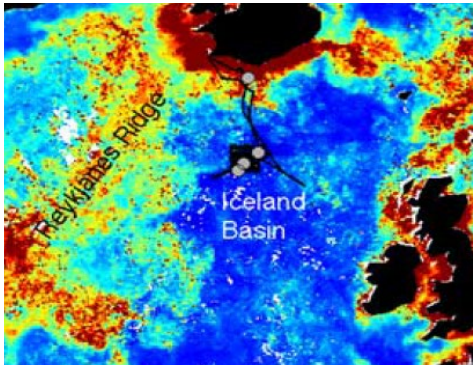
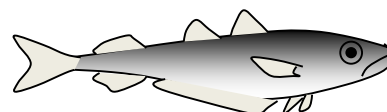
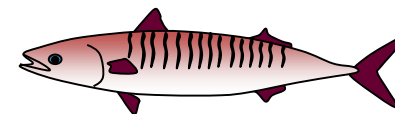


Blue whiting



Mackerel



Herring

Selected short-stories from Icelandic waters

Hjálmar Hátún

And many good people ☺



Max-Planck-Institut
für Meteorologie

Sjávarútvegsráðstefnan 2018, 15.-16. nóvember í Hörpu.



HAVSTOVAN
FAROE MARINE RESEARCH INSTITUTE

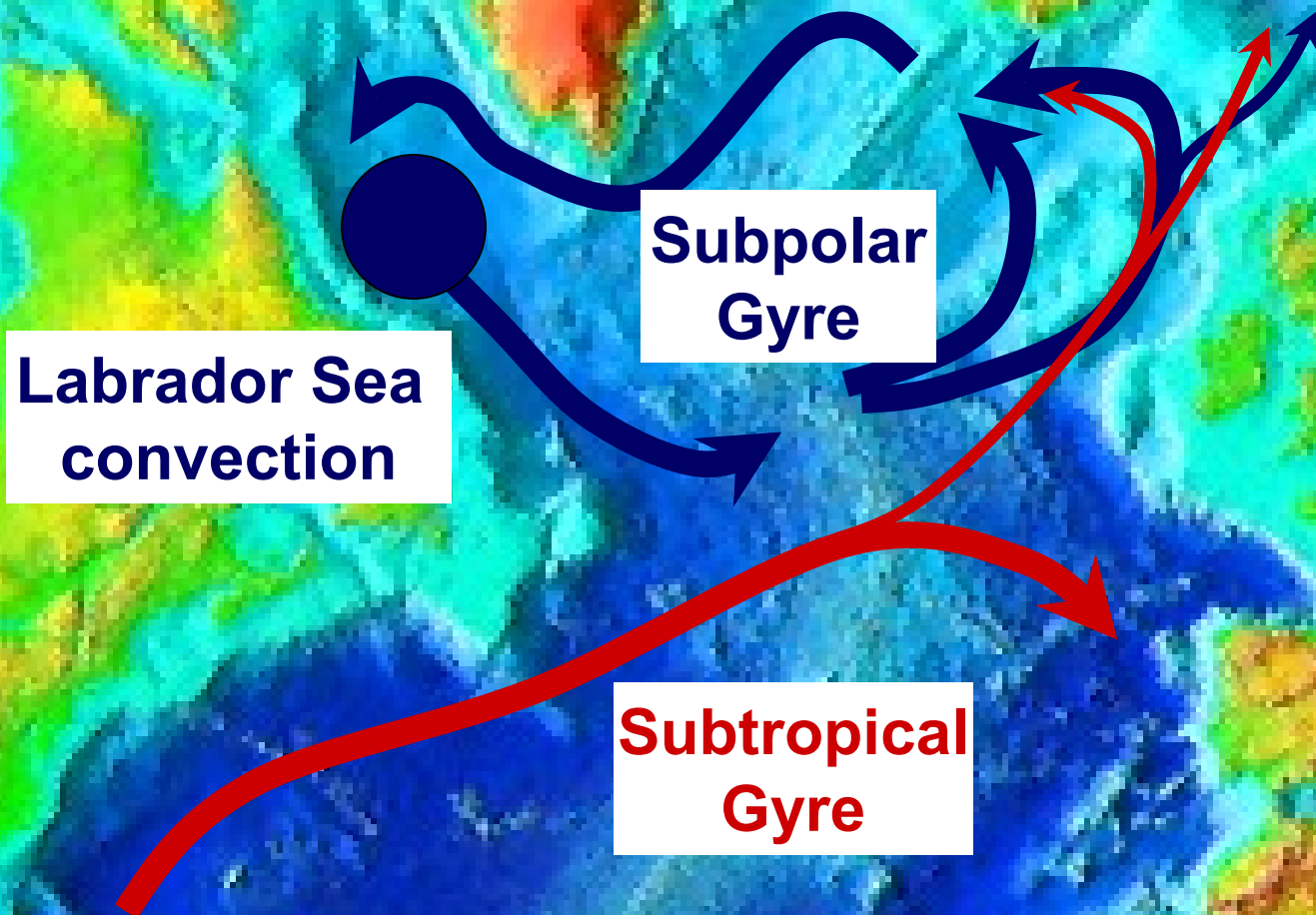
BLUE ACTION

November 2018

Outline

1. The subpolar gyre
2. The post-1995 blue whiting boom
3. The post-2006 mackerel expansion
4. Disappearance of 'rauðáta' (*Calanus hyperboreus*) north of the Faroes after 2003.
5. The gyre revived after 2014
6. Collaboration between science and industry

1. The subpolar gyre – and the marine climate



duction

3

I

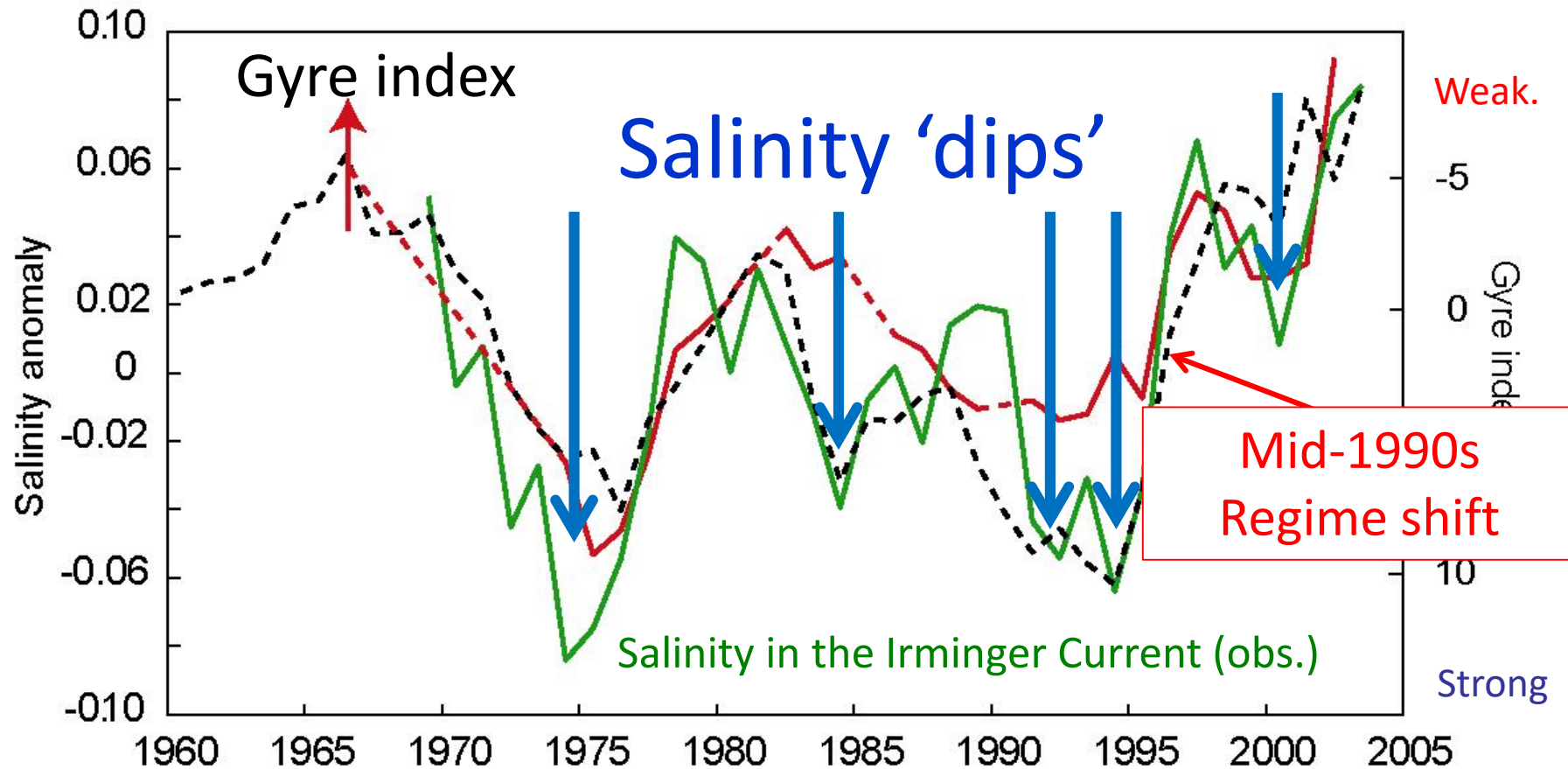
2

Subpolar Gyre

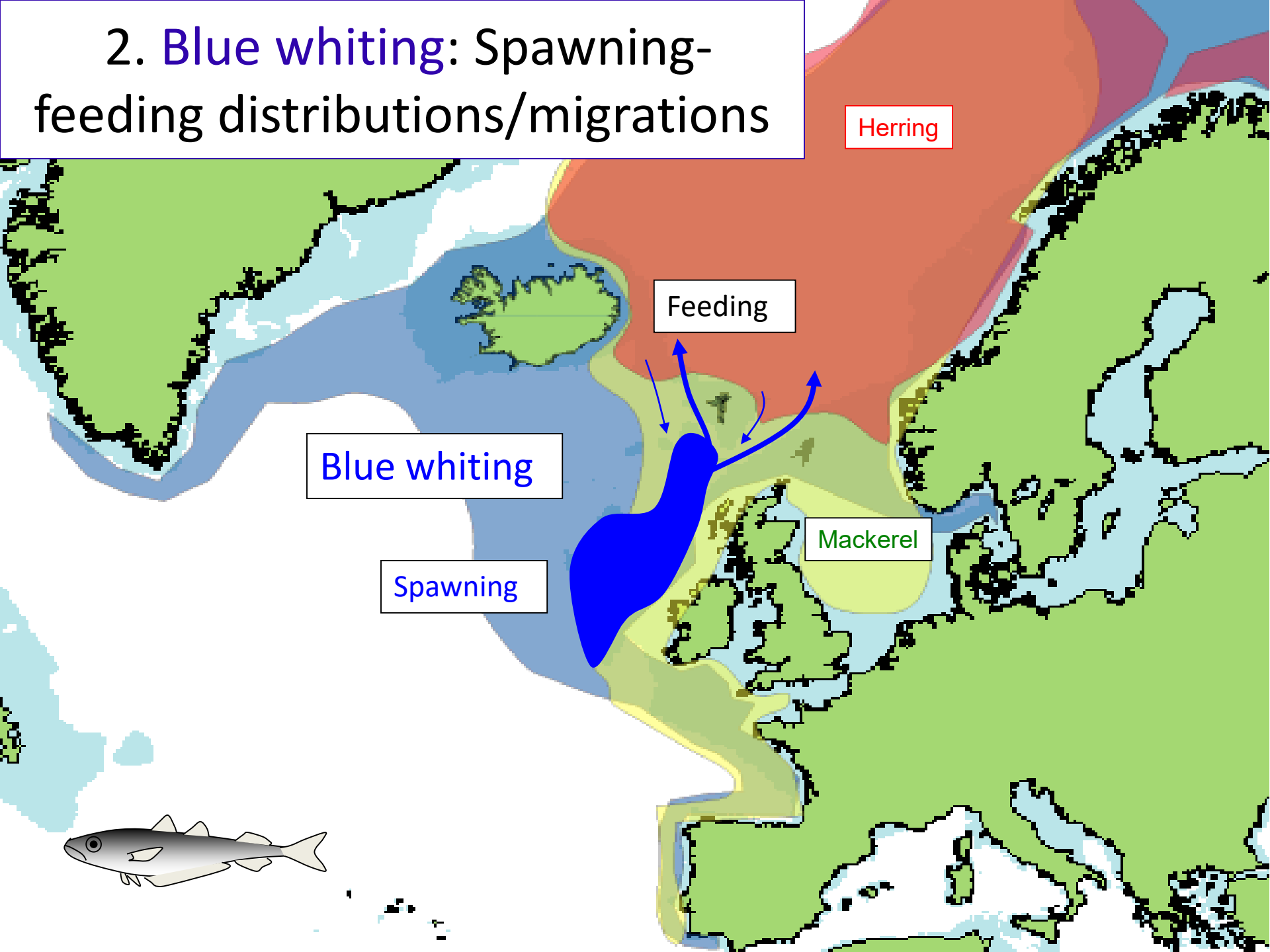
R

The diagram illustrates ocean circulation. A large blue arrow labeled '2' indicates a flow from the left towards the 'Subpolar Gyre'. A smaller blue arrow labeled '3' points upwards from the 'Subpolar Gyre' towards a green box labeled 'I'. A red arrow labeled 'R' points downwards from the 'Subpolar Gyre' towards the bottom right. The background is a satellite image of the ocean with various colors representing different temperatures or depths.

