

The Norwegian Sea overgrazing hypothesis

Jens Christian Holst



Background

Hypothesis launched that the Norwegian Sea's zooplankton is overgrazed by large pelagic stocks with increased natural mortality caused by hunger in at least the NSSH stock as a consequence.

In my view there is a large empiric basis for the hypothesis

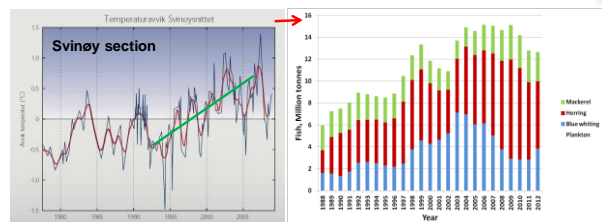
The Speech

- Background
- The ecologic development in the Norwegian Sea
- Can we estimate the increase in natural mortality?
- What to do?
- Summing up, my advice

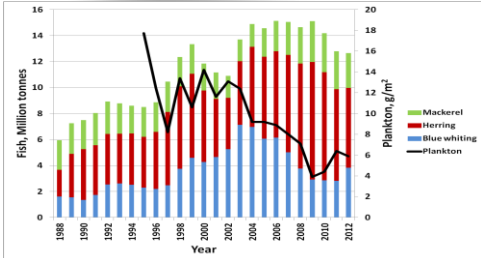
Later ecologic development in the Norwegian Sea

Later ecologic development in the Norwegian Sea

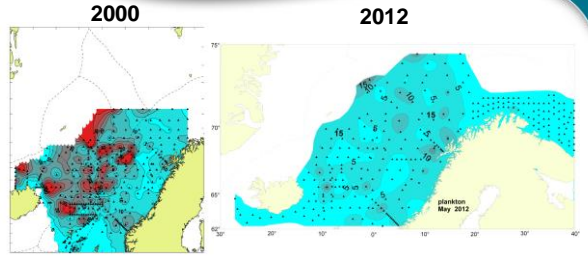
Strong temperature rise from 1995 led to an 'explosion' in the pelagic stocks



And a parallel 'collapse' in the plankton



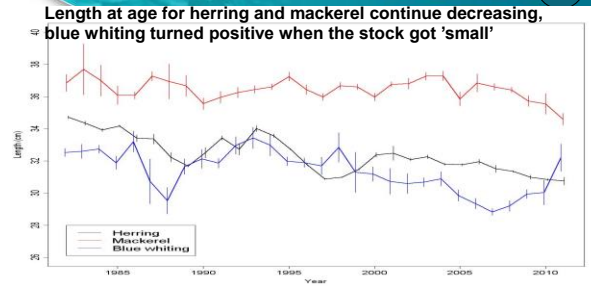
How did the plankton look?



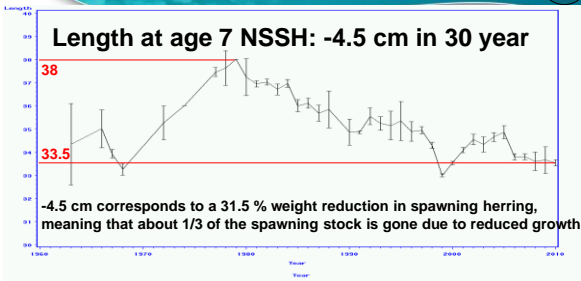
How did the fishes react?

Growth

How did the fishes react?



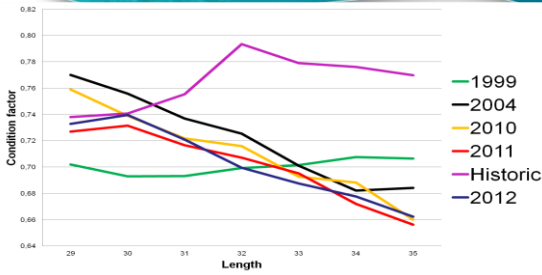
How did the fishes react?



How did the fishes react?

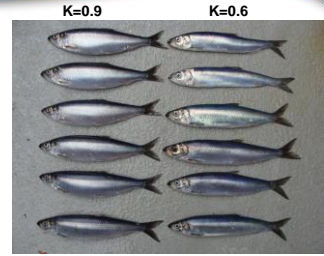
Condition factor in May

Comparison historic and present



How did the fishes react?

