Multidecadal climate signal and its association with the Nordic Seas pelagic fish complex and their zooplankton prey

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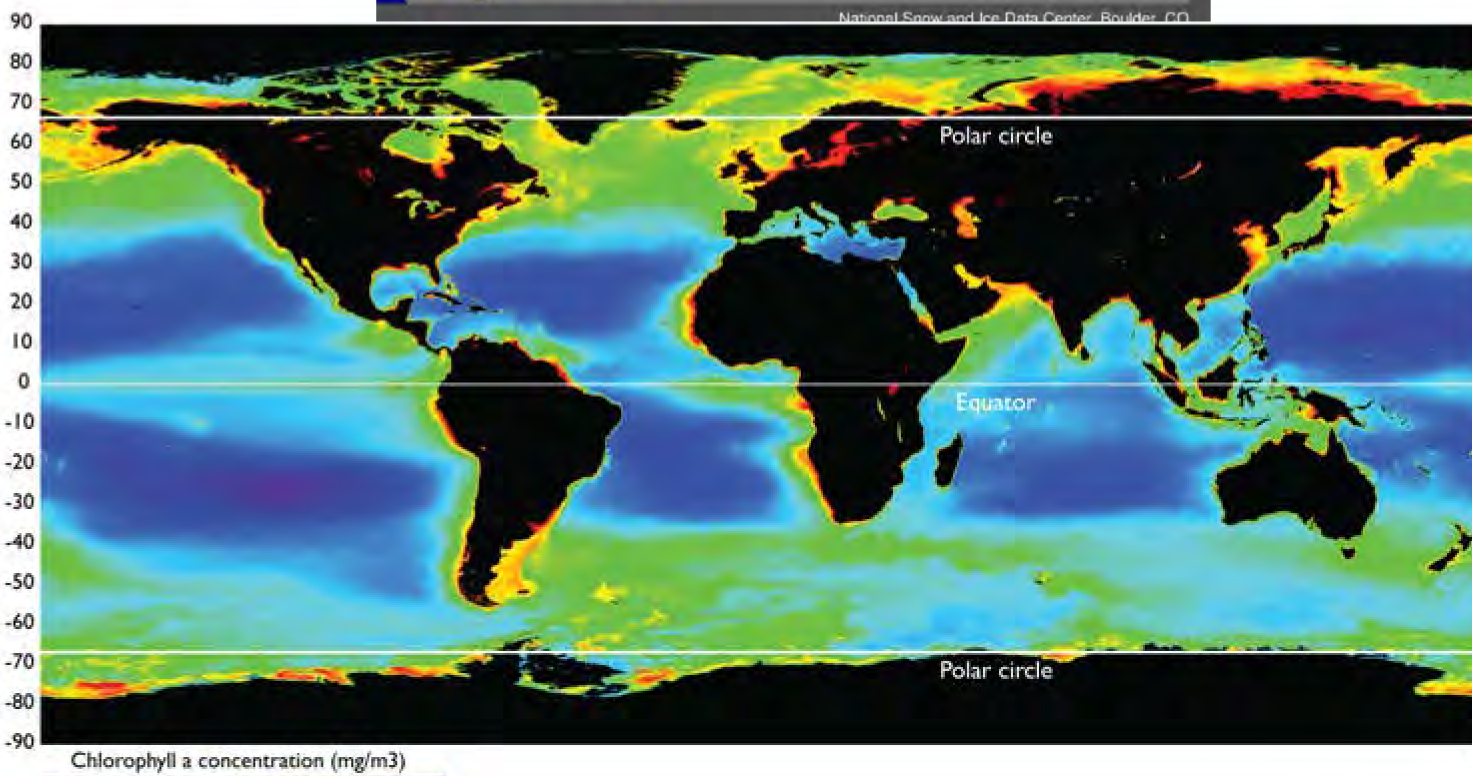
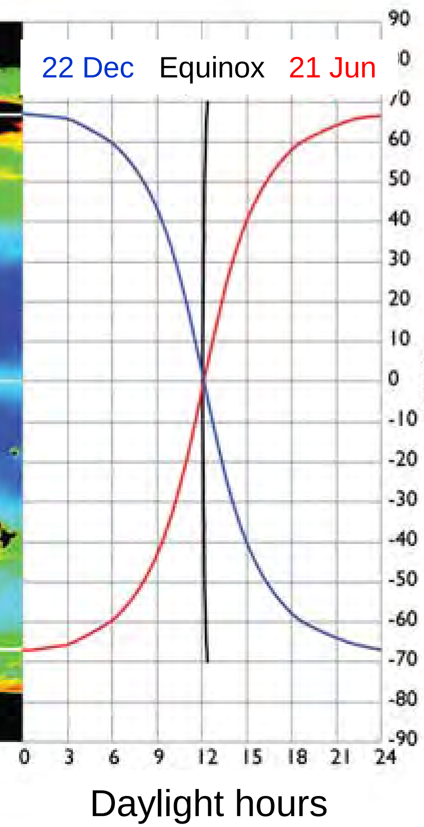
ICES/PICES INTERNATIONAL SYMPOSIUM ON
"DRIVERS OF DYNAMICS OF SMALL PELAGIC FISH RESOURCES"
Session 1: Environmental control of spatio-temporal changes in population size, distribution and migration of small pelagic fish in the ecosystem context