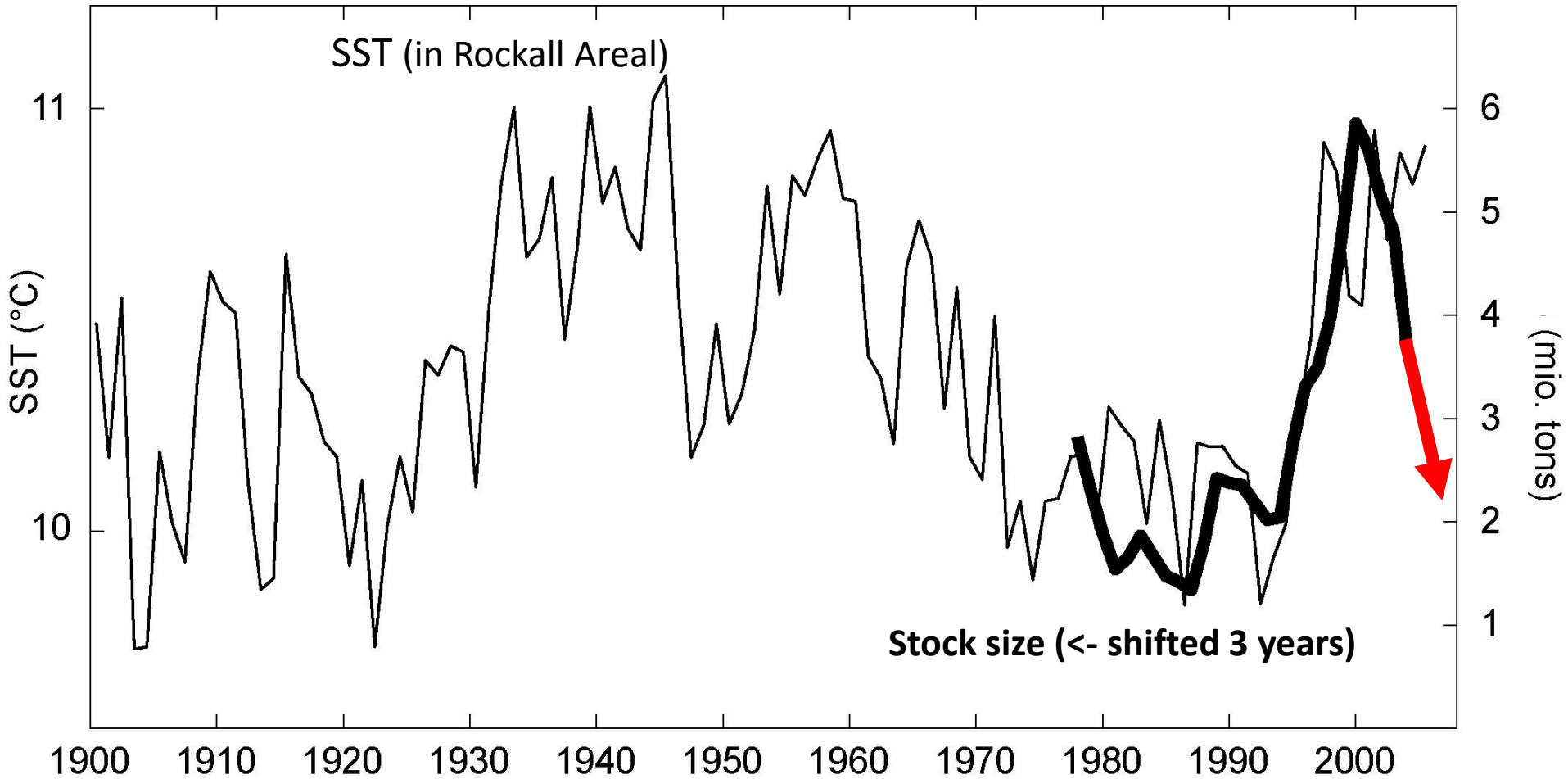
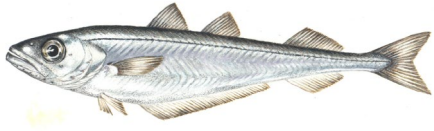
- and salinity 'dips'



2. Blue whiting: Spawning-feeding distributions/migrations

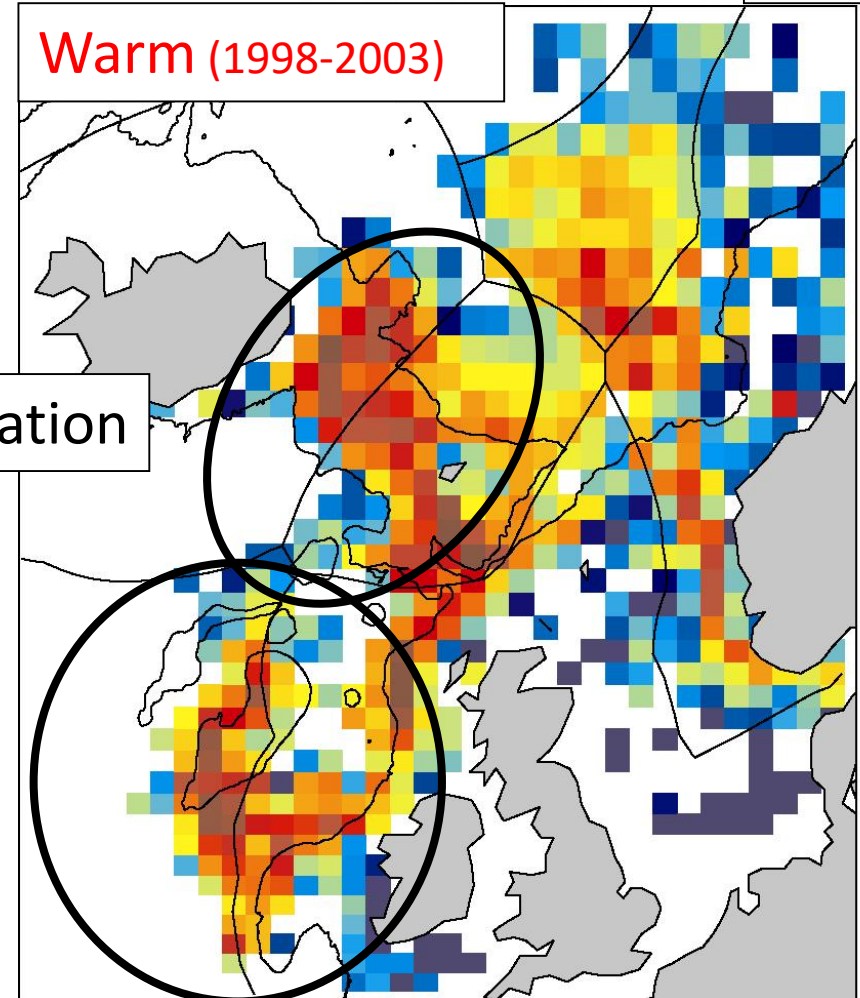
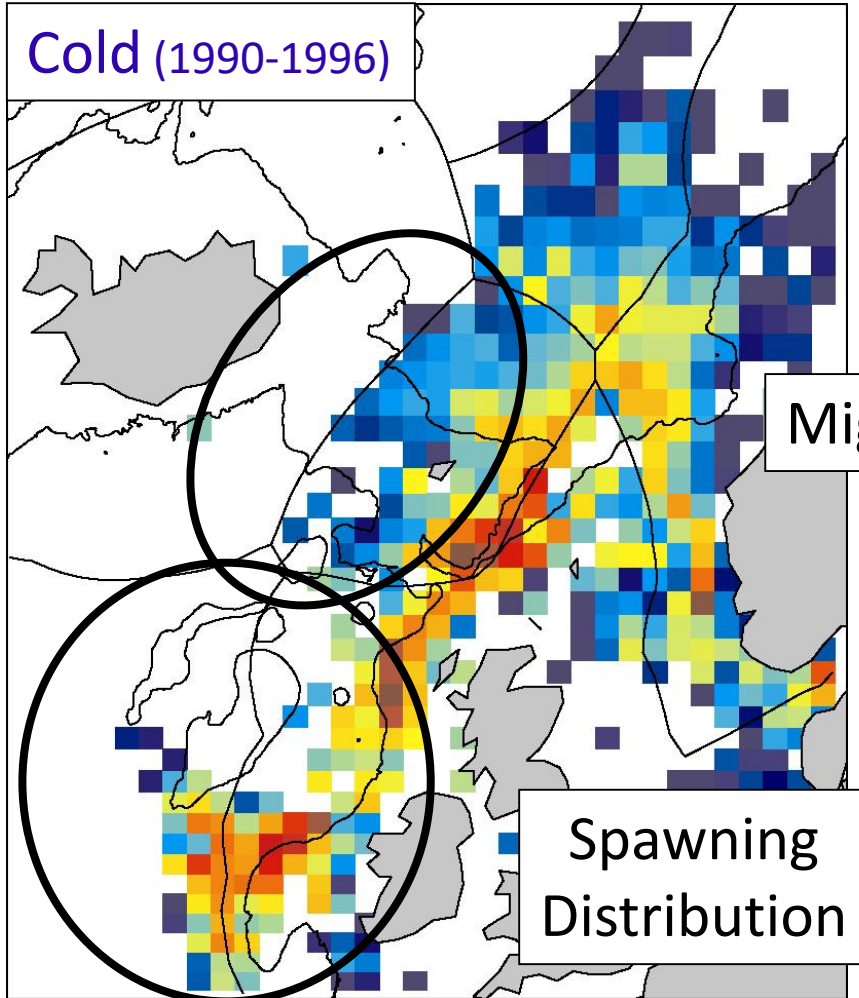
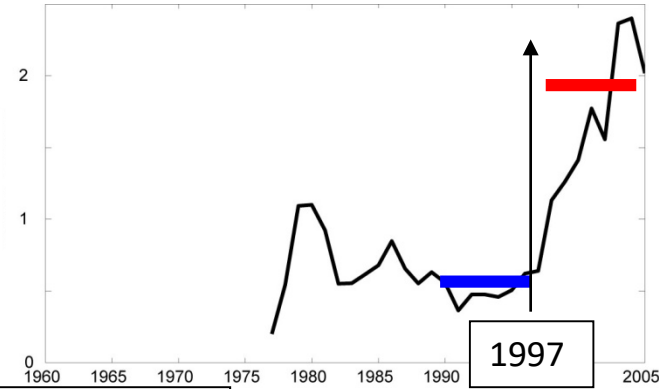


2. Blue whiting: A threefold stock-size increase



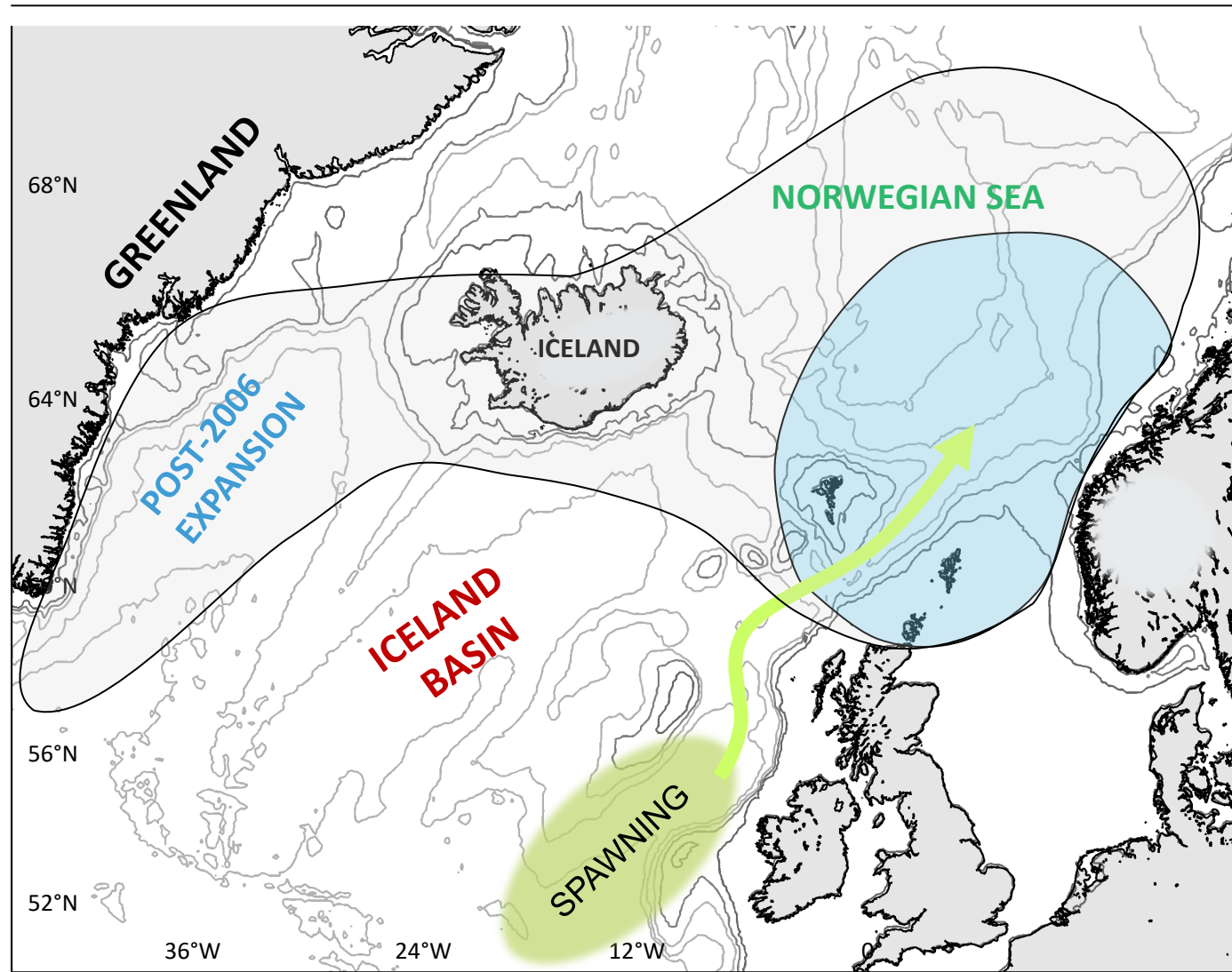
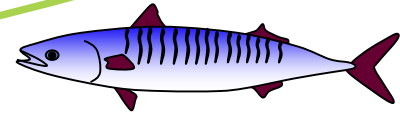
2. Spatial Shifts

(Catches – all nations)

