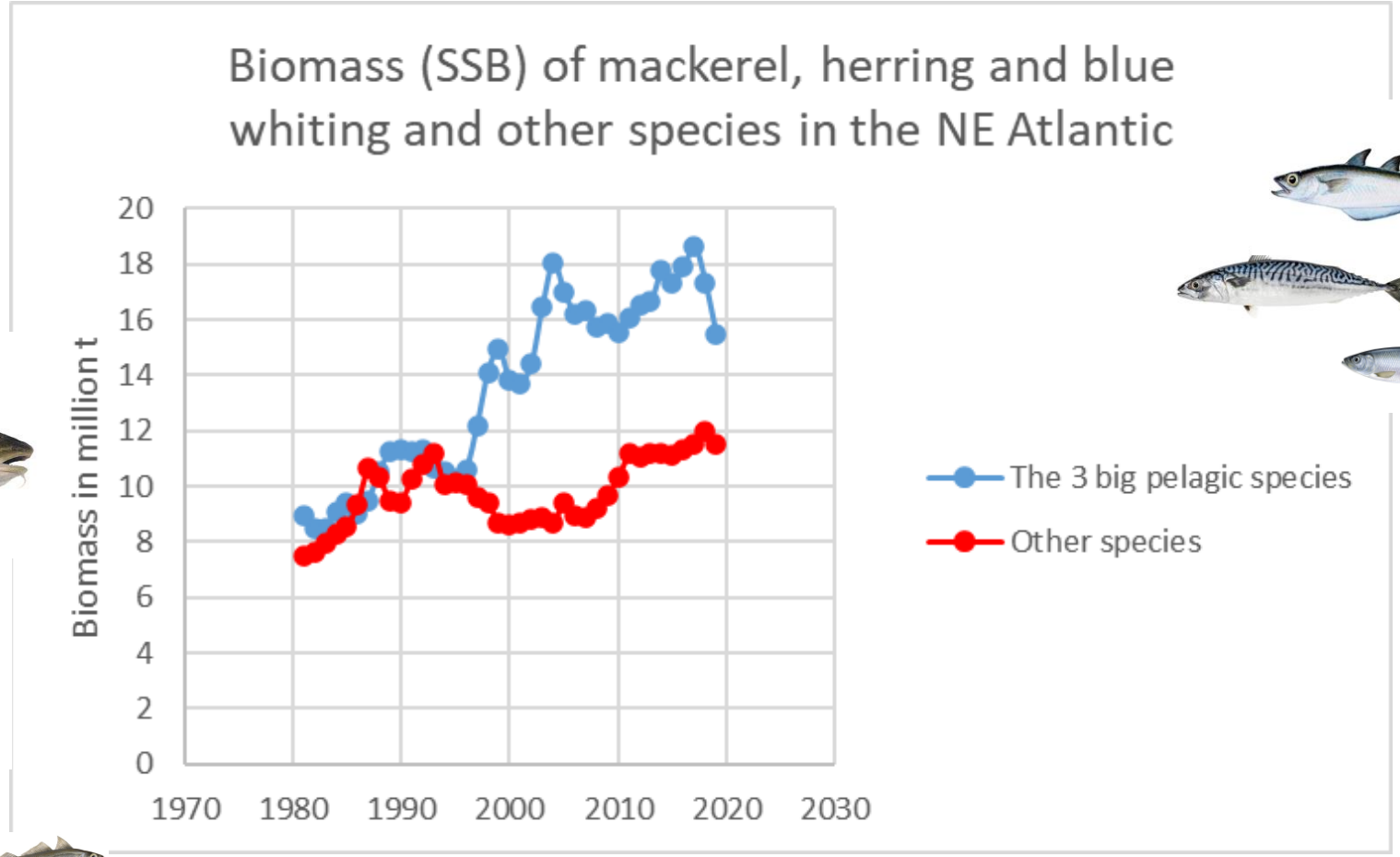


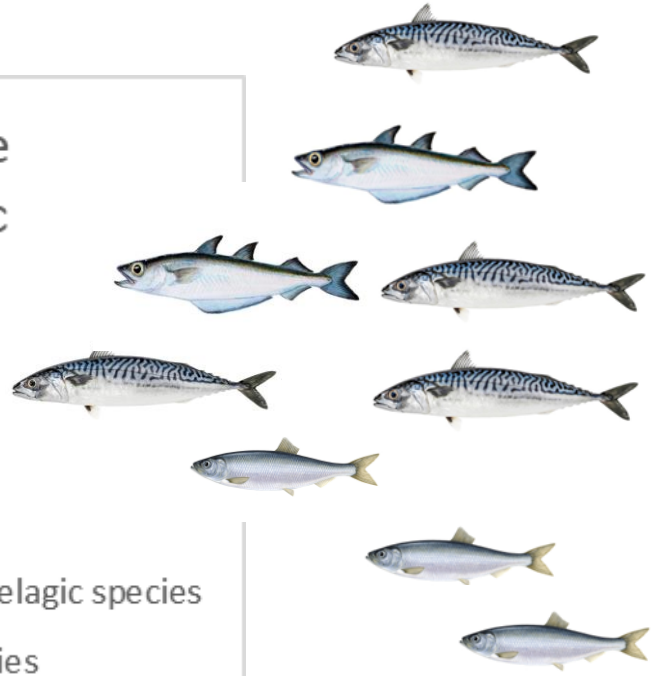
Success story – Over-fishing has ended in the NE Atlantic!!