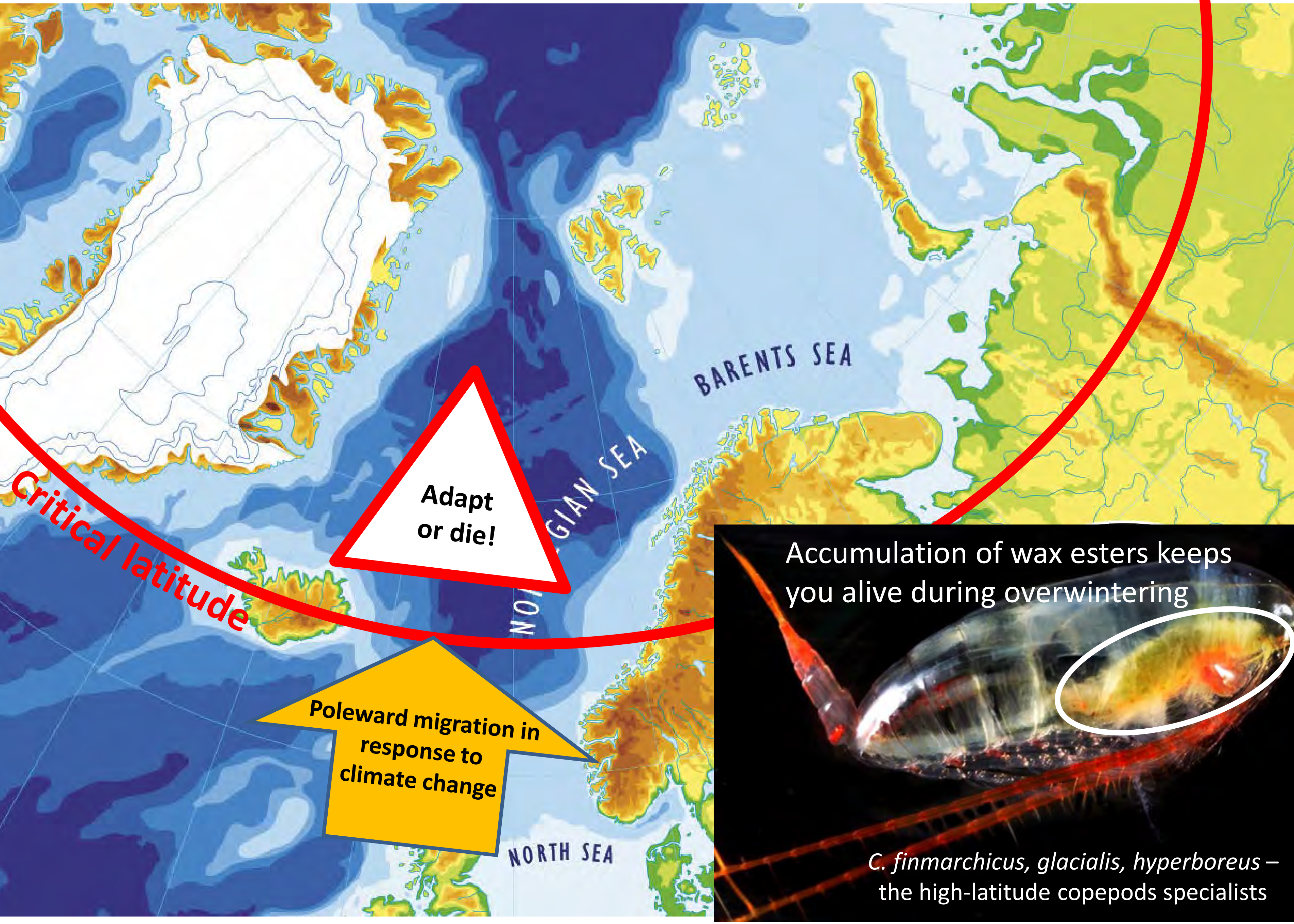
Victoria, British Columbia, 6 – 11 March 2017

High-latitude marine ecosystems are strongly constrained by **the seasonal light cycle**

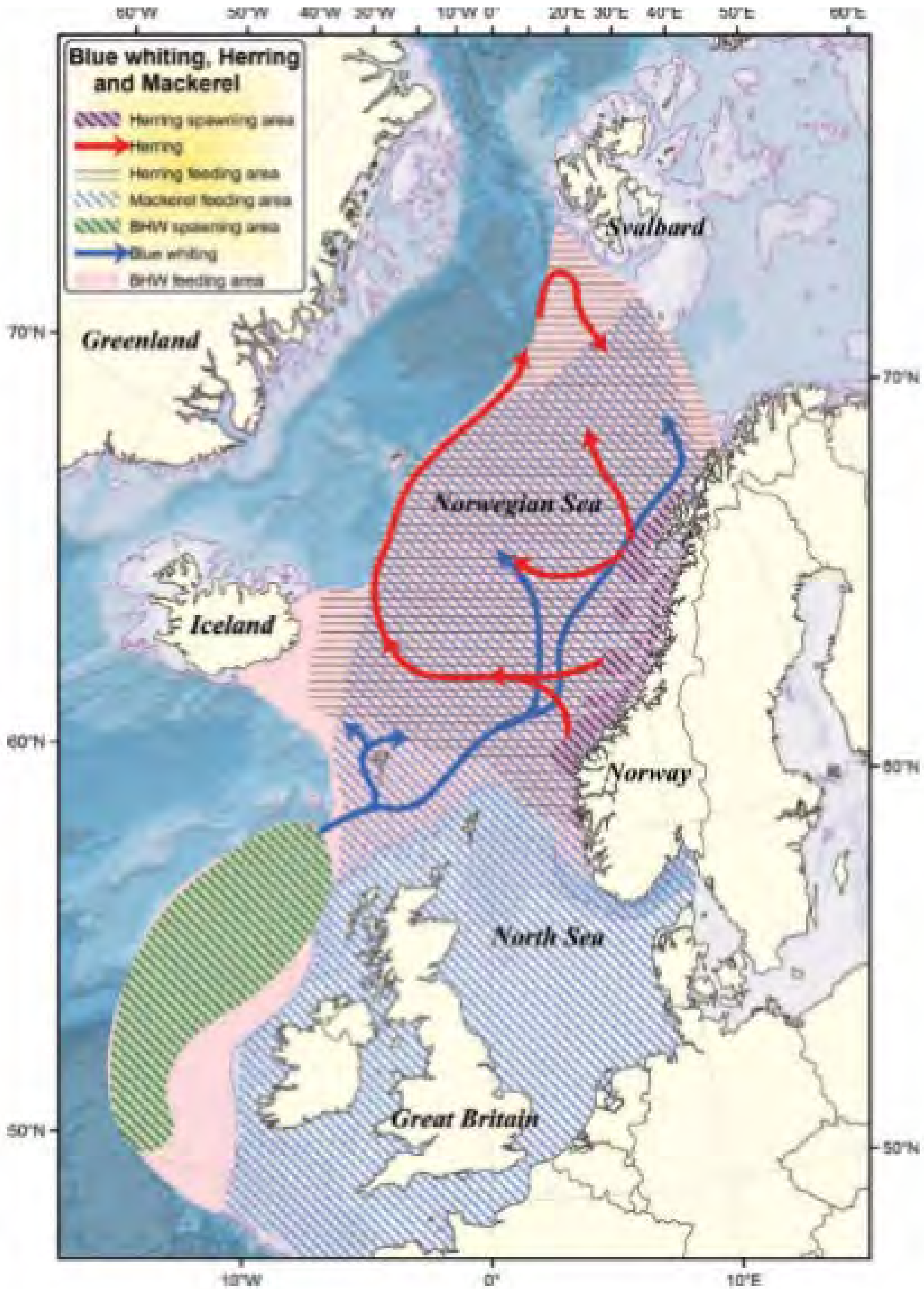




Sundby et al. (2016, Front. Mar. Sci.)



Sundby et al. (2016, Front. Mar. Sci.)



