The Barents Sea Long Term Monitoring Plan for multiple stressors on Benthic Mega-Fauna

Lis Lindal Jørgensen*[1], Pavel Ljubin*[2],
Renate Degen*[3], Myriam Lacharite*[4]

*[1]Institute of Marine Research (IMR), Norway
*[2]Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Russia
*[3] Alfred-Wegener-Institut (AWI), Germany
*[4] Dalhousie University, Canada

Arctic Biodiversity Assessment

Circumpolar Biodiversity Monitoring Program, Marine: Effects of stressors and drivers of relevance to biodiversity"

December 3, 13:00-14:30 in room San Siro 1.

HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

ABA Recommendation 16

Research *and* ***monitor*** ***individual and cumulative effects*** *of* ***stressors*** *and* ***drivers*** *of relevance to* ***biodiversity***

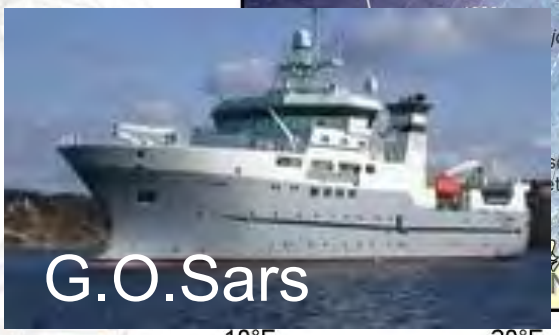
Focus on: stressors that are expected to have rapid and significant impacts, knowledge-gaps.

- ***Future species range changes as a result of these stressors***.
- Developing knowledge of and identifying tipping points thresholds and ***cumulative effects*** for Arctic biodiversity.
- Developing robust quantitative ***indicators for stressors***.

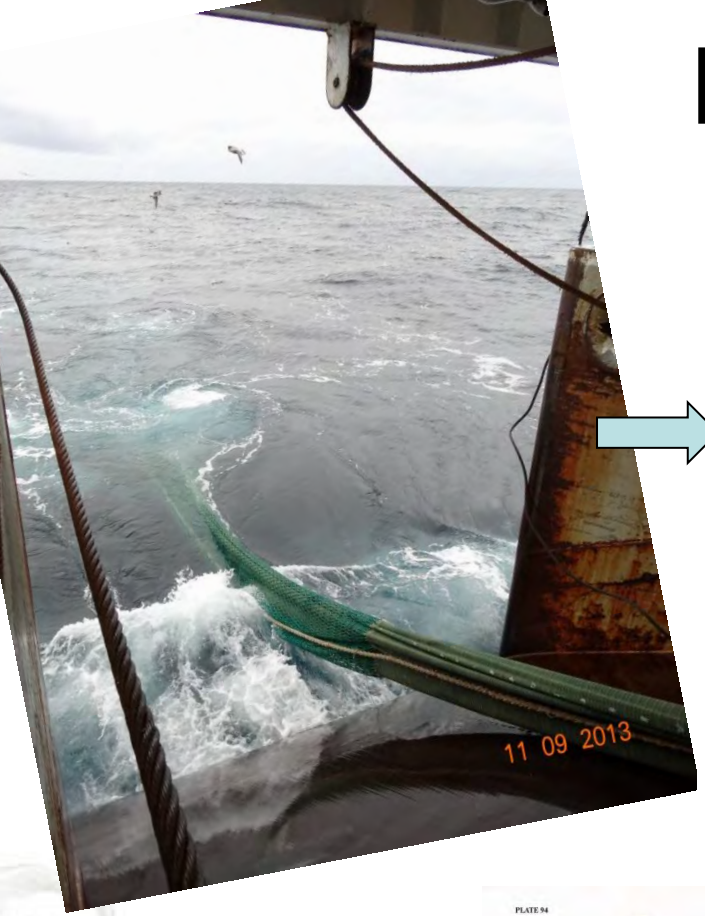
Stressors and drivers in the Barents Sea