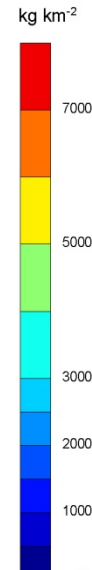
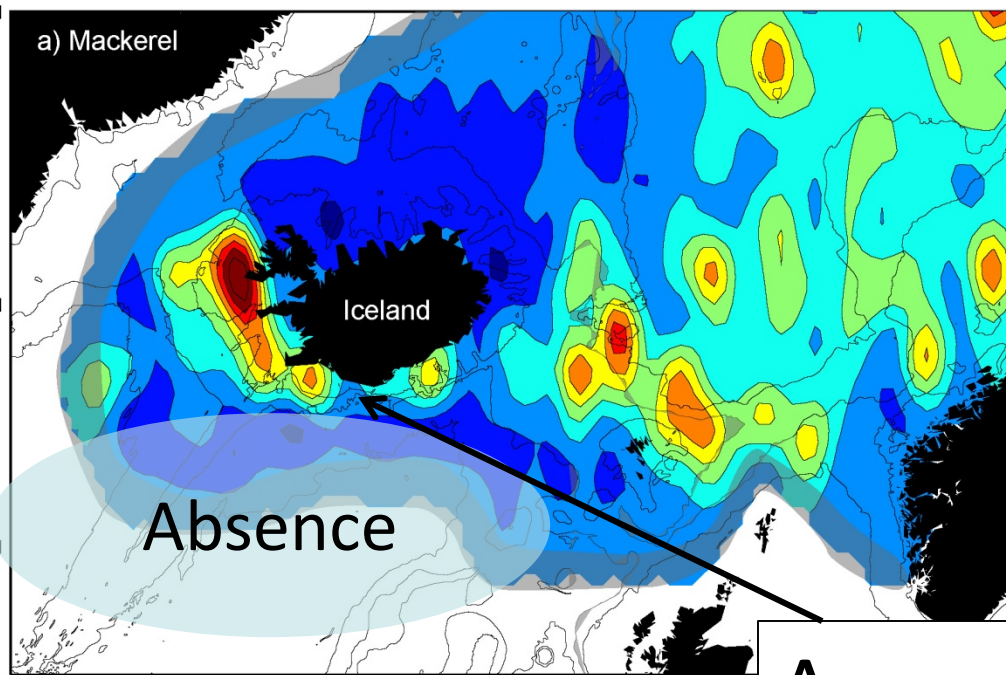
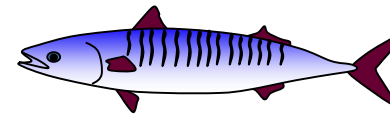




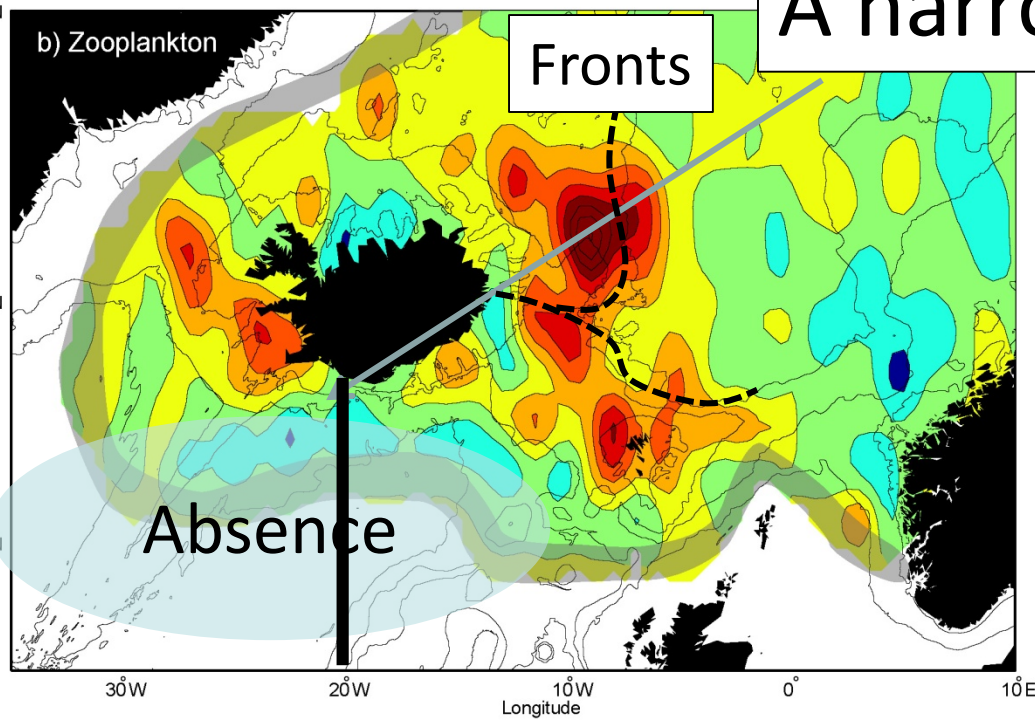
3. The post-2006 **mackerel** expansion



3. International July mackerel surveys (2009-2014)

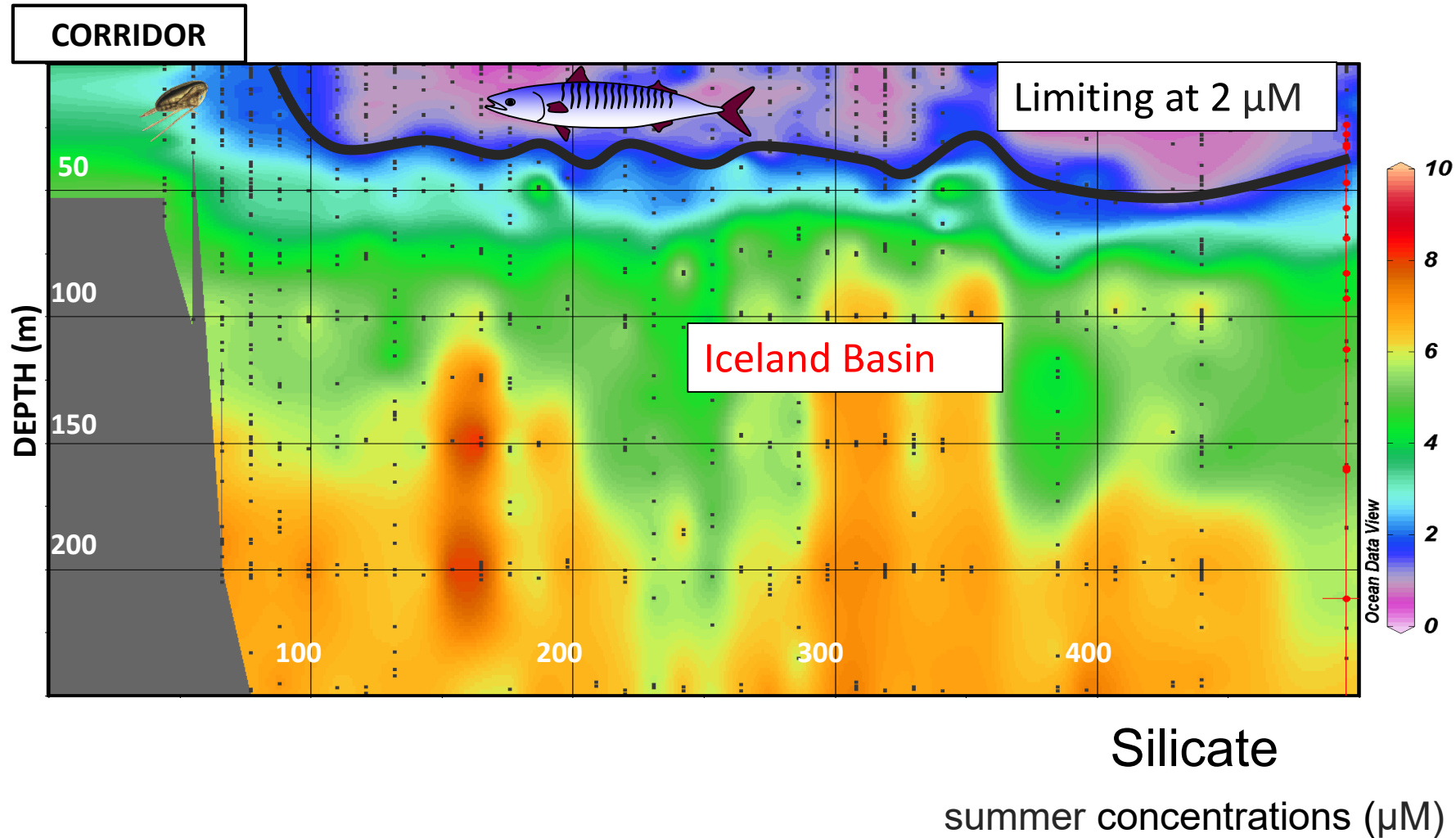


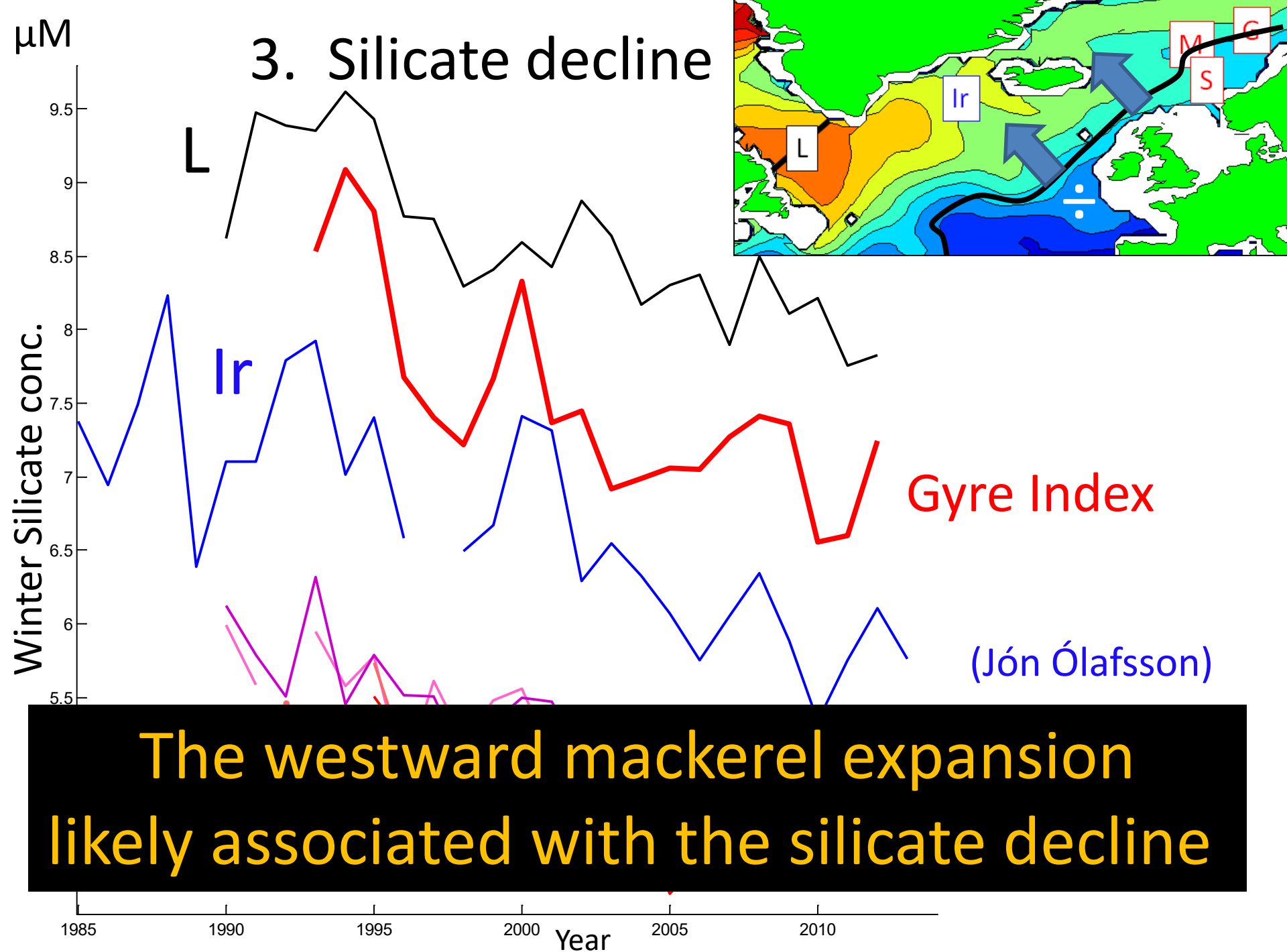
A narrow 'corridor'