Utne et al. (2014)

The «pelagic complex» of the Nordic Seas

Norwegian spring-spawning herring (NSSH) :

The original inhabitant with its entire life cycle witin the ecosystem

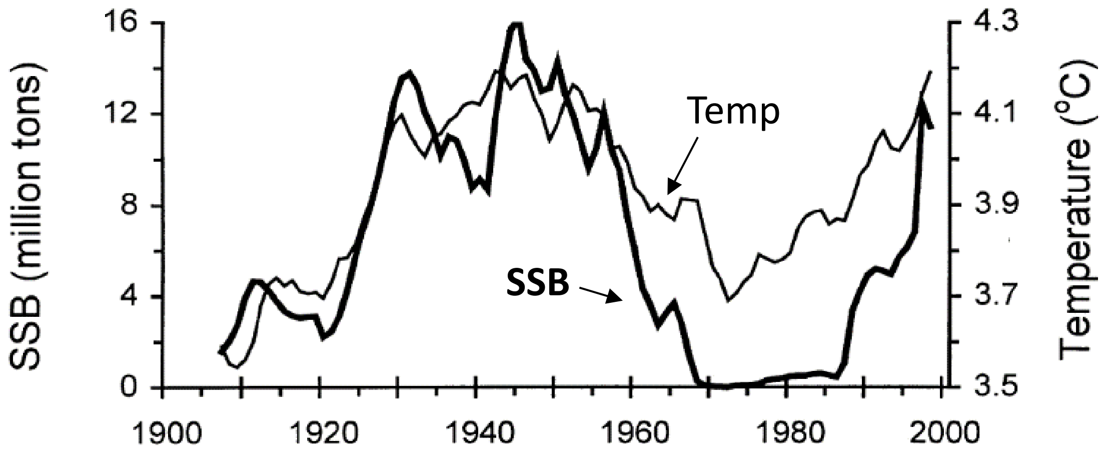
Blue whiting:

The seasonal visiter feeding on zooplankton in the summer

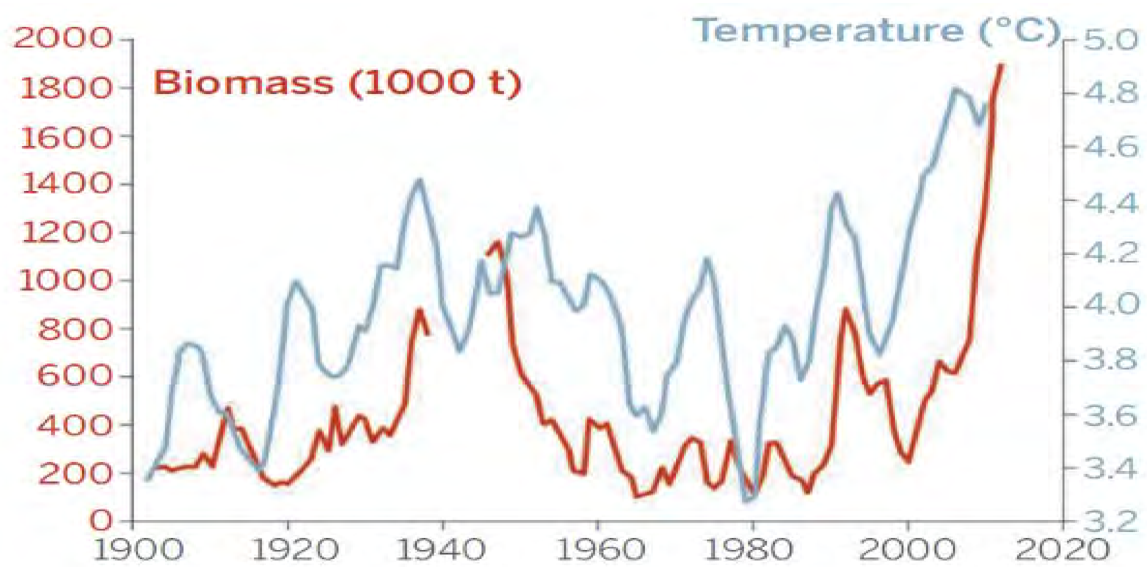
Atlantic mackerel:

The summer tourist invading the region during warm periods

The Atlantic Multidecadal Oscillation (AMO) and fish stock in the Norwegian and Barents seas

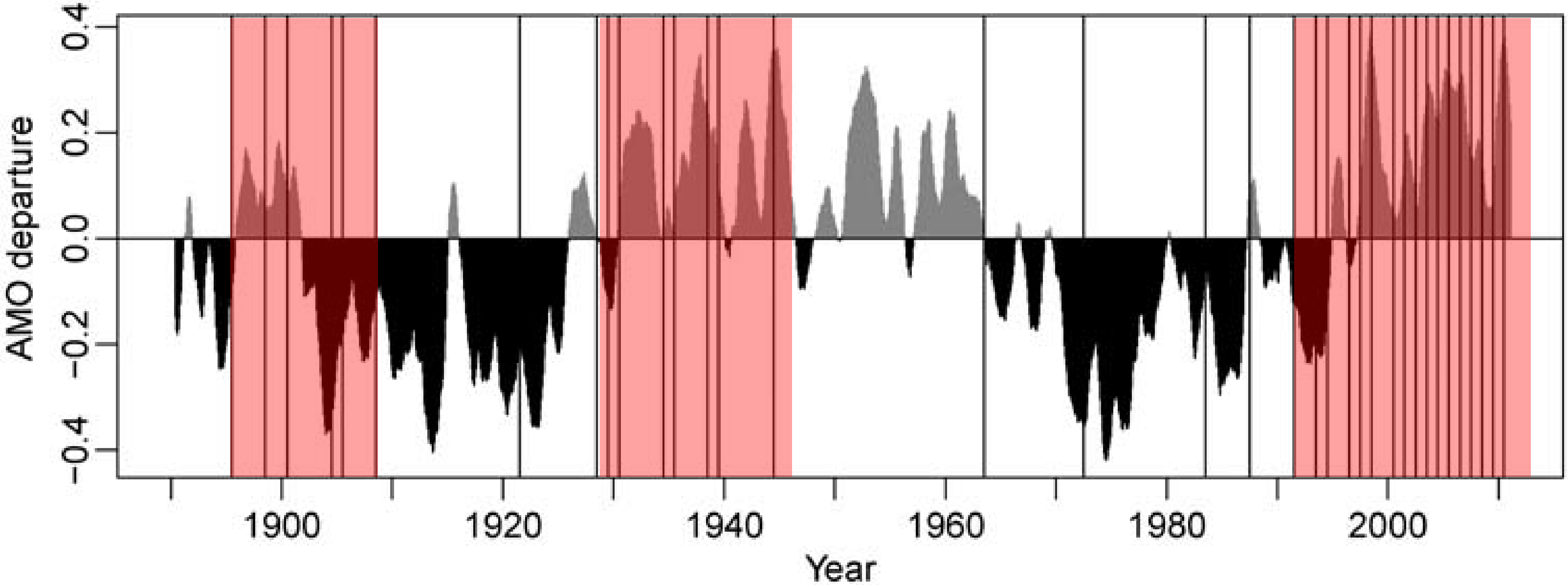


Norwegian spring-spawning herring
(Toresen and Østvedt 2000, F&F)



Northeast Arctic cod
(Hollowed and Sundby 2014, Science)

The Atlantic Multidecadal Oscillation (AMO) temperature index and Icelandic catch frequency (vertical bars) of Atlantic mackerel



(Astthorsson et al. 2012, ICES JMS)

1948: ICES Symposium on
«Climatic changes in the Arctic in relation to plants and animals»

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CONTRIBUTIONS
TO
SPECIAL SCIENTIFIC MEETINGS
1948

"Climatic changes in the Arctic in relation to plants and animals"