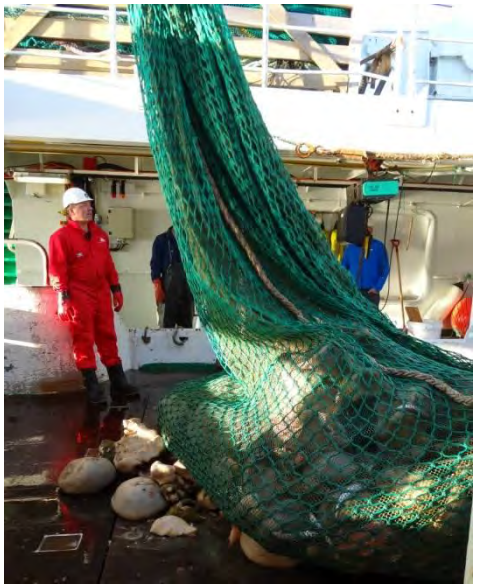
- Temperature change
- Trawling in new areas
- New species

Annual Norwegian-Russian Surveys

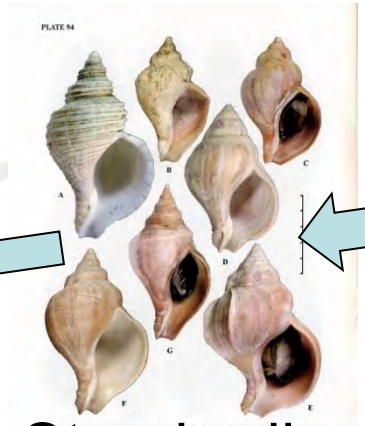


Field work - benthos





Standardized knowledge (exchange program)