…about 10 year ago

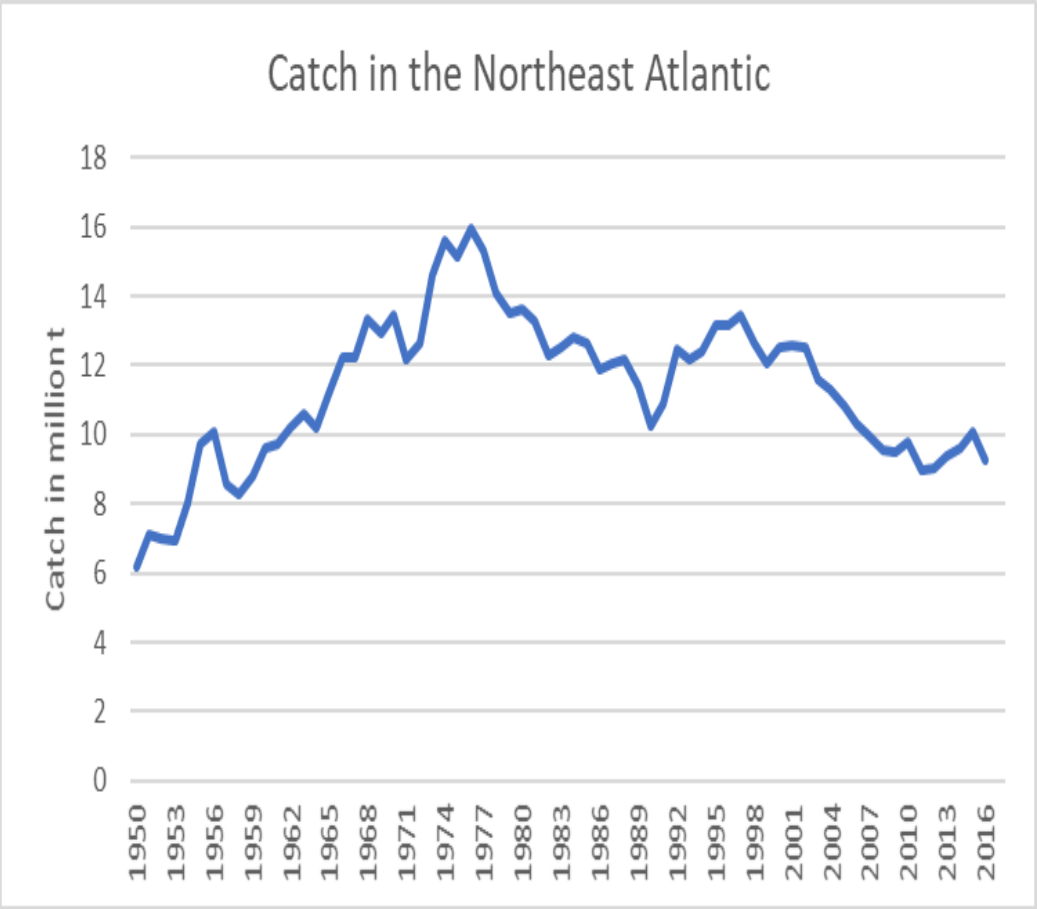
Stocks increased – especially ”the 3-big pelagics”