Preface by *Gunnar Rollefsen* with Appendix: Enquiry into the Problem of Climate and Ecological Changes in Northern Waters

Introductory address by *Hans W:son Ahlmann*

A. Contribution to Physical Changes

Recent Climatic Fluctuations *by Leo Lysgaard*

The increase in the Sea Temperature in Northern Waters during Recent Years *by Jens Smed*

B. Contributions on Biological changes

On Changes in the Marine Fauna on the North-Western Atlantic Area, with special reference to Greenland by *Å. Vedel Tåning*

Boreo-tended Changes in the Marine Vertebrate Fauna of Iceland during the last 25 years *by Arni Fredriksson*

Fluctuations in the two most important Stocks of Fish in Northern Waters, the Cod and the Herring *by Gunnar Rollefsen*

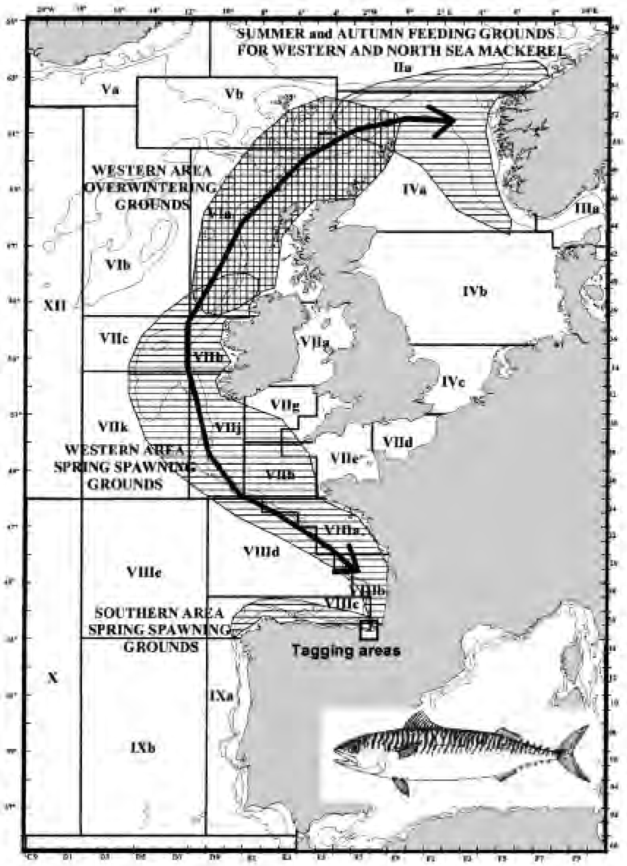
On Changes inthe Distribution of Terrestrial Animals in Relation to Climatic Changes *by Poul Jespersen*

The Forecasting of Climatic Fluctuations and Its Importance to the Arctic Fisheries *by Arthur Lee*

Atlantic mackerel

”Traditional” seasonal distribution between Bay of Biscay and North Sea

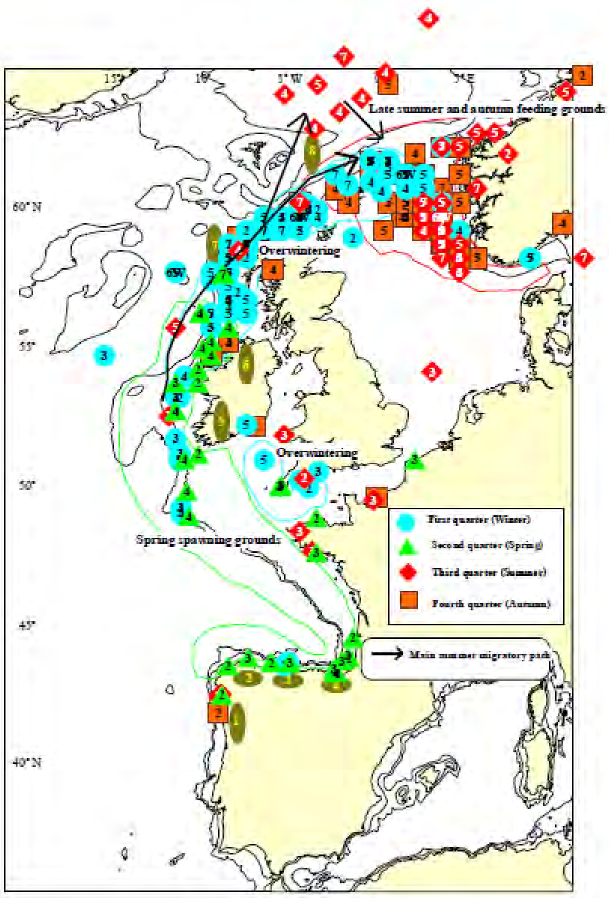
observations from 1994



Uriarte and Lucio (2001)

Centre of gravity starting to move towards north

observations from 1997 and 1998



Uriarte et al. (2001)

From Astthorsson et al. (2012) ICES Journal of Marine Science:

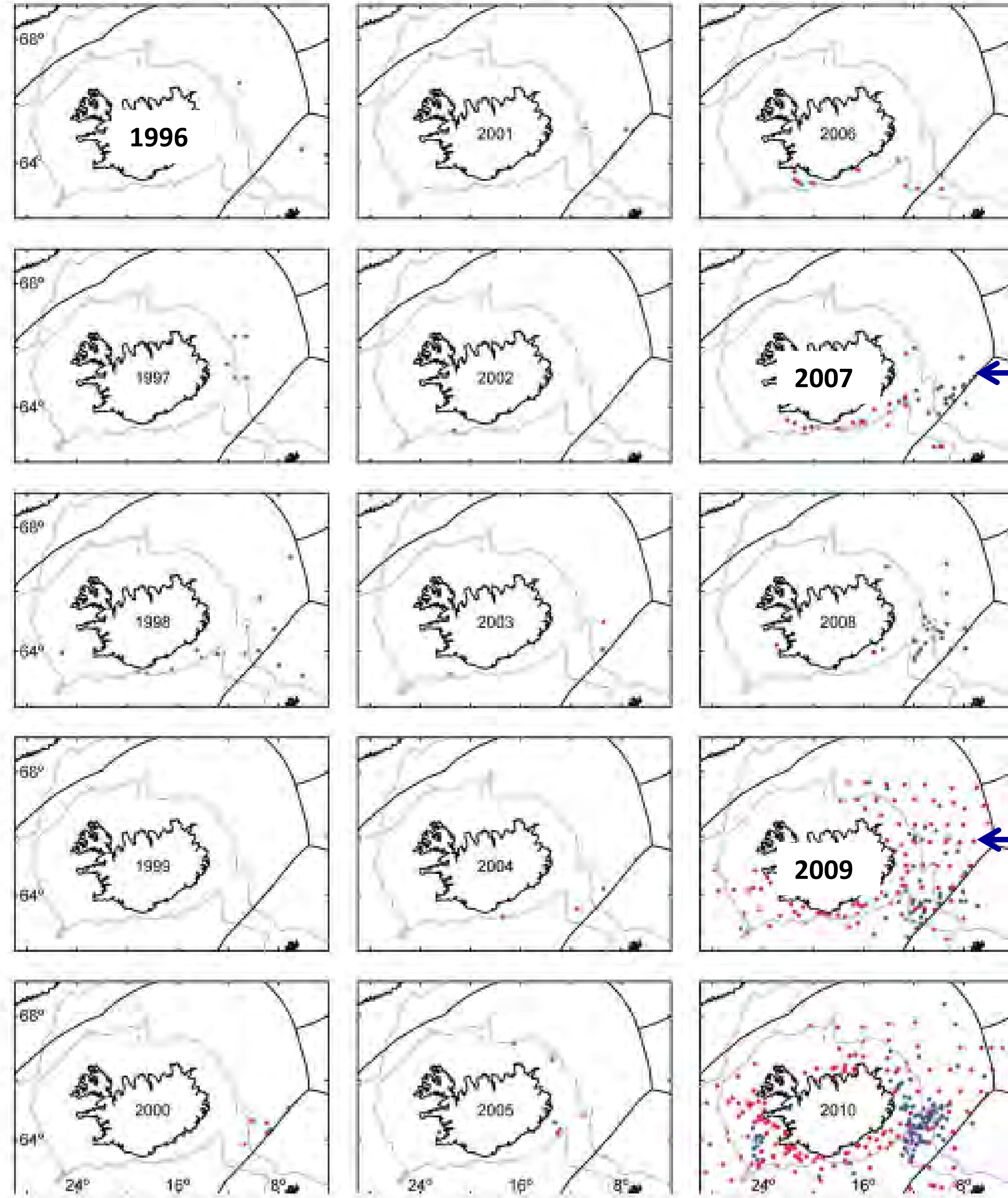
Atlantic mackerel

Catches in Icelandic waters

1996-2010

Red dots: research vessel catches

Blue dots: commercial catches

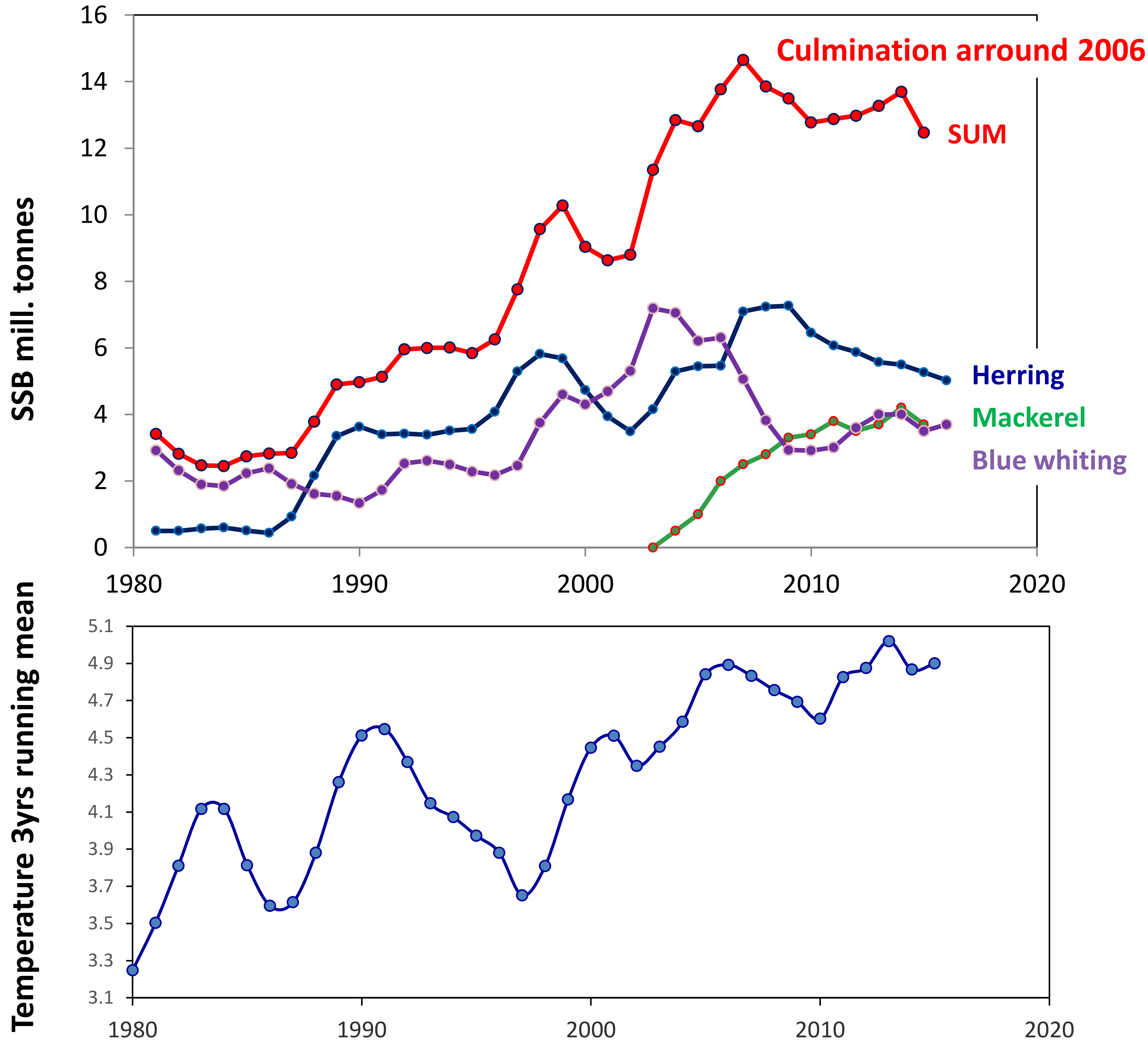


Start of Icelandic commercial fishing

Massive abundances beyond the Norwegian Sea

Figure 5. Locations of mackerel catches from scientific surveys by the Marine Research Institute (red) and of mackerel samples taken by the