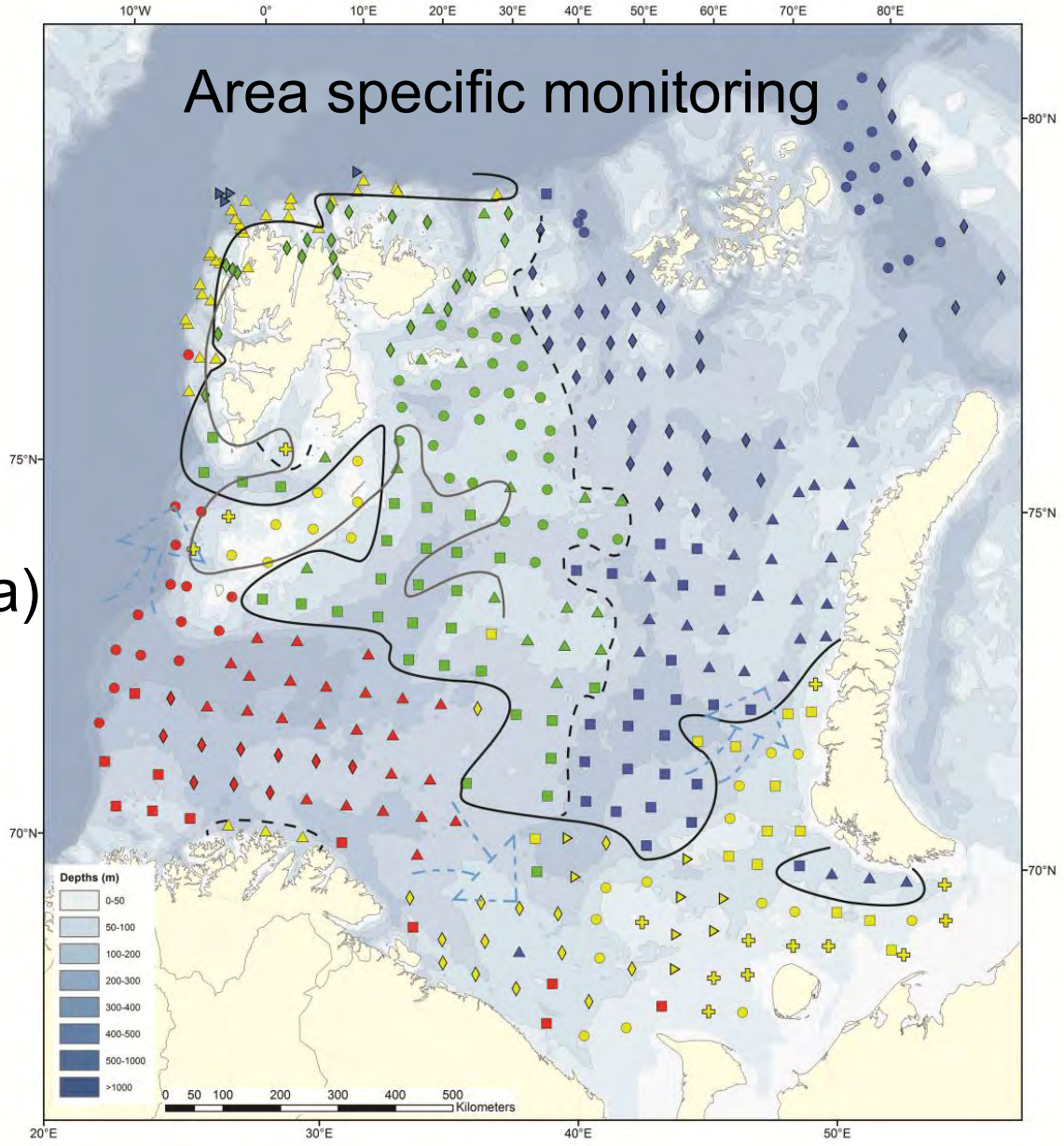
Standardized literature

Shared
Russian
Norwegian
Database

Baseline map for the benthos

354 taxa
(218 to species level)