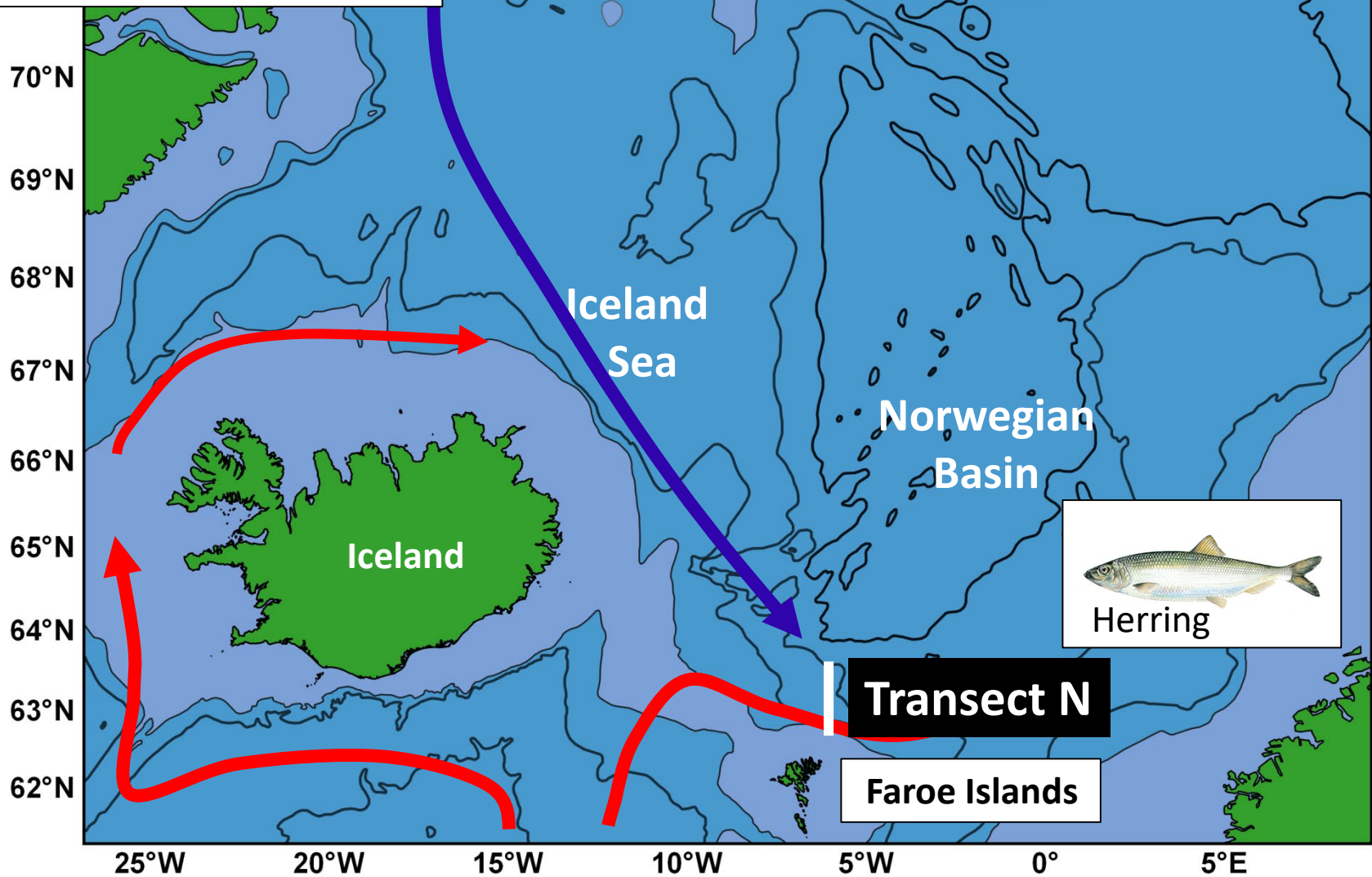
Zooplankton

3. Empty Iceland Basin? – a richer ‘corridor’

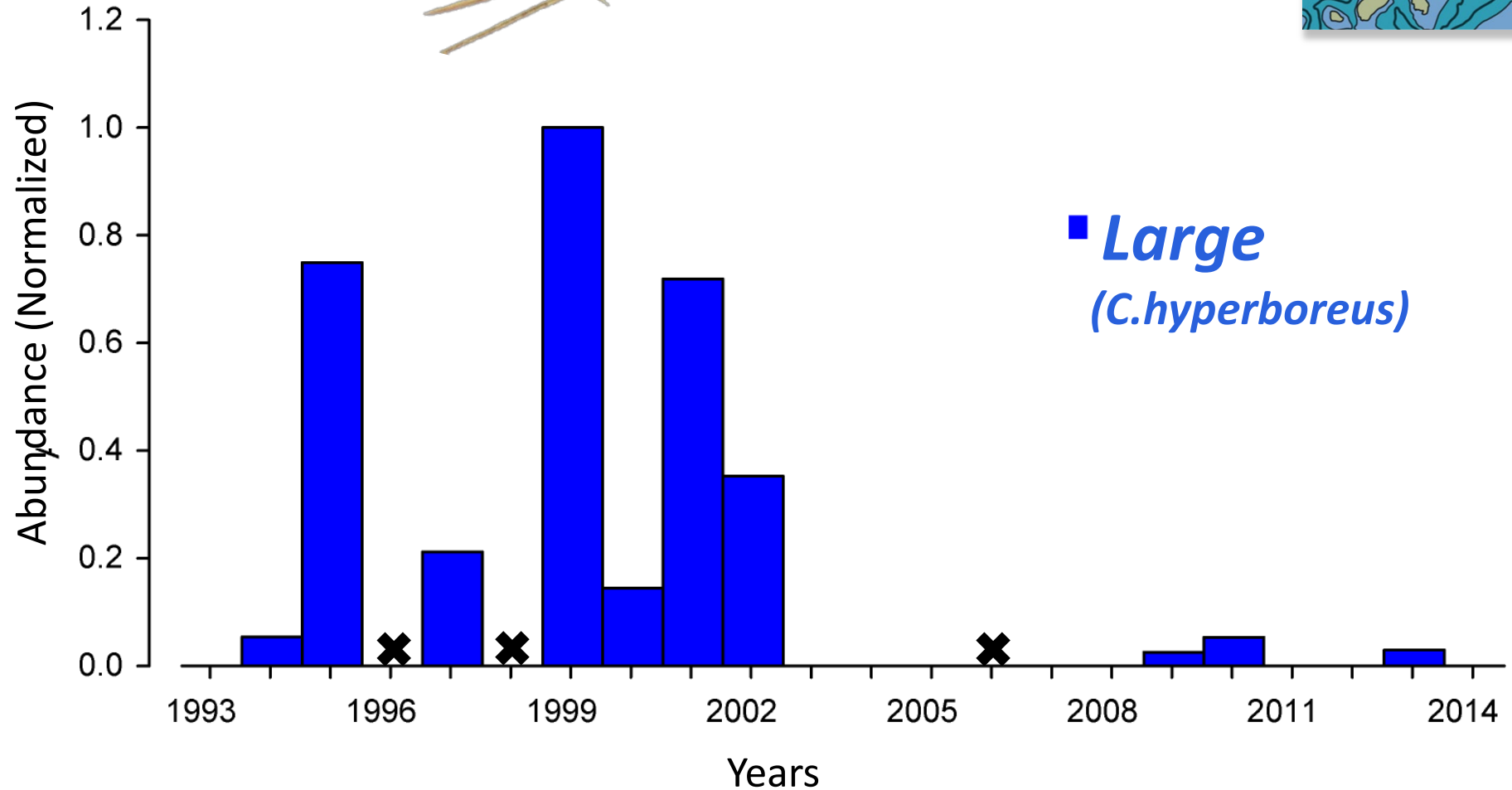
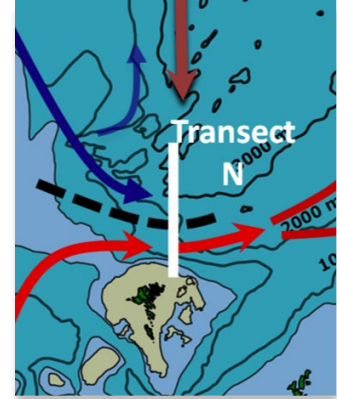




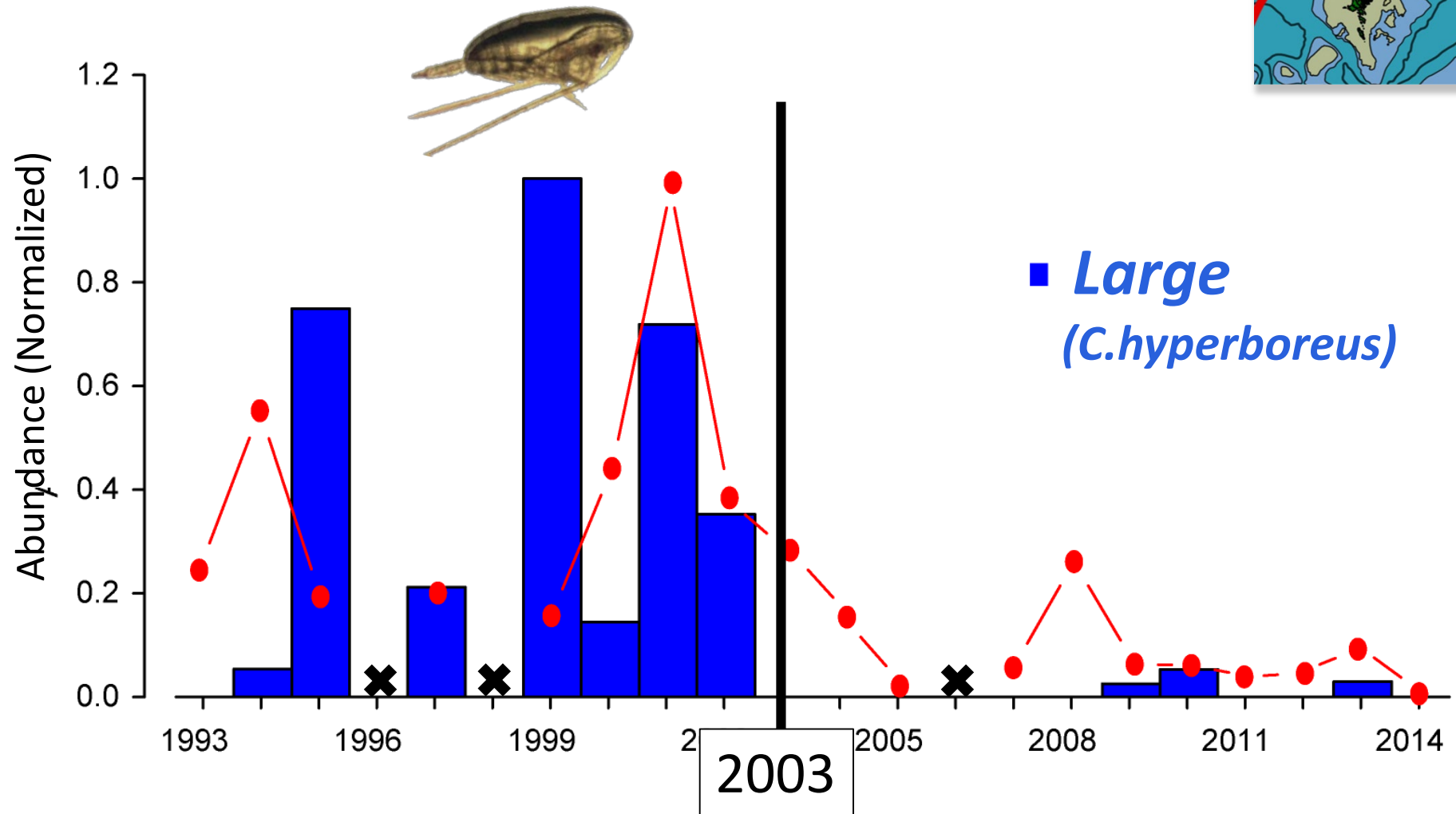
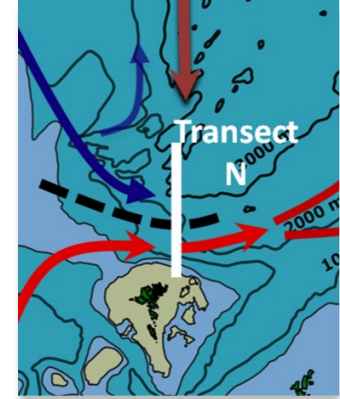
4. Zooplankton (*rauðáta*) - for herring



4. Zooplankton (*rauðáta*)

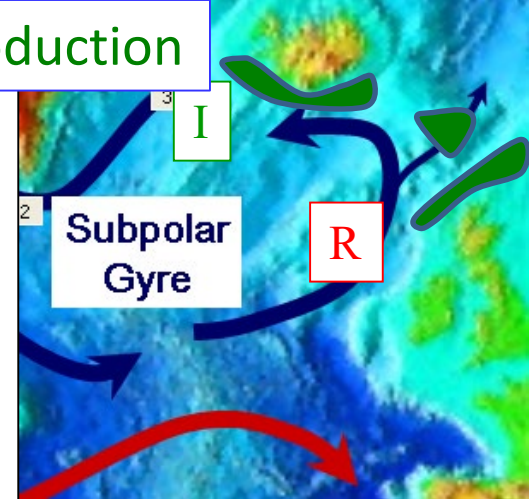


Likely caused by reduced influence of East Icelandic Water



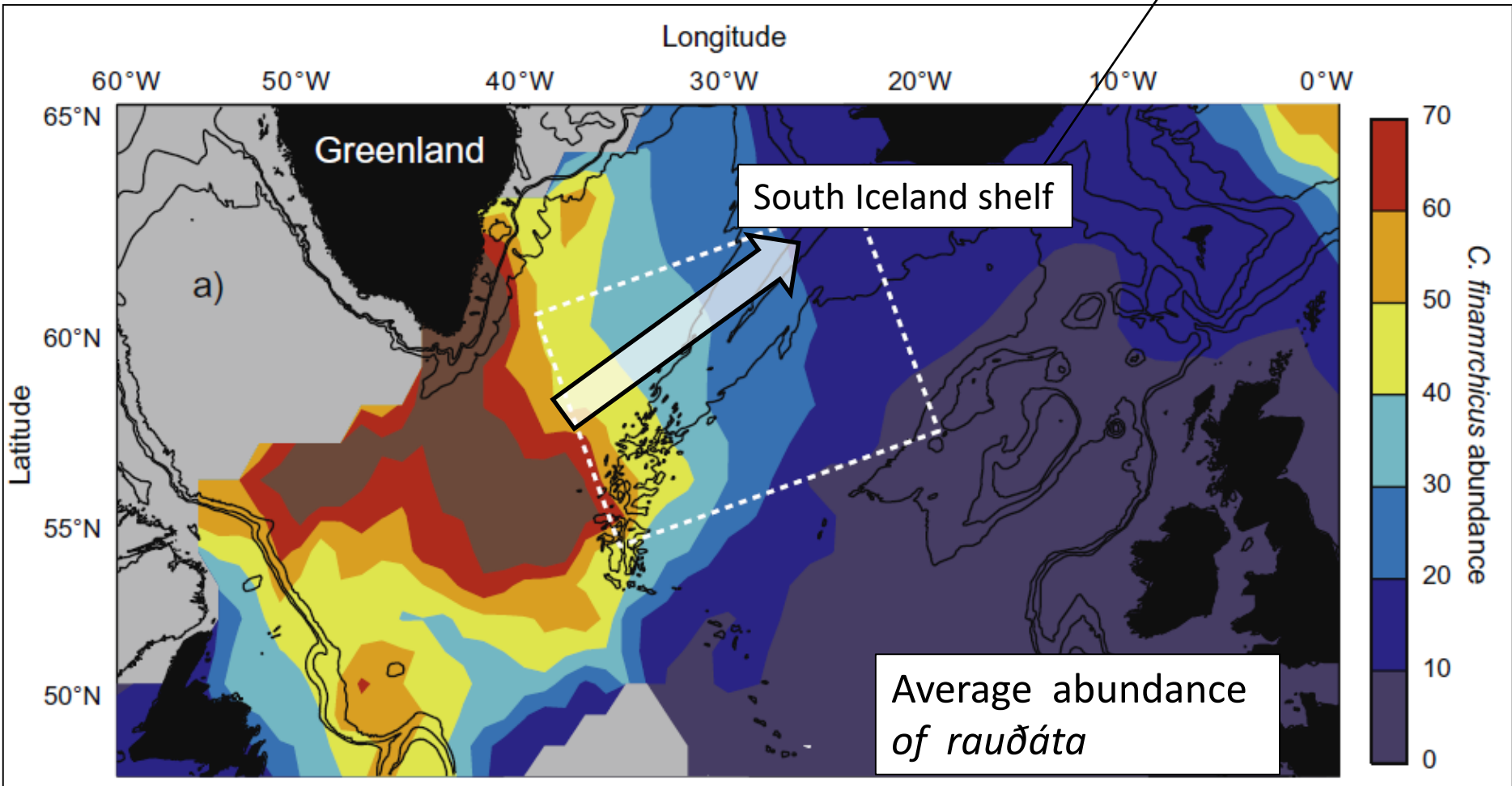
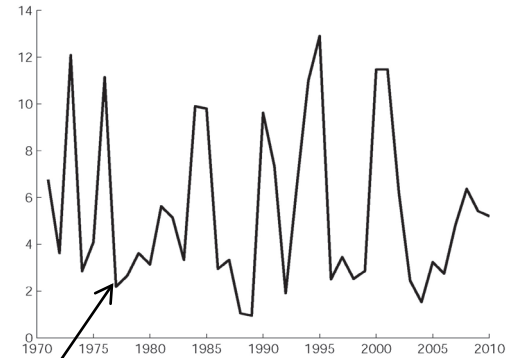
The diagram illustrates ocean circulation. A large blue arrow labeled '2' indicates a flow from the left towards the 'Subpolar Gyre'. A red arrow labeled '1' points downwards from the bottom left. A green arrow labeled '3' points upwards from the 'Subpolar Gyre' towards the top left. A red box labeled 'R' is located on the right side. The background is a map of the North Atlantic Ocean with various colored regions.