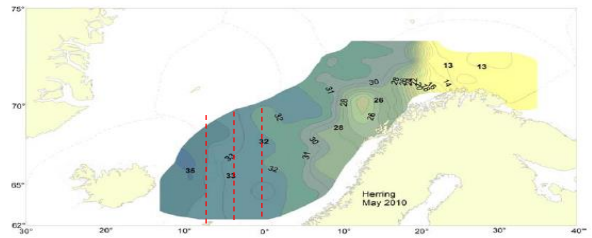
Observed starving herring in the Norwegian Sea after 2010
Jan Mayen august 2011



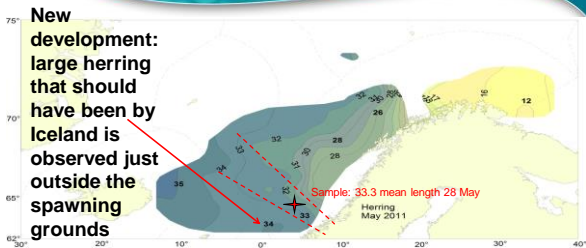
How did the fishes react?

Migration

'Normal' length distribution in the ocean in May

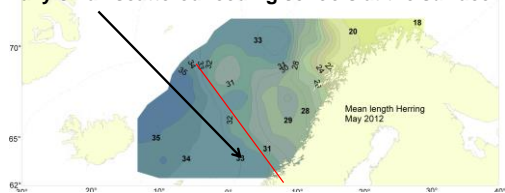


Changed length distribution from 2011



And 2012

We observe large schools of poorly conditioned large herring in the depth with empty stomachs. Normally small scattered feeding schools at the surface

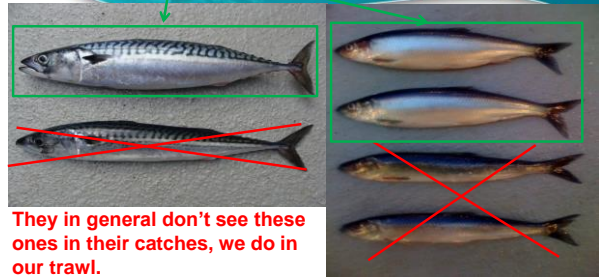


PROBABLE MECHANISM:

After spawning the herring is at the lowest energetic level of the year, it 'desperately' needs energy to carry out a 1000 km NW migration

In particular the largest herring do not find enough food on the westward migration and an increasing portion are not able to migrate and eventually are eaten or sinks out

But the fishermen are happy!



They in general don't see these ones in their catches, we do in our trawl.

Other changes in the migrations

- There are dramatic changes in the migrations of both the mackerel and herring
 - Mackerel all around Iceland, icelandic kids fish mackerel from the piers, 'Never happened before'
 - Mackerel fishing in Greenland waters and mackerel in the Irminger Sea
 - Wintering, spawning mackerel and 0-group in the Norwegian Sea
 - Spawning in Biscay 1-1.5 months earlier (Villamor et al., 2012)
 - Enters the Norwegian Sea 1-1.5 months earlier
- NSSH is not entering the wintering grounds as expected, earlier spawning
- In my opinion all these changes relates to 'lack of energy' due to food shortage, they are not able to maintain their normal migration pattern. Happens in parallel in both stocks.

Maturity

Maturation

- We see large changes in the maturation, the herring now building gonads in August just after the feeding has ceased. Earlier this happened from October
- Probably the same in mackerel as spawning is earlier

Increased natural mortality

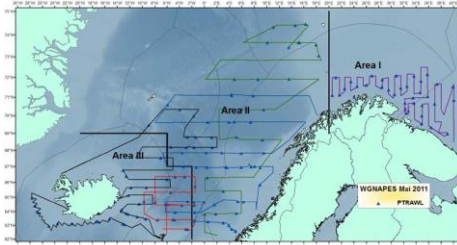
Can we say something about how many crossed 'the point of no return', that is, how much has the natural mortality increased?

Natural mortality

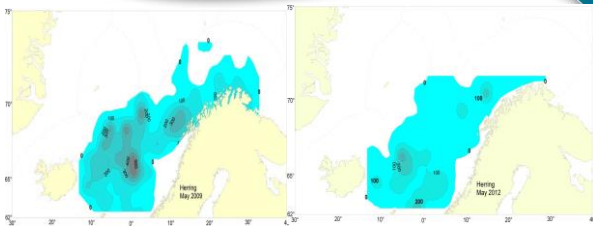
Total mortality =
Natural mortality + Fishing mortality