Unfortunately, catches have decreased – where is the ”long-term gain for the short-term pain” scientists told managers in 1980-2000?



We find that part of the reason is –

The real Fmsy (including all DD) are <u>50% higher</u> than currently used values.

Urgent need to change?

– loosing at least 2-3 million t in foregone catch per year!

…not like a too low TAC in one year, where the extra amount of surviving fish can be added to the TAC the following year, because:

- the fish has already been eaten by larger fish;
- reduced individual fish growth has already been realised due to food competition.

With an average price of 1 Euros per kg, 2-3 million t is equal to a loss of 2-3 billion Euros for each year the switch to the new Fmsy values is postponed, or 100-150 million people could be brought from 0 fish consumed to the UN average annual fish consumption of 20 kg/year

Urgent change needed

- Scientific institutions are ”super-tankers” - changing current approaches takes about 10 years – you have to reach out to 4000 scientists.

- Can society or science afford waiting?

- One solution is to use the new Fmsy values now in combination with the standard hockey-stick Harvest Control Rule.

- …and use e.g. the new MSE approach to fine-tune the new Fmsy values and to evaluate sophisticated HCRs over the coming 10 years.

Thank you !

- Supplementary slides

Robustness

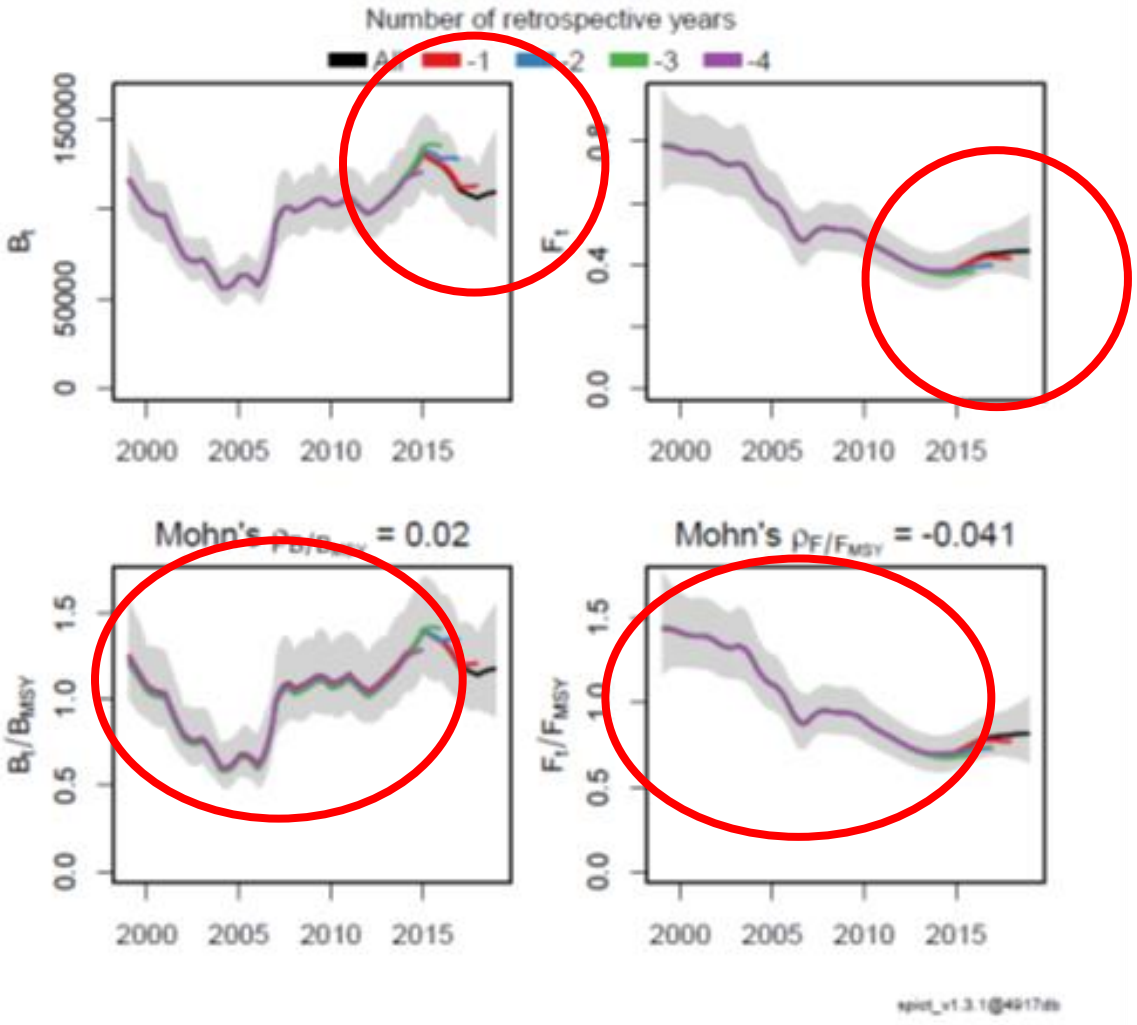
Plaice - North Sea….very robust to adding a new data year.