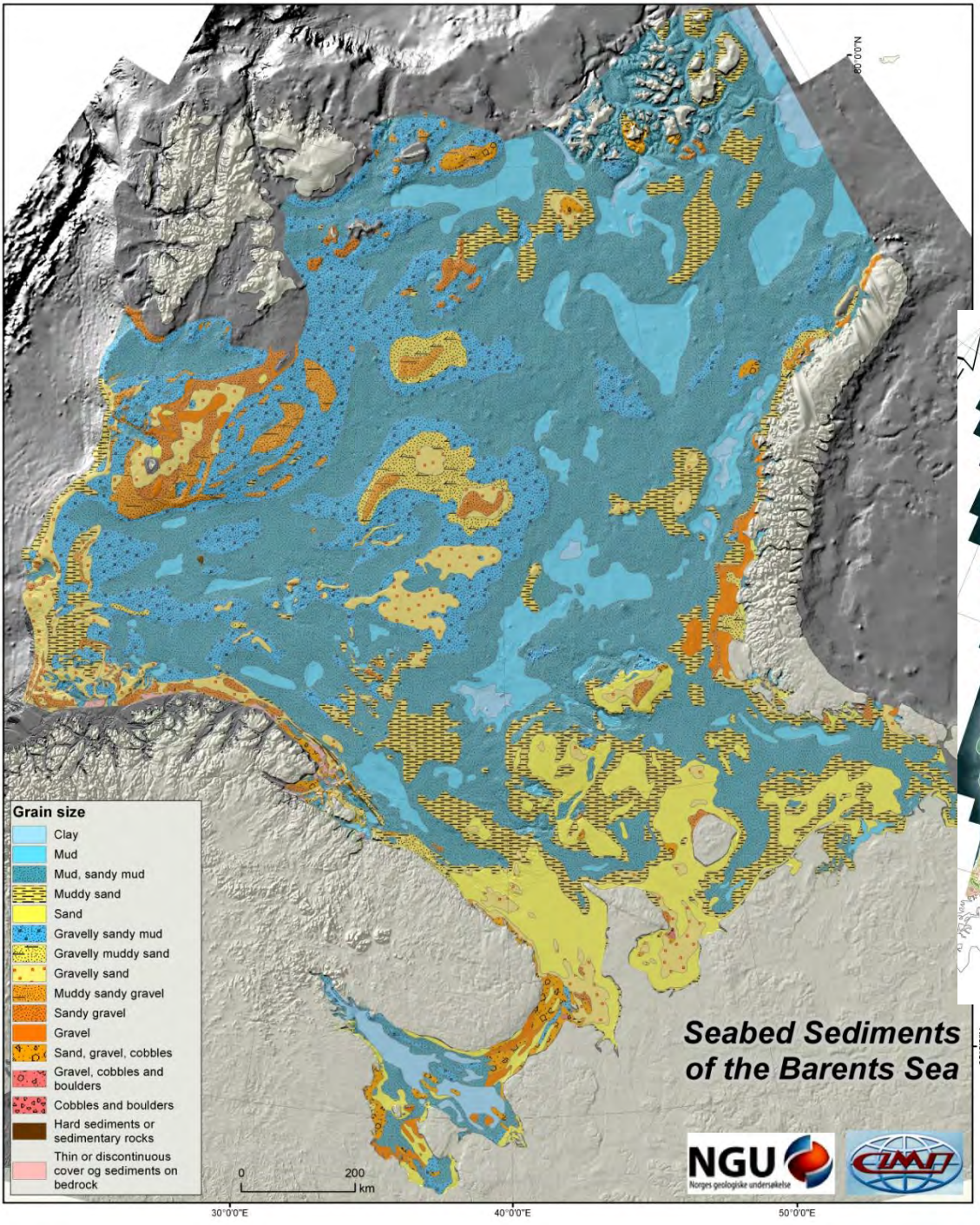
- Mollusca (101 taxa)
- Crustacea (60 taxa)
- Echinodermata (60 taxa)
- Porifera (30 taxa)
- Polychaeta (23 taxa)
- Cnidaria (22 taxa)