The diagram illustrates ocean circulation. A large blue arrow labeled '2' indicates a flow from the left towards the 'Subpolar Gyre'. A red arrow labeled '1' points downwards from the bottom left. A green arrow labeled '3' points upwards from the 'Subpolar Gyre' towards the top left. A red box labeled 'R' is located on the right side. The background is a map of the North Atlantic Ocean with various colored regions.



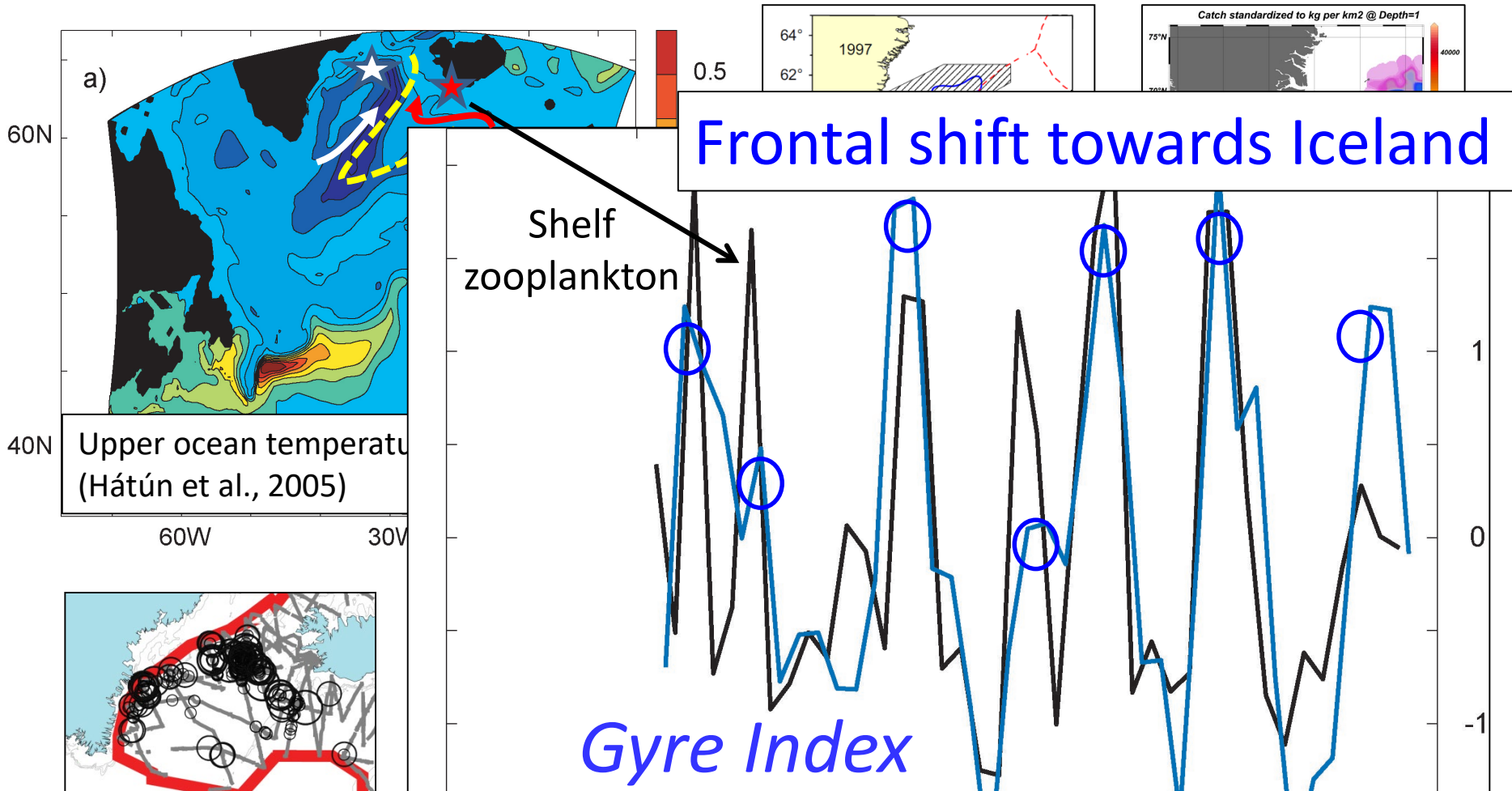
5. The Subpolar Gyre:

A large **zooplankton** source
- Continuous Plankton Recorder (CPR)



5. The biologically productive *sub-arctic front*

Bluefin tuna

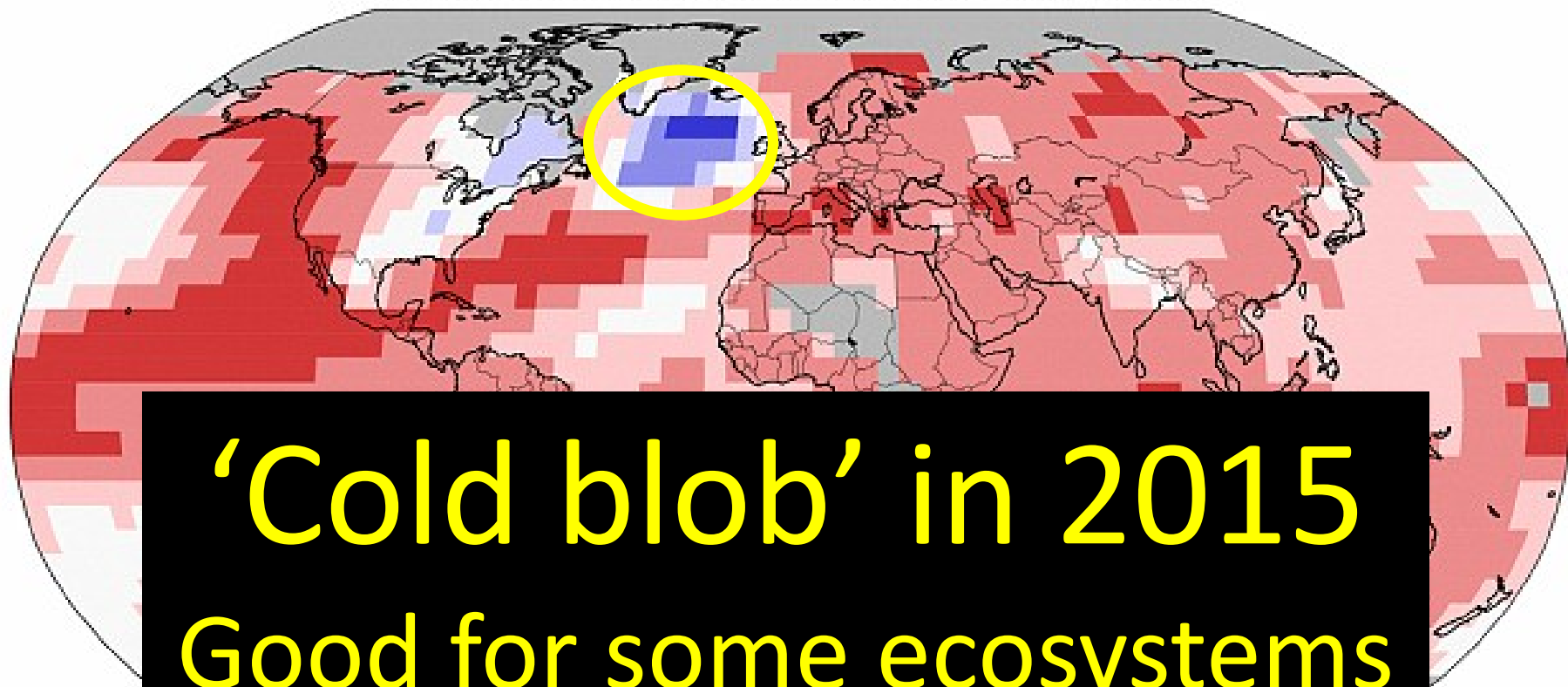


Increased zooplankton abundance
when the *sub-arctic front* is shifted towards Iceland

Land & Ocean Temperature Percentiles Jan–Aug 2015

NOAA's National Centers for Environmental Information

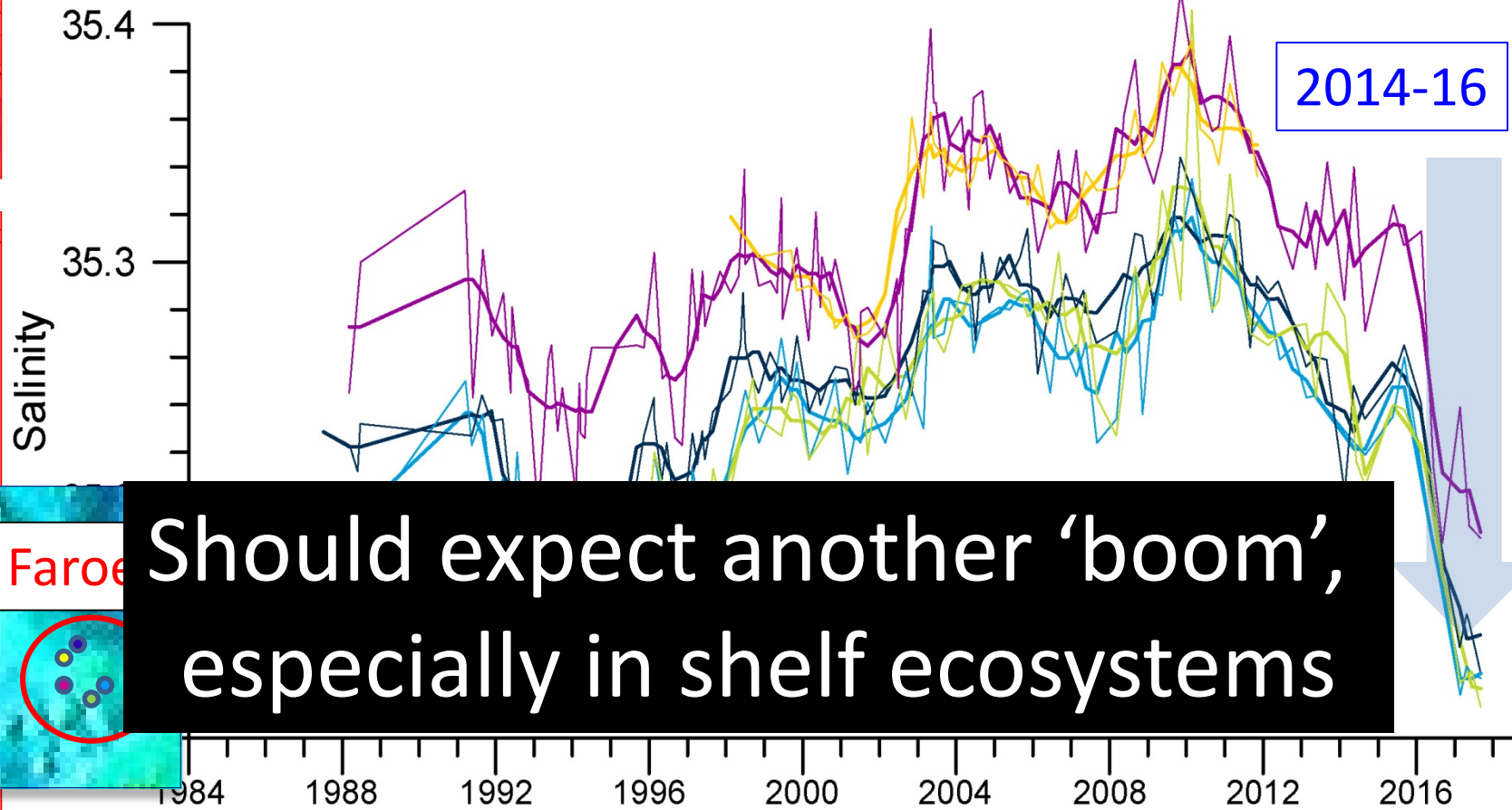
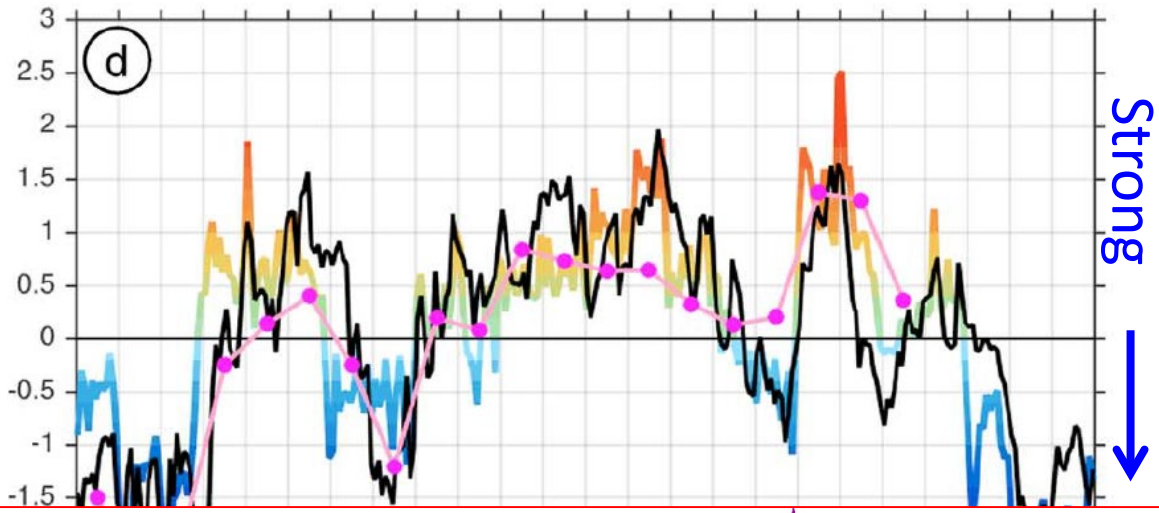
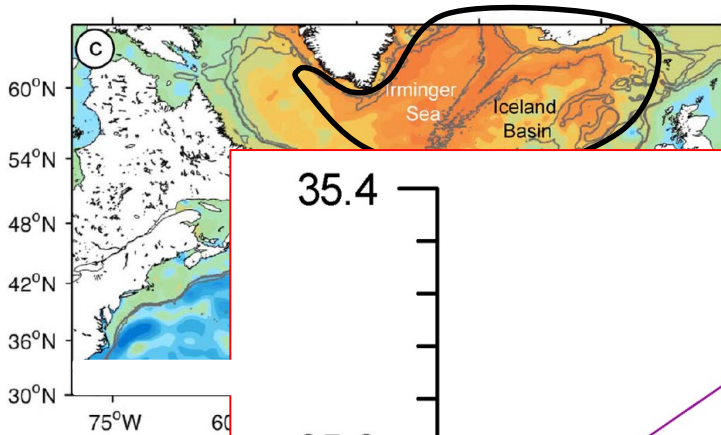
Data Source: GHCN–M version 3.3.0 & ERSST version 4.0.0