SPM model	Number of para-meters estima-ted	Bmsy/K (curve shape parameter)	R^2	AICc	SSBmsy '000' t	MSY in '000' t	K (Carrying capacity) '000' t	MSY/ TBmsy (Fmsy)
2000-2015	3	0.5762	0.81	14.3	534	222	1253	0.31
2000-2016	3	0.5650	0.81	13.8	540	221	1288	0.30
2000-2017	3	0.5904	0.81	13.3	539	226	1235	0.31
2000-2018	3	0.5910	0.81	13.2	529	224	1214	0.31
2000-2019	3	0.5825	0.81	12.8	522	220	1215	0.31

Sprat - North Sea…very robust to adding a new data year

SPM model #6	Number of para-meters estima-ted	Bmsy/K (curve shape parameter)	R^2	AICc	SSBmsy '000' t	MSY in '000' t	K (Carrying capacity) '000' t	MSY/ TBmsy (Fmsy)
1996-2015	1	0.265	0.70	22.5	227	186	1388	0.51
1996-2016	1	0.265	0.71	22.4	232	191	1421	0.51
1996-2017	1	0.265	0.71	23.6	233	191	1426	0.51
1996-2018	1	0.265	0.71	24.4	231	190	1416	0.51
1996-2019	1	0.265	0.71	25.1	234	192	1429	0.51

Cod - North Sea…retrospective analysis using SPiCT, quite robust



Caveat for this and the previous 2 slides – it is only the SPM which have been tested – not the annual assessment it is based on.

Argument against the new Fmsy values

”ICES Fmsy includes a precautionary element, the new ones does not…”

Yes, right… …and the reasons are:

- We don’t think it is correct to include a management objective in a scientific concept like Fmsy. Science should be neutral, unbiased and non-political.
- The present Fmsy is not the fishing pressure that gives msy (maximum sustainable catch) – very confusing and non-transparent.
- Inconsistent with what is done on other parts of the World.
- Will make the management in the Northeast Atlantic look worse than it is, because fishing pressures will be compared with too low Fmsy values (See e.g. FAO The State of Worlds Fisheries, 2020).

But <u>the management is still precautionary</u>, because F is reduced when the stock is small (see previous slide) - only a 5% risk to get below Blim

The SPM approach often used for data-poor stocks

- Why should data rich stocks have a higher degree of precautionarity?
- It should rather be the other way around - the less data you have about a stock, the more precautionary you should be!!