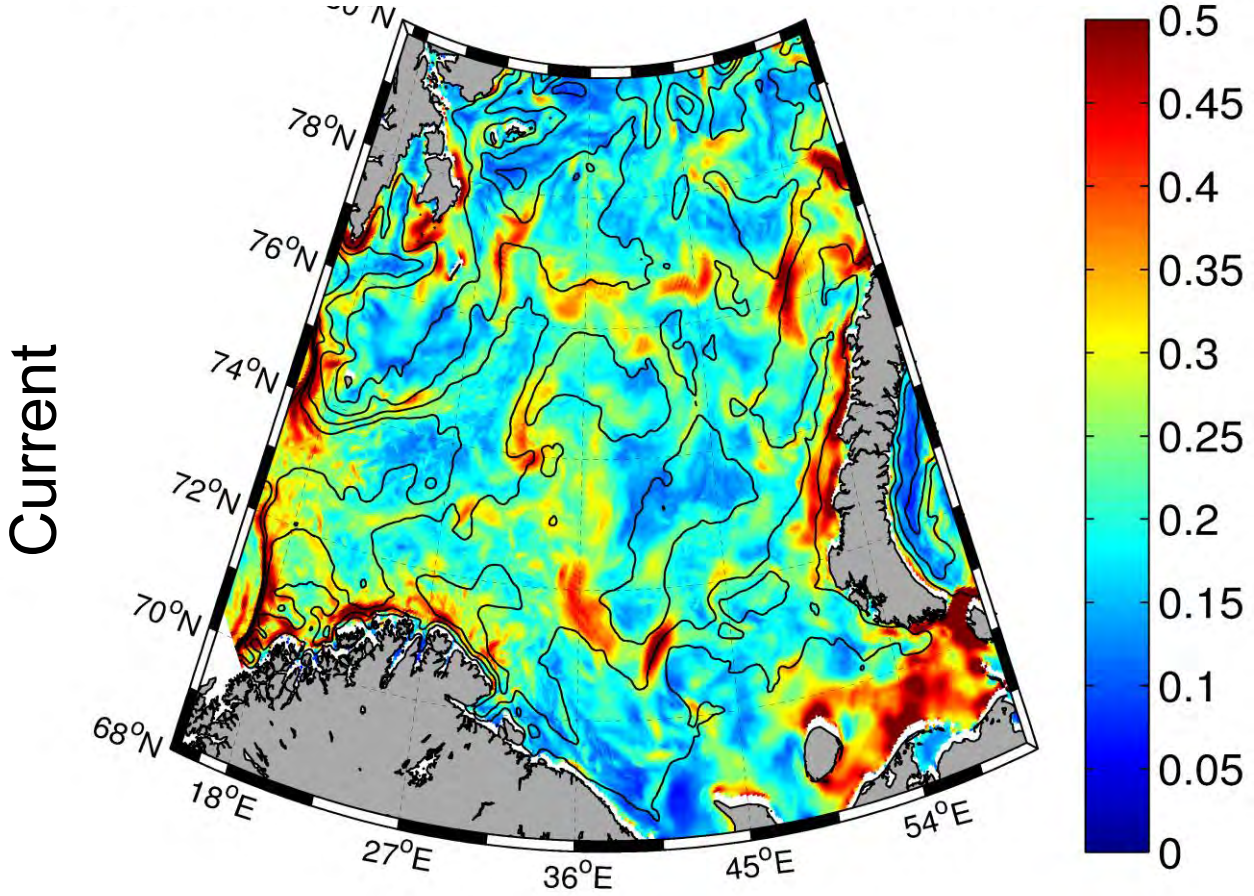
Jørgensen et al 2014. Distribution of benthic megafauna in the Barents Sea: baseline for an ecosystem approach to management. ICES Jour of Mar Scien

What structures the fauna of the 4 regions and 19 local areas ?