‘Cold blob’ in 2015
Good for some ecosystems
- as suggested by Hátún et al., 2016

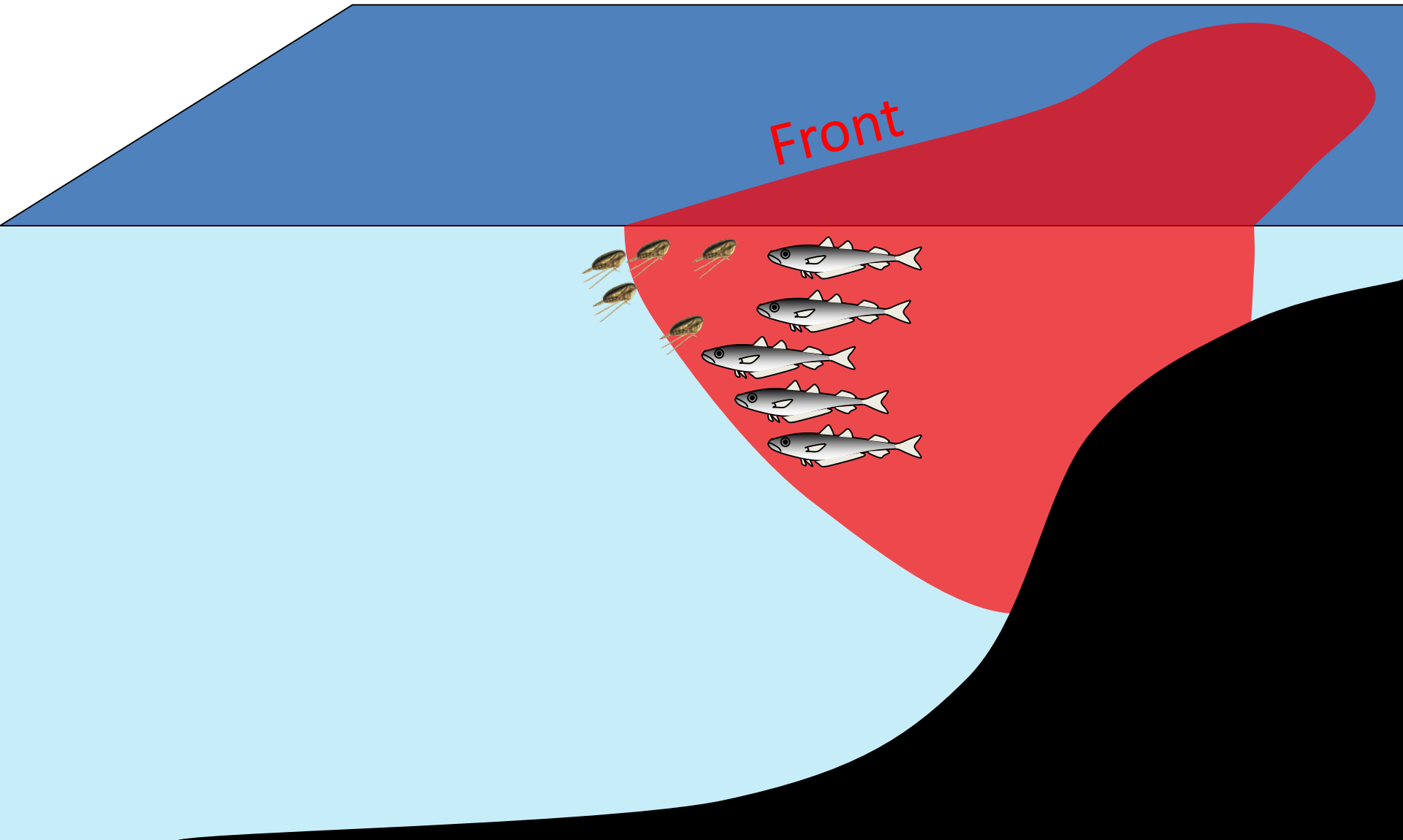


5. Revived subpolar gyre after 2014

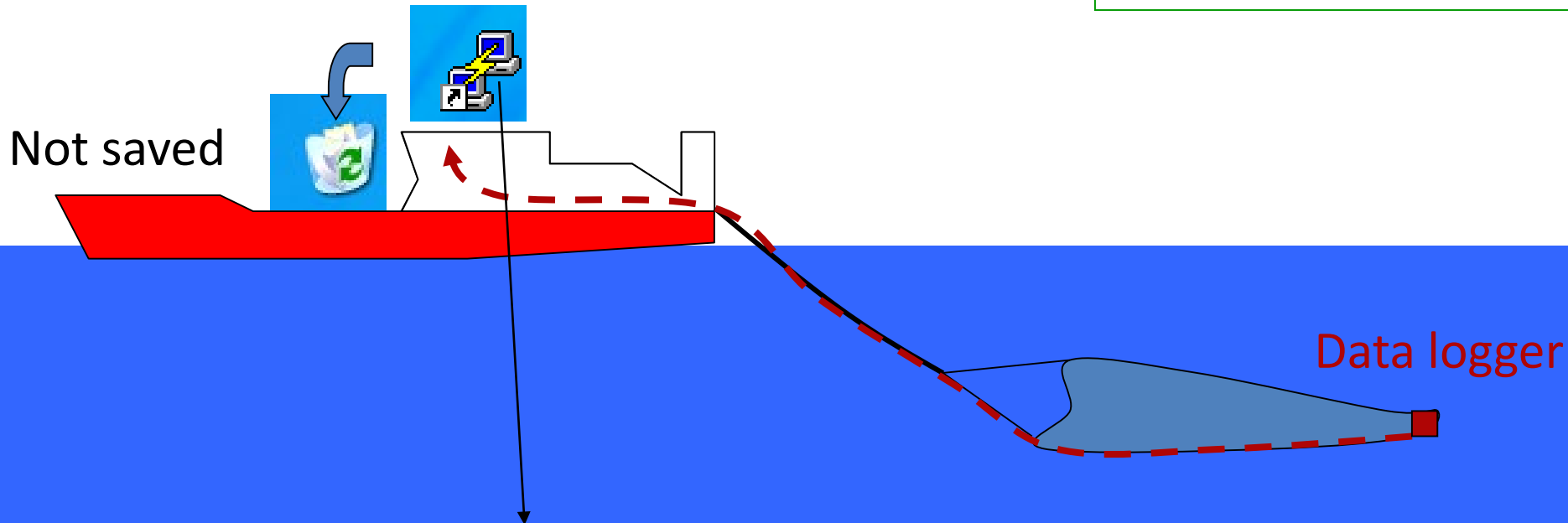


Should expect another 'boom',
especially in shelf ecosystems

6. Science-industry collaboration



Data from the industry



Lat	Lon	time	Date	Temp	Depth
6149.645	47.776	08:34:53	13.06.2009	8.56	249.13
6149.639	47.778	08:34:58	13.06.2009	8.56	249.19
6149.634	47.78	08:35:03	13.06.2009	8.56	249.19
6149.629	47.784	08:35:08	13.06.2009	8.56	247.5
6149.624	47.786	08:35:13	13.06.2009	8.56	249.81
6149.619	47.788	08:35:18	13.06.2009	8.38	250.06
6149.614	47.791	08:35:23	13.06.2009	8.38	248.19
6149.609	47.793	08:35:28	13.06.2009	8.38	250.5
6149.604	47.795	08:35:33	13.06.2009	8.38	248.5
6149.599	47.798	08:35:38	13.06.2009	8.38	250
6149.594	47.801	08:35:43	13.06.2009	8.38	250.5

Data from
the industry

2. To satellites

1. Save onboard

Data logger

Lat

Lon

time

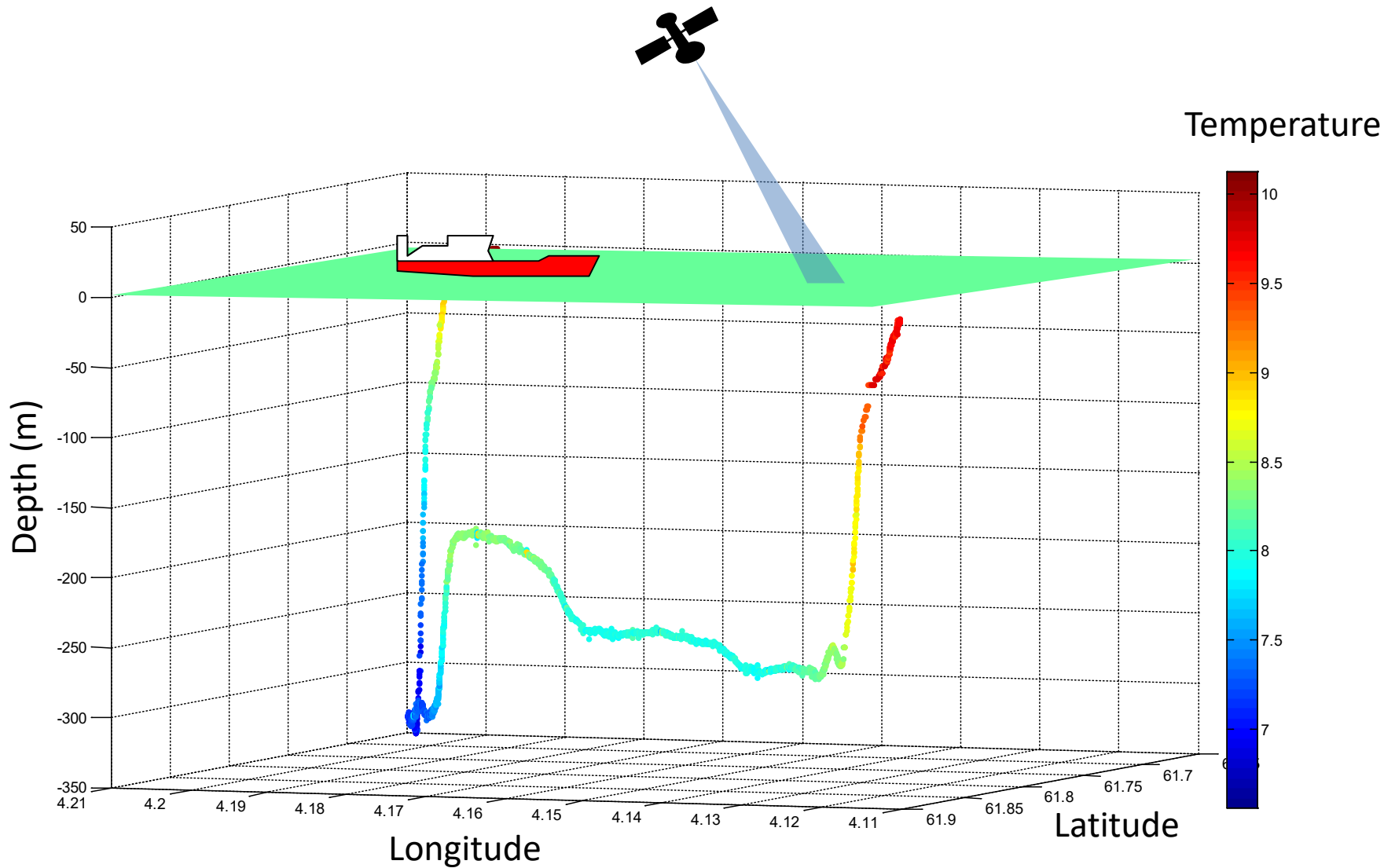
Date

Temp

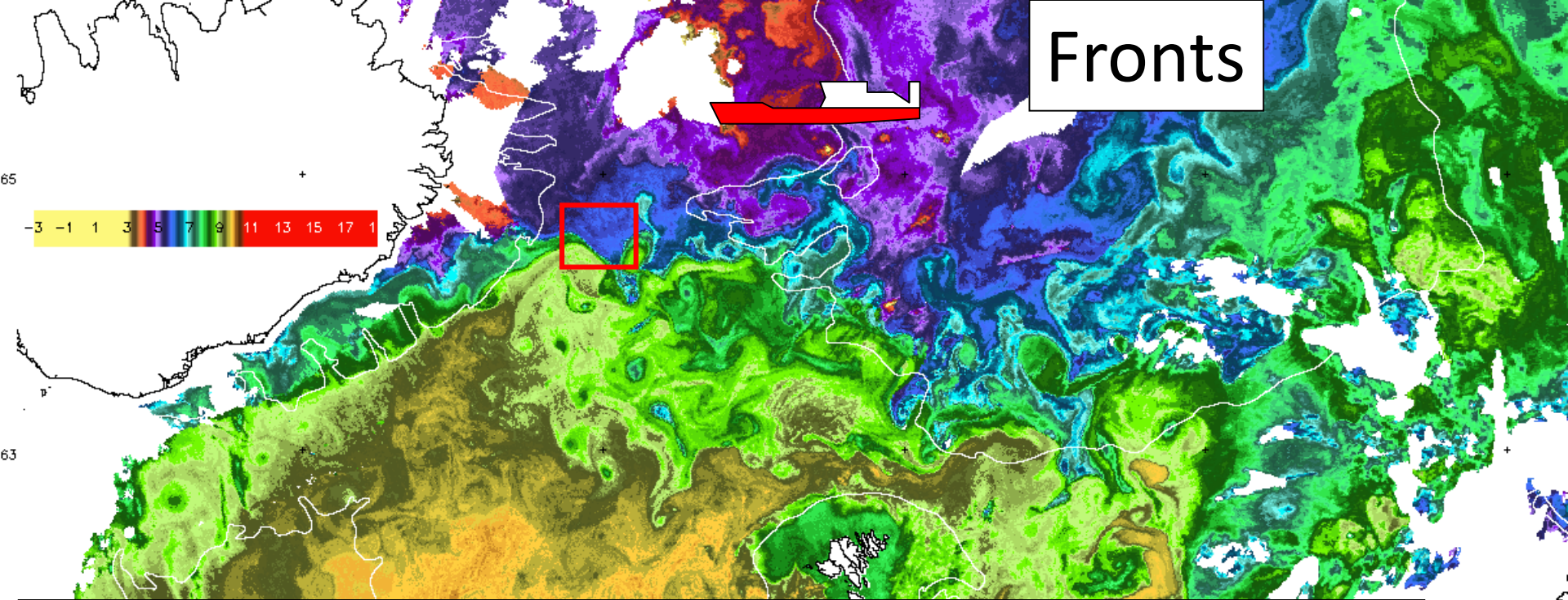
Depth

Data.txt - No								
Filer	Rediger	Formater	Vis	Hjælp				
6149.645		47.776	08:34:53	13.06.2009	8.56	249.13	248.81	250.38
6149.639		47.778	08:34:58	13.06.2009	8.56	249.19	250.13	250.06
6149.634		47.78	08:35:03	13.06.2009	8.56	249.19	250.06	250.06
6149.629		47.784	08:35:08	13.06.2009	8.56	247.5	248.94	251.56
6149.624		47.786	08:35:13	13.06.2009	8.56	249.81	250.19	246
6149.619		47.788	08:35:18	13.06.2009	8.38	250.06	249.13	249.19
6149.614		47.791	08:35:23	13.06.2009	8.38	248.19	249.81	250.13
6149.609		47.793	08:35:28	13.06.2009	8.38	250.5	249	245.44
6149.604		47.795	08:35:33	13.06.2009	8.38	248.5	249	254
6149.599		47.798	08:35:38	13.06.2009	8.38	250	249.75	254.63
6149.594		47.801	08:35:43	13.06.2009	8.38	250.5	251	254.63