Ocean climate and the pelagic complex in the Norwegian Sea



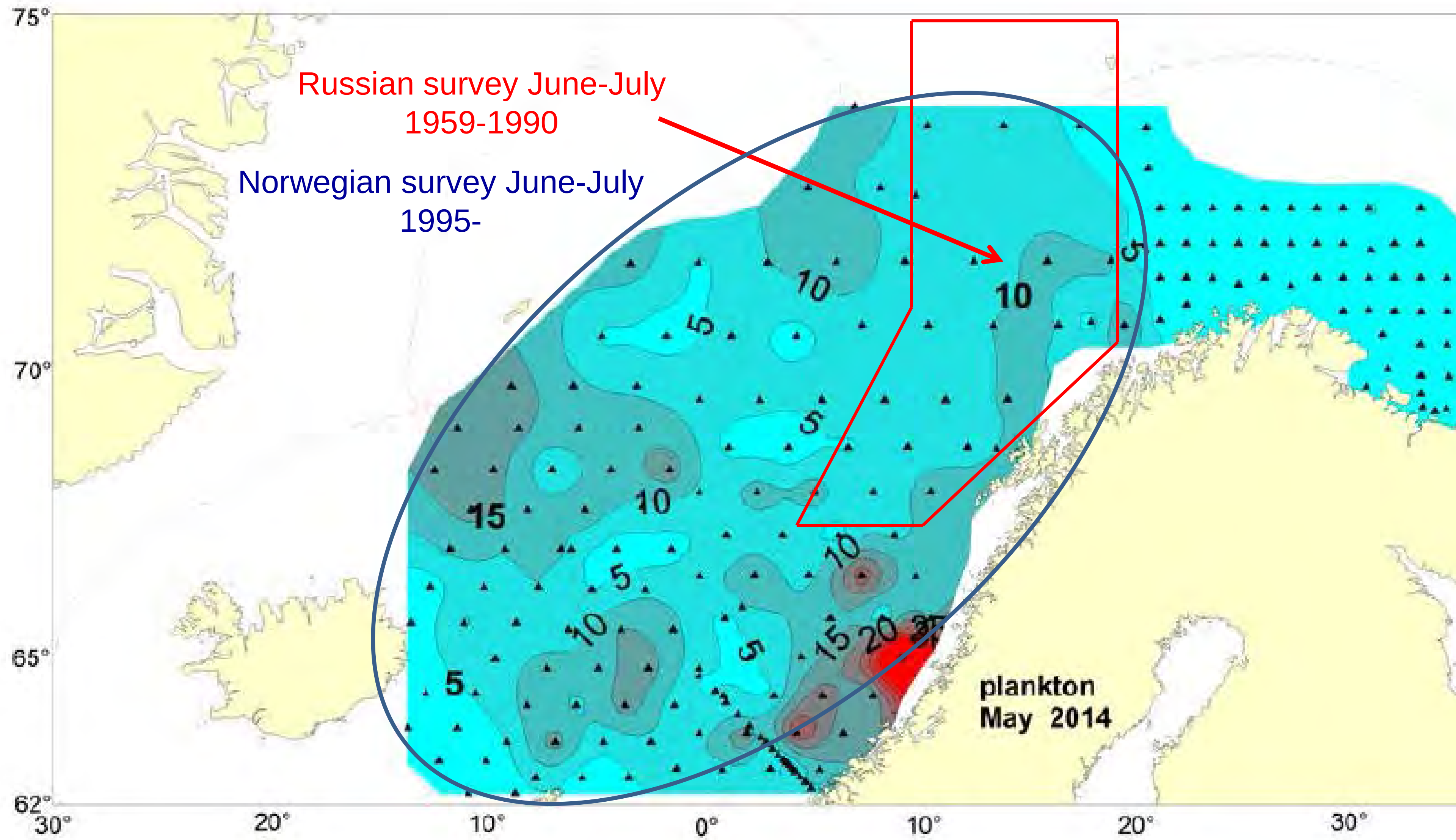
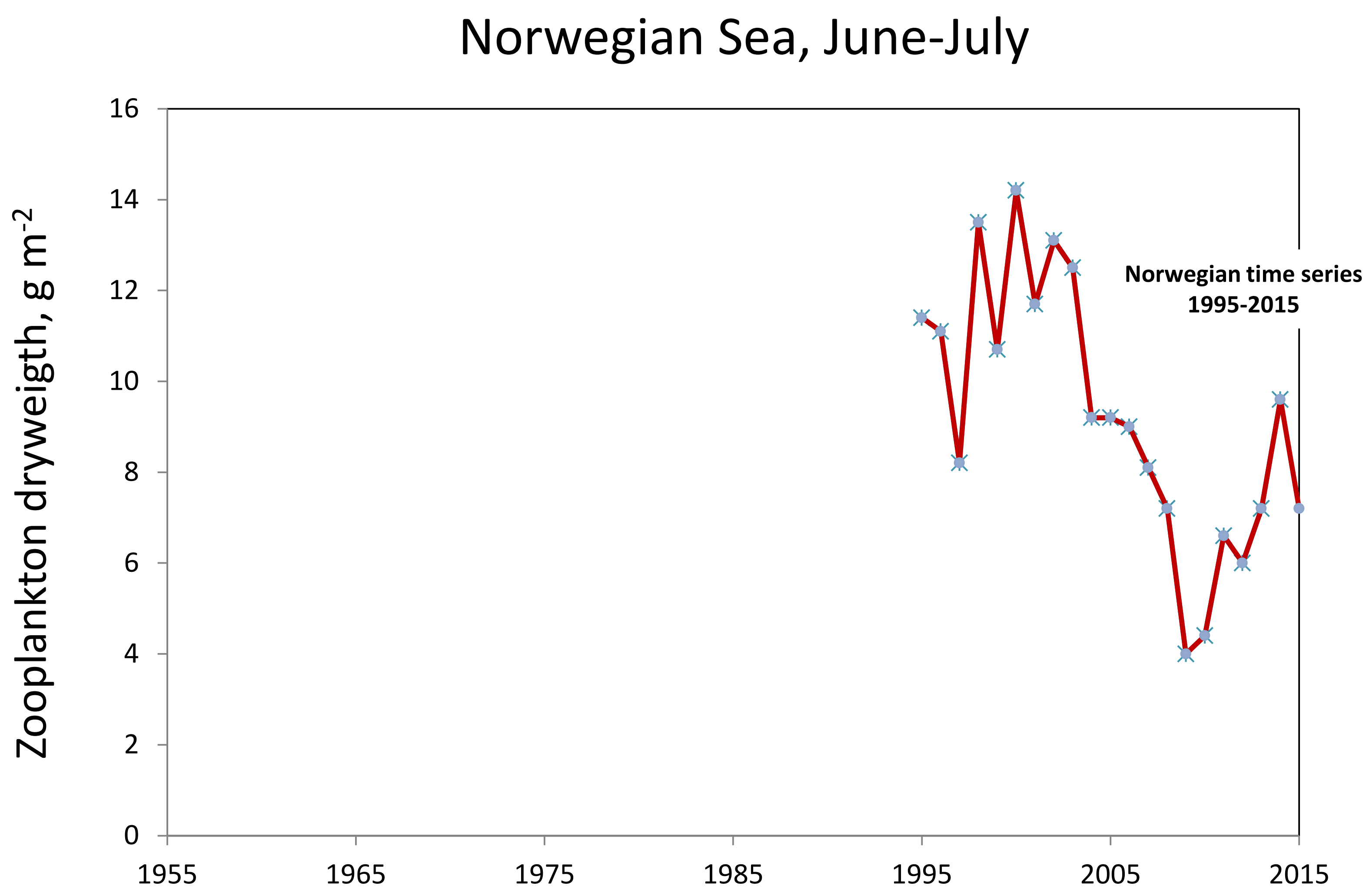
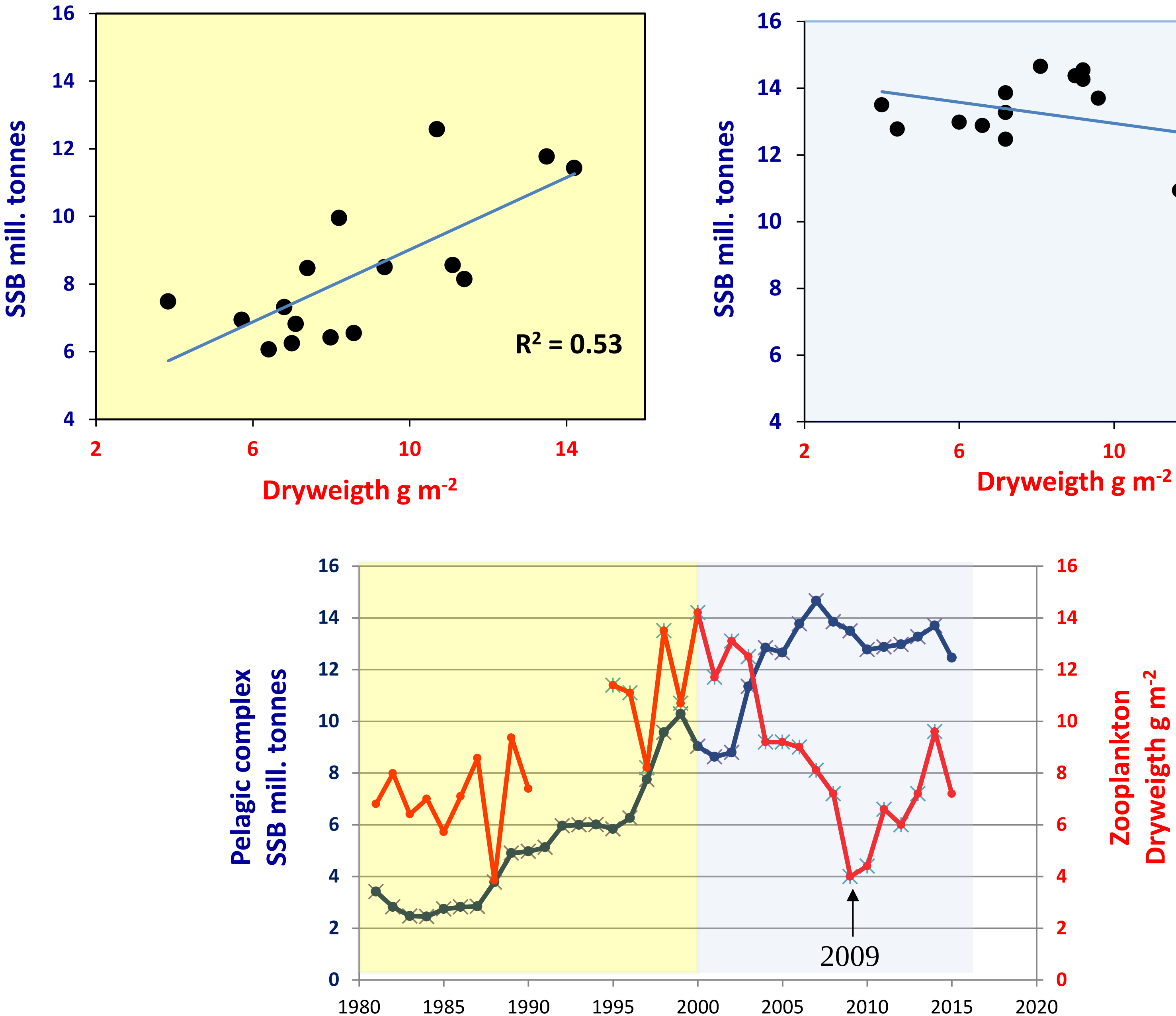