$$Z = M + F$$

NSSH yearly measured in May



2009 and 2012

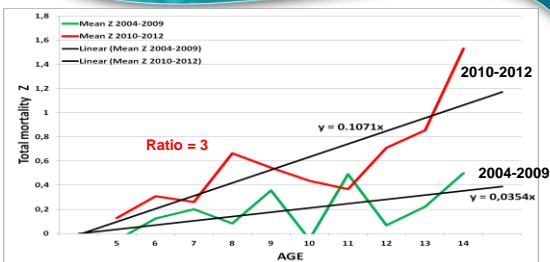


Calculating Z in the surveys

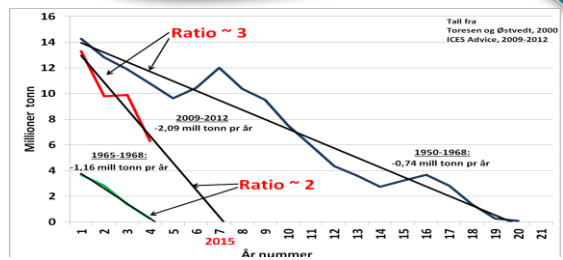
ÅLDER	ÅR											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012		
1	32073	0	0	0	0	0	0	81	0	0		
2	8114	13738	1293	19	411	1193	410	364	1094	1480		
3	6561	1543	19673	306	2889	587	2316	1195	2588	2132		
4	9985	5227	1353	14563	5877	8332	2314	3329	1845	575		
5	9961	12571	1765	1396	20292	8270	13545	2156	3856	1160		
6	1499	10710	6205	2011	1264	16345	8937	8282	2460	2192		
7	732	1075	5371	6521	1942	1381	12023	4146	8407	2379		
8	146	580	651	6978	6780	1920	1333	4519	2879	4400		
9	228	76	388	679	5582	3958	1334	391	4813	1810		
10	1865	313	139	713	647	2500	2696	513	611	2324		
11	2359	362	262	173	488	416	1488	804	963	363		
12	1769	1294	526	407	372	242	208	331	794	521		
13	0	1120	1003	921	403	159	175	45	293	319		
14	287	10	364	618	1048	217	65	17	15	92		
15	0	88	115	243	1010	408	232	25	41	49		

2002 year class 5-6 year: $Z = \ln(16345 / 20292) = 0,22$

Increase in Z after 2009



Stock development during the 60'ies and after 2009



Ecologic consequences

- They are to many to be listed and we don't see most of it
- A very large mackerel stock, combined with large herring and blue whiting stocks, causing dramatic ecologic change to the benefit of no one
- Strongly reduced individual growth in pelagic fish, large changes
- New and heavy predation on larvae of NSSH from mackerel
- Plankton eating sea birds doing very bad
- The large whales migrate through the Norwegian Sea for better feeding grounds
- +++

Possible strategies

1. Continue current management and see what happens
2. Take out controlled a large biomass of grazing capacity and see what happens (not realistic today!)
3. Dramatic increase in scientific focus on this subject
 - The two different strategies to be tested in models by the appropriate body which will be the new ICES working group WGINOR (Working Group on Integrated Assessment of the Norwegian Sea)

The way forward

- These issues are not being addressed at the appropriate level today given the potential economic and ecologic consequences
- The new ICES WGINOR must be prioritized and given the necessary means to work heavy and dedicated on this
- The available resources today are far from large enough to have the necessary progress in the group
- Models are under way for such evaluation but moving too slow
- No one today can say what is the appropriate action, and no one will in the future unless action is taken NOW!

On current methods in mackerel assessment

- In my view the egg methods for estimating the mackerel spawning stock is not adequate any more, due in particular to the large changes seen in spawning dynamics originating much in my view from the present hunger
- There are two new methods under way which should take over as the main stock estimating tools as soon as possible i.e. in connection with the coming benchmark assessment
 - Trawl method
 - RFID tag method
- By moving all resources from the egg method into the two latter the precision in the mackerel estimate will be hugely improved which is prudent for understanding the actual status of the NE Atlantic ecosystem and the mackerels role in it's dynamics

One way to liberate resources

- Maybe naive but worth to be mentioned!
- Today's system of stock ownership is exhaustive to the research, management and fishermen
- It is also suboptimal in economic terms, the bottom line
- Too much energy is used in fighting about small changes
- The fish stocks migrations and zonal distribution will continuously and for ever vary with stock sizes and climate
- Alternative: Change focus to optimal harvesting given parameters like quality, market demand, price, Co₂ output and bottom line
- Use agreed and continuously updated models to steer fishery for best possible sharing, given fixed ownership to each stock by party
- In my view this will boost resources for ecosystembased research and also the bottom line

My advice

- Because science is conservative the fishermen have to involve much more directly into the research and management through raising internal competence to move processes quicker. Needs to be able to ask the right questions and follow up till things move. This is (too slowly) under way.
- Use all available channels strategic to get these processes moving, science moves far too slow under the current very uncertain and dynamic regime in the ocean
- The main goal should be to see a change from single species models into ecosystembased models taking in particular food availability into account