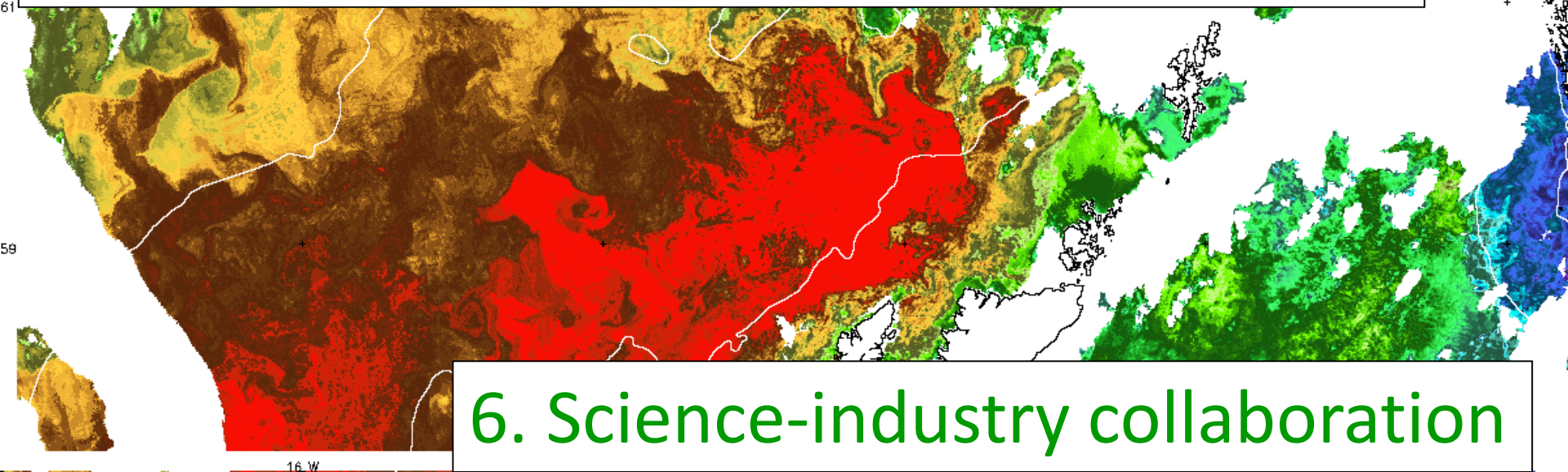
6. A temperature trace



Fronts



Reduce searching time, and CO₂ emissions



6. Science-industry collaboration

Conclusions

- The subpolar gyre impacts Icelandic waters
- The post-1995 blue whiting expansion was caused by a weakening subpolar gyre
- The post-2006 mackerel westward shift likely associated with a nutrient decline
- Herring food (large rauðáta in the southwestern Norwegian Sea) declined after 2003
- Intensified gyre after 2014 has invigorated shelf ecosystems
- More collaboration between industry and science warranted



The research leading to these results has received funding from the European Union 7th Framework Programme (FP7 2007-2013), under grant agreement n.308299

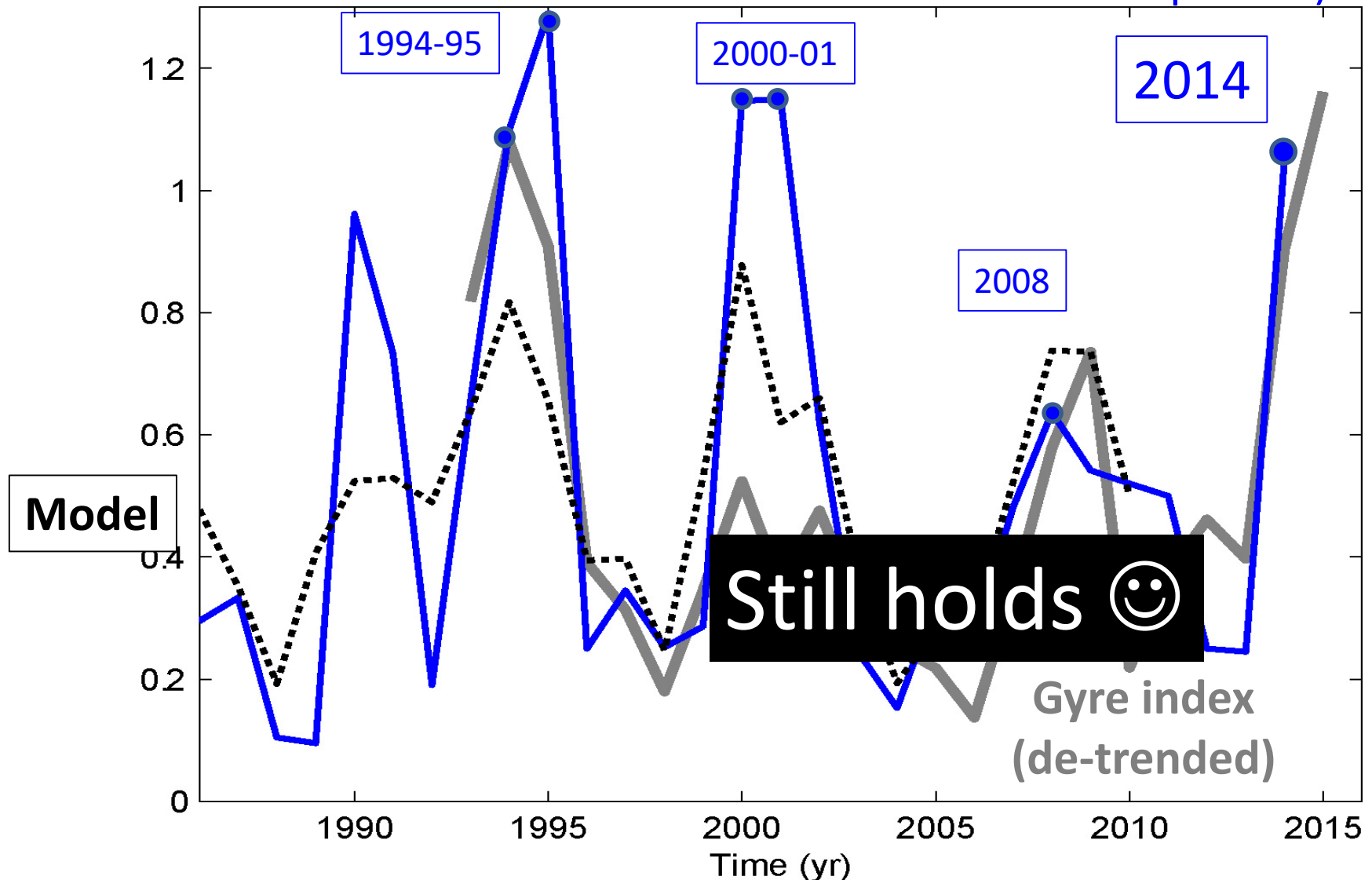
NACLIM www.nacliim.eu



5. Impact of recent convection

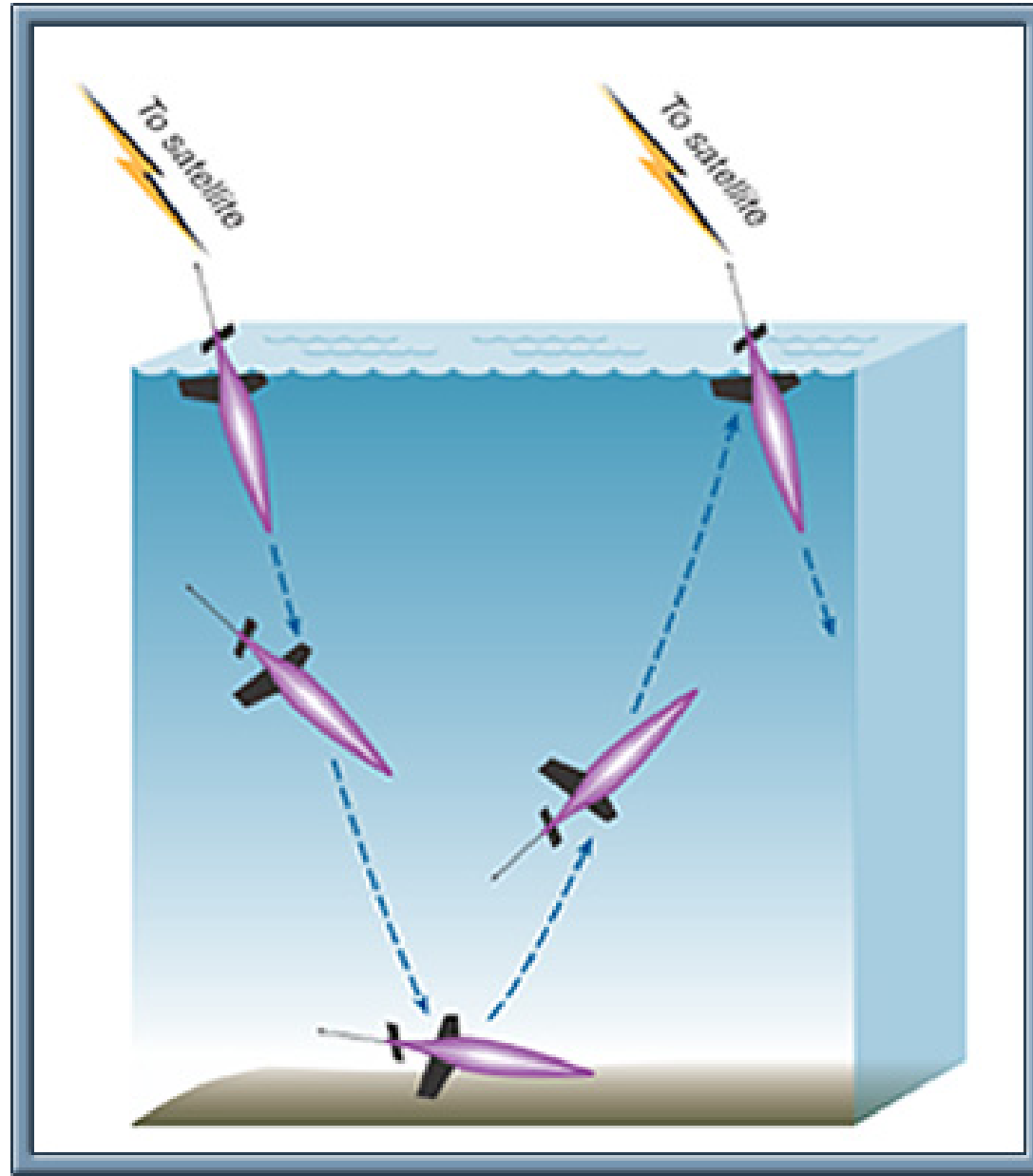
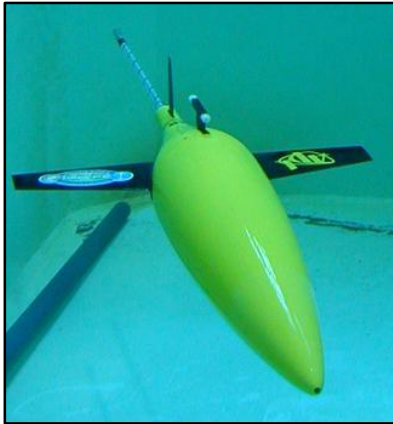
- Iceland zooplankton

(Hátún et al., 2016, updated)