Figure 19. Zooplankton biomass (g dw m-2; 200–0 m in April-June 2014.

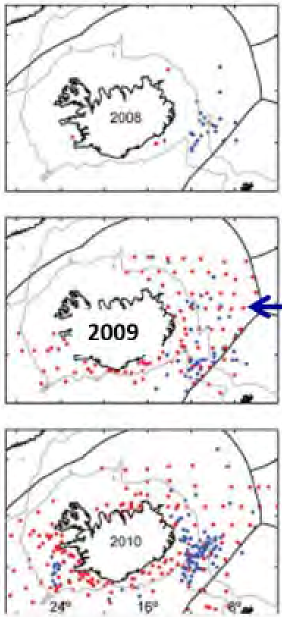


For conversion of Russian data from mg m^{-3} , 0-50 m depth, wet weight, to g m^{-2}, dry weight, is used Kiørboe (2013) Limnology&Oceanography (Table 1) conversion factor assuming 50% copepods, 30% euphausids, and 20% amphipods: Dry weight 19.72% of wet weight.



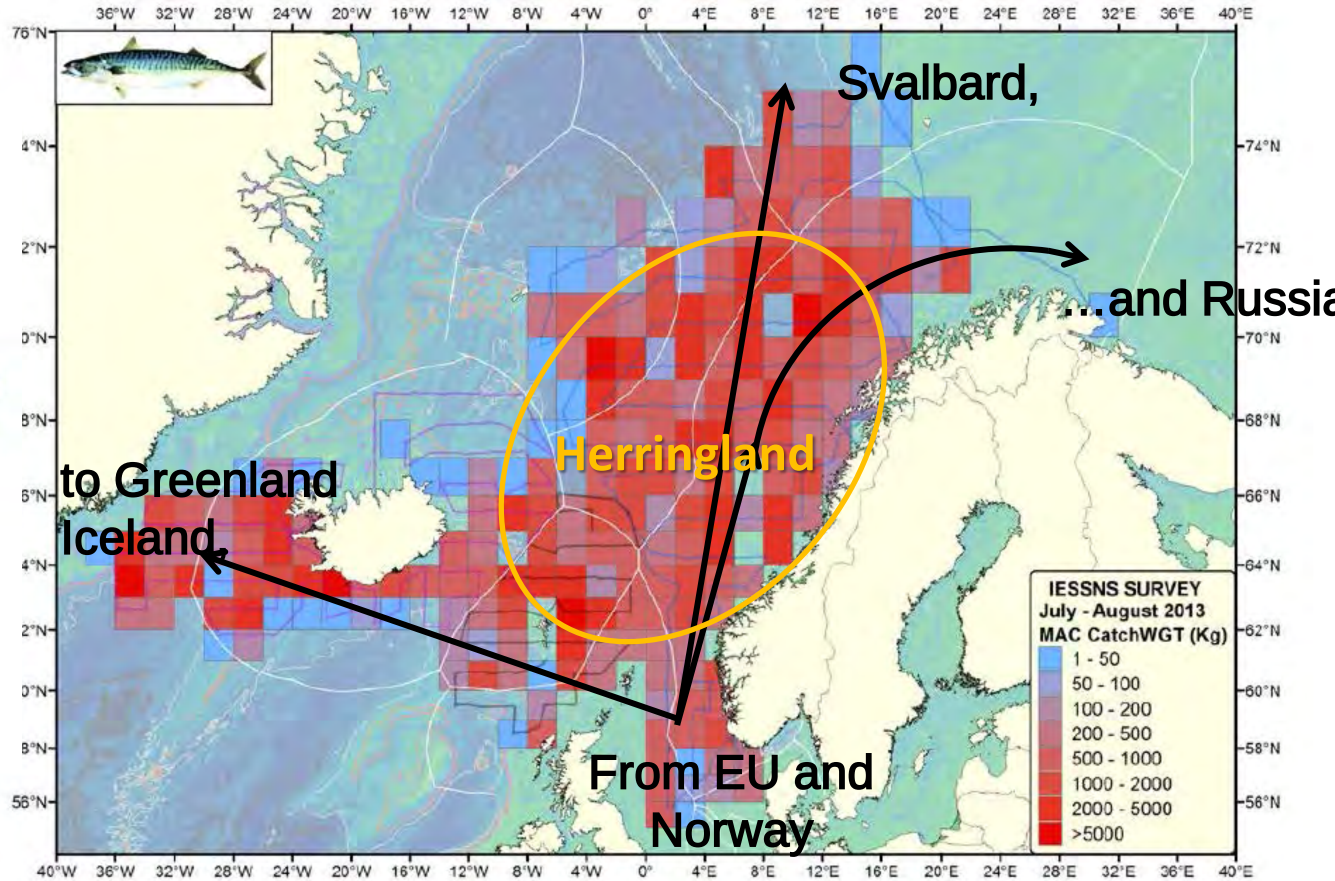
SSB mill. tonnes
Dryweigth g m-2
R2 = 0.53
SSB mill. tonnes
Dryweigth g m-2
R2 = 0.16
Pelagic complex
SSB mill. tonnes
Zooplankton
Dryweigth g m-2
2009