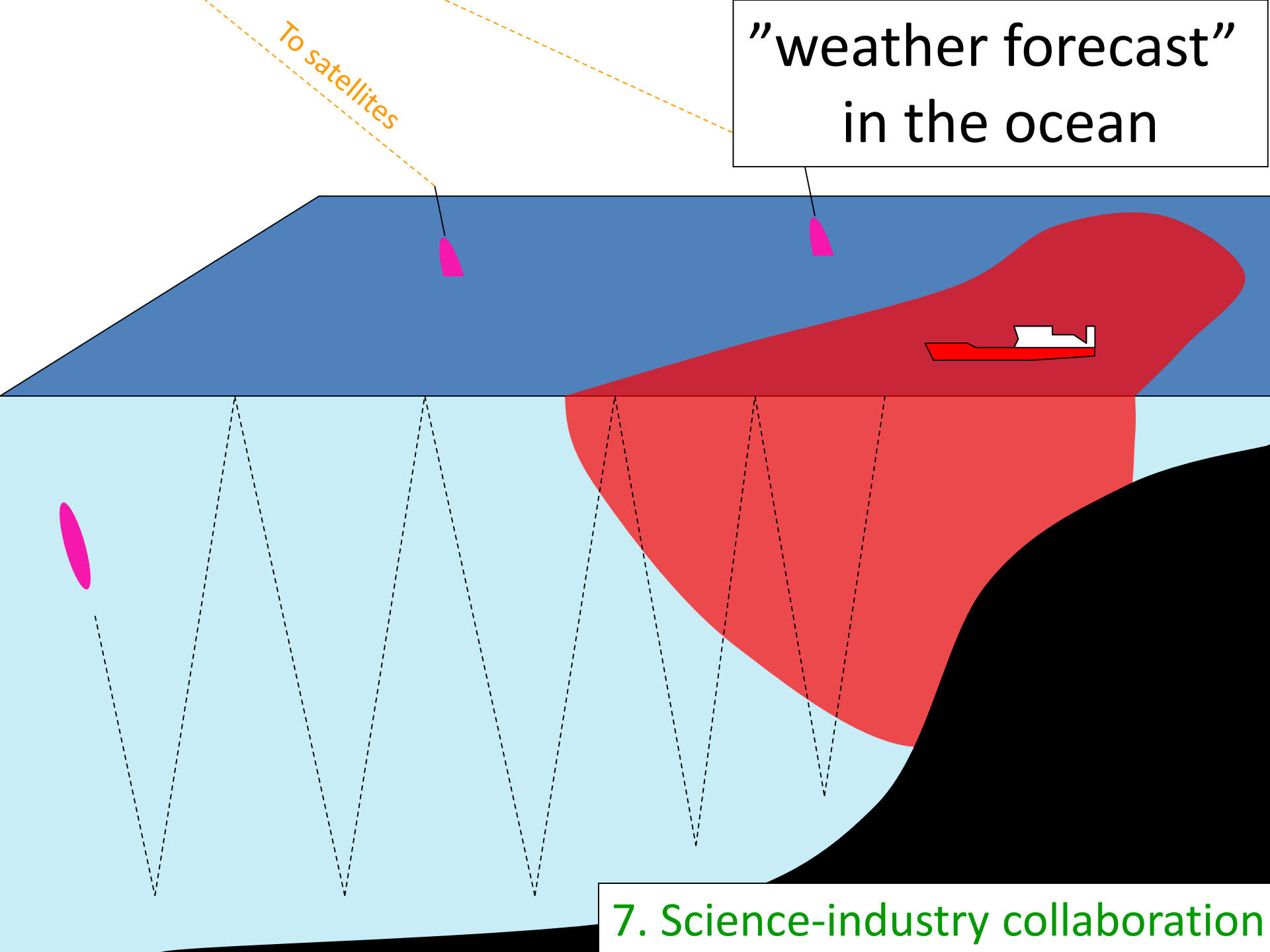


Seagliders

(Collaboration with
University of Washington)



Samples:
Temperature, salinity, oxygen
algae and currents



"weather forecast"
in the ocean

To satellites

Allowed or pushed poleward?

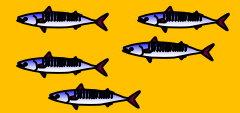
Allowed

Pushed

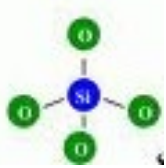
Oligotrophic

Cold

Warm



Go North or West ?

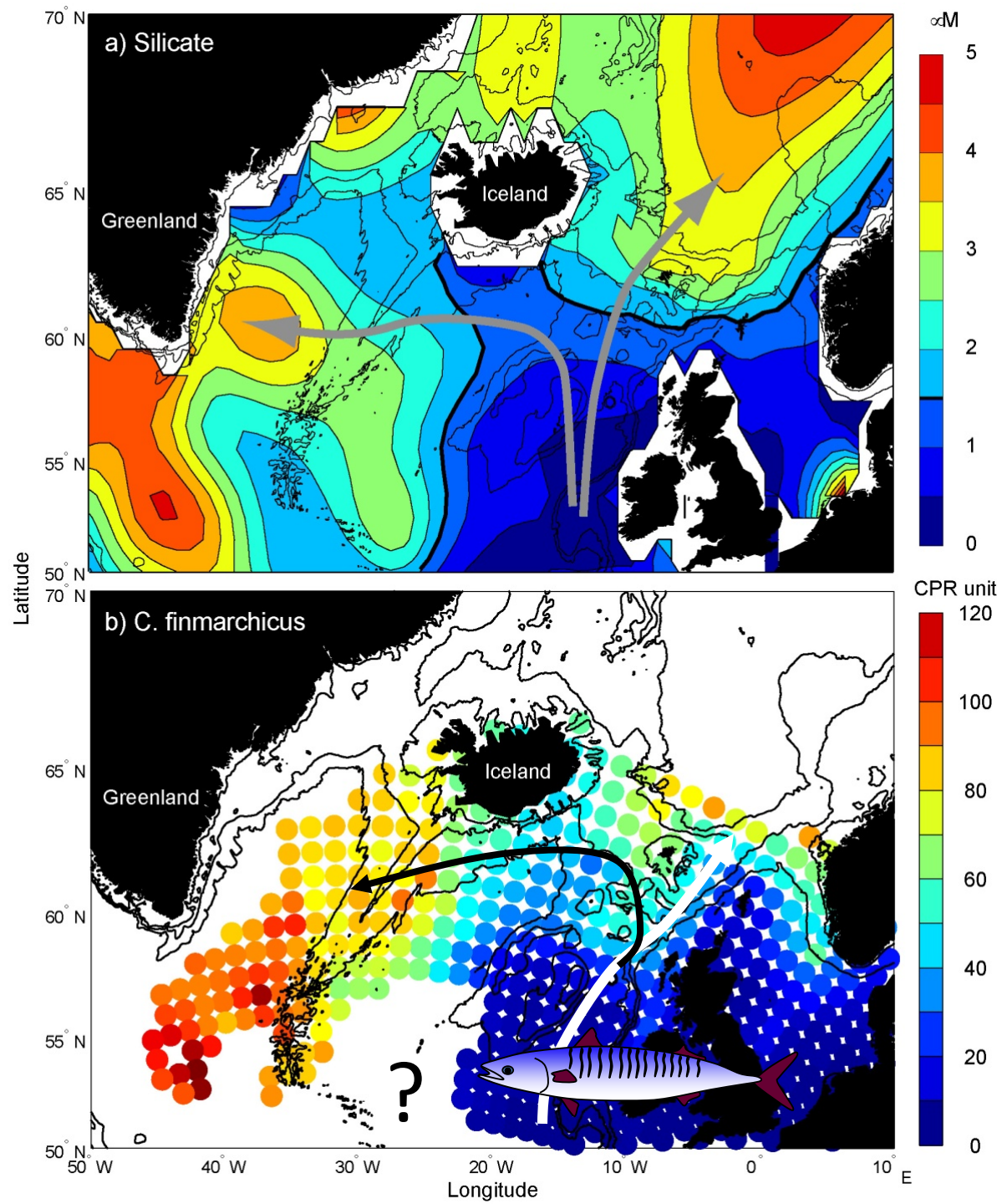


Silicate

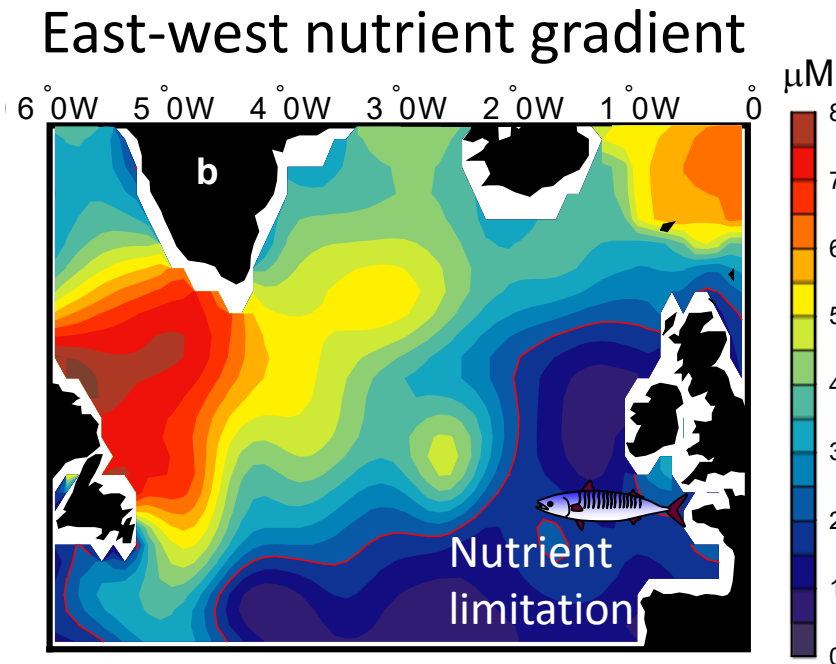


Calanus finmarchicus

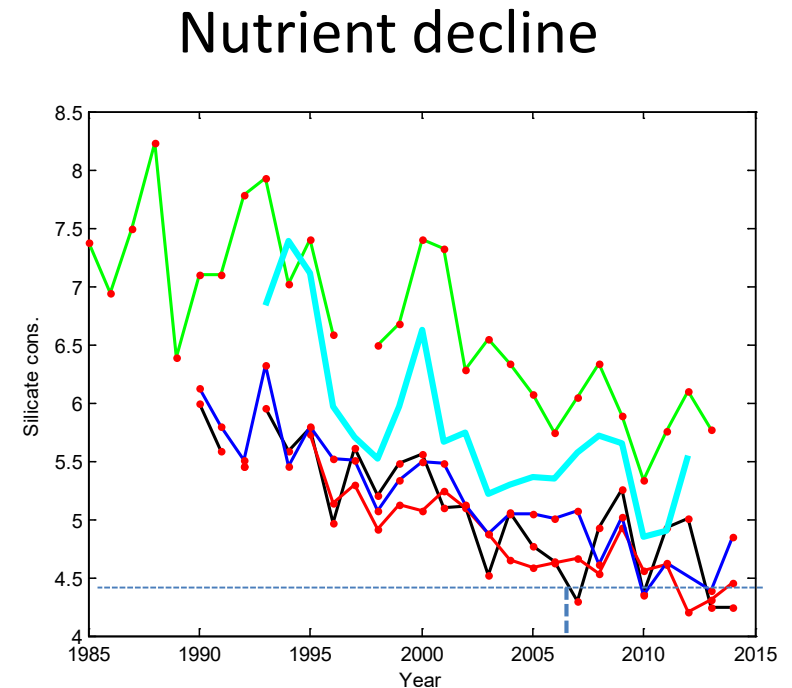
Average for June



3. A new mackerel hypothesis



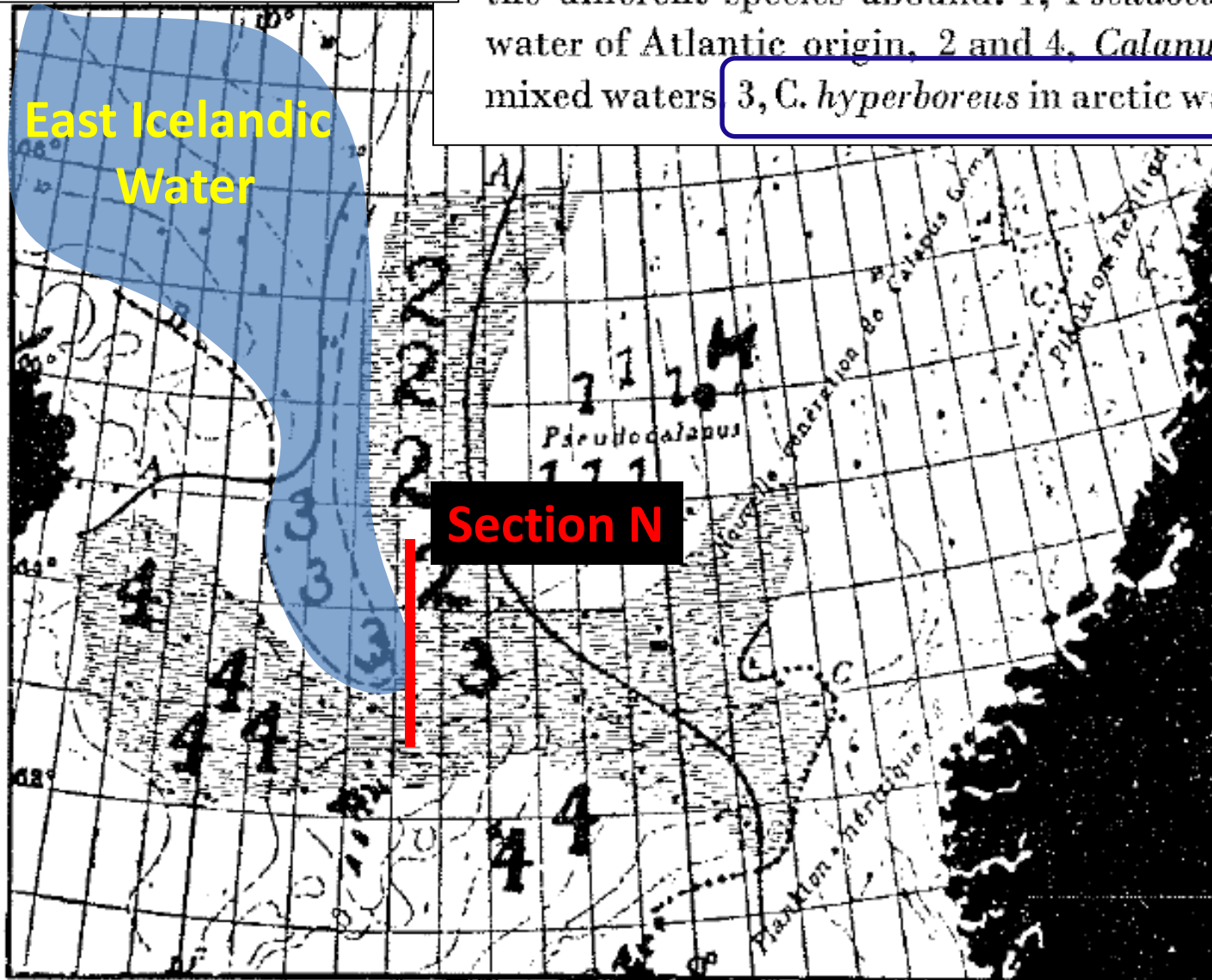
+



The post-2006 westward mackerel expansion is induced by the west-high, east-low nutrient gradient, together with the recent strong nutrient decline in the North Atlantic

4. Zooplankton (rauðáta)

Fig. 10. The distribution of Calanidae in the southern Norwegian Sea according to DAMAS(1905, Pl. I), reconstructed by SØMME (1934). The numbers denote the areas where the different species abound. 1, *Pseudocalanus minutus* in water of Atlantic origin, 2 and 4, *Calanus finmarchicus* in mixed waters 3, *C. hyperboreus* in arctic water. See also text.



(Wiborg, 1955)