Distribution of mackerel summer 2013



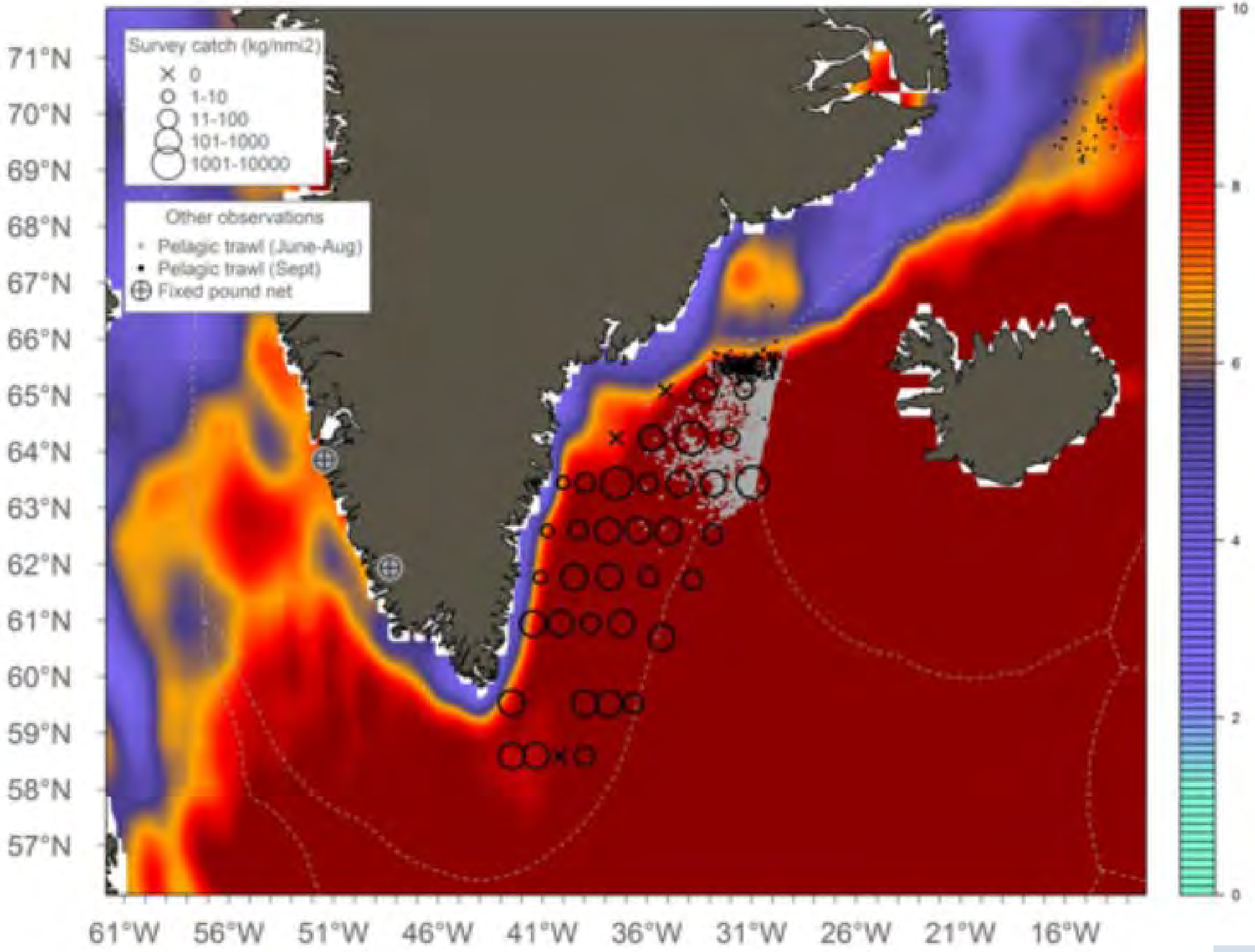
Massive abundances beyond the Norwegian Sea

Astthorsson et al. (2012)



Nøttestad et al. (2013)

http://www.natur.gl/kommunikation/nyheder/nyhed/a/makrel-traef-for-naalakkersuisut-og-inatsisartut-medlemmer/



From the Nature Institute of Greenland 2014: Research and commercial mackerel catches in East Greenland waters in 2014

Kortet viser instituttets makrel-togt i østgrønlandsk farvand i 2014. Runde områder fortæller om antallet af makreller (jo større jo flere) og krydserne, at der ikke var makreller. Grå og sorte briller fortæller om det grønlandske fiskeris udbredelse i 2014.

Concluding remarks

Interdecadal variation with large changes in abundance is not limited to small pelagic (planktivorous) fish (SPF) – but the boosts and collapses are more pronounced attributes in SPF

SPFs display the well-known pattern of boost and collapse also in others ecosystems than upwelling systems

Long-lived and multiple spawning SPFs, like the Norwegian spring-spawning herring (NSSH), also display «boost and collapse» behaviour

In the high-latitude Northeast Atlantic the AMO is a major driver behind changes in abundance and distribution of marine populations – but the **mechanisms** behind the changes is only partly known

There are indications that the Norwegian Sea ecosystem has reached its carrying capacity for planktivorous fish since 2000 – but we do not know whether this is start of a new collapse in NSSH or whether it will make a soft landing