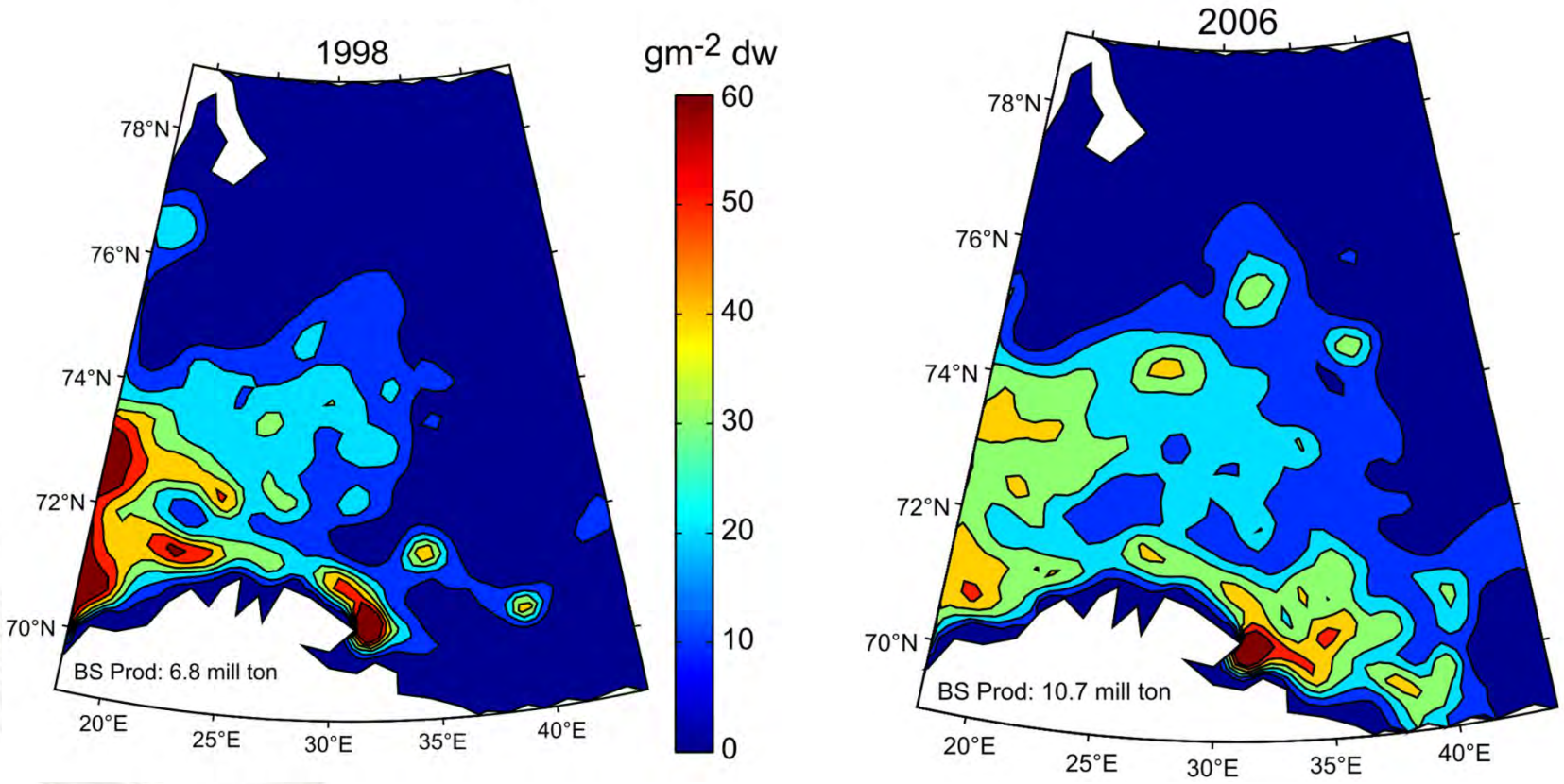
Depth, sediment



Current

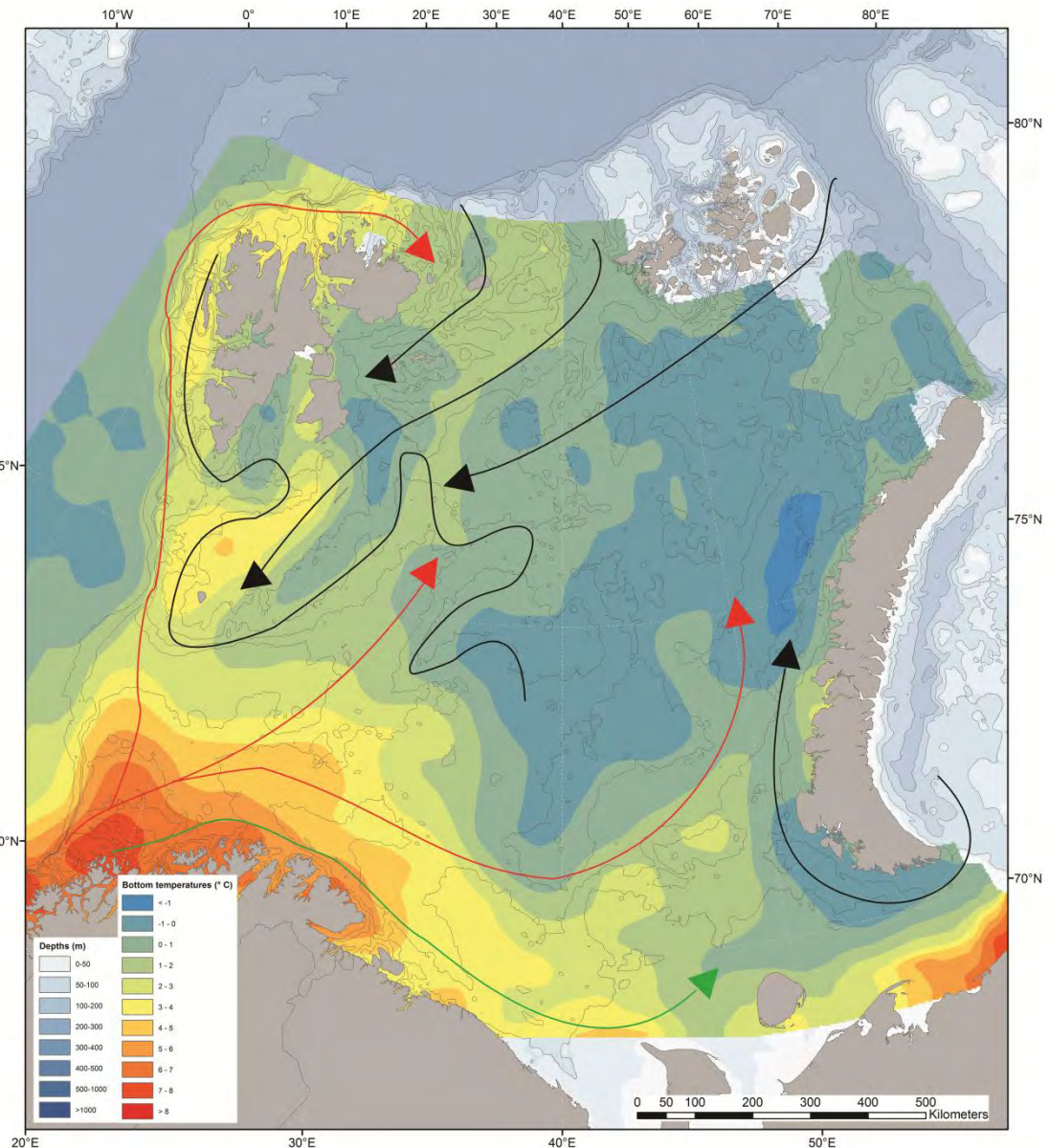

Current
78°N
76°N
74°N
72°N
70°N
68°N
18°E
27°E
36°E
45°E
54°E
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0

Pelagic production/Ice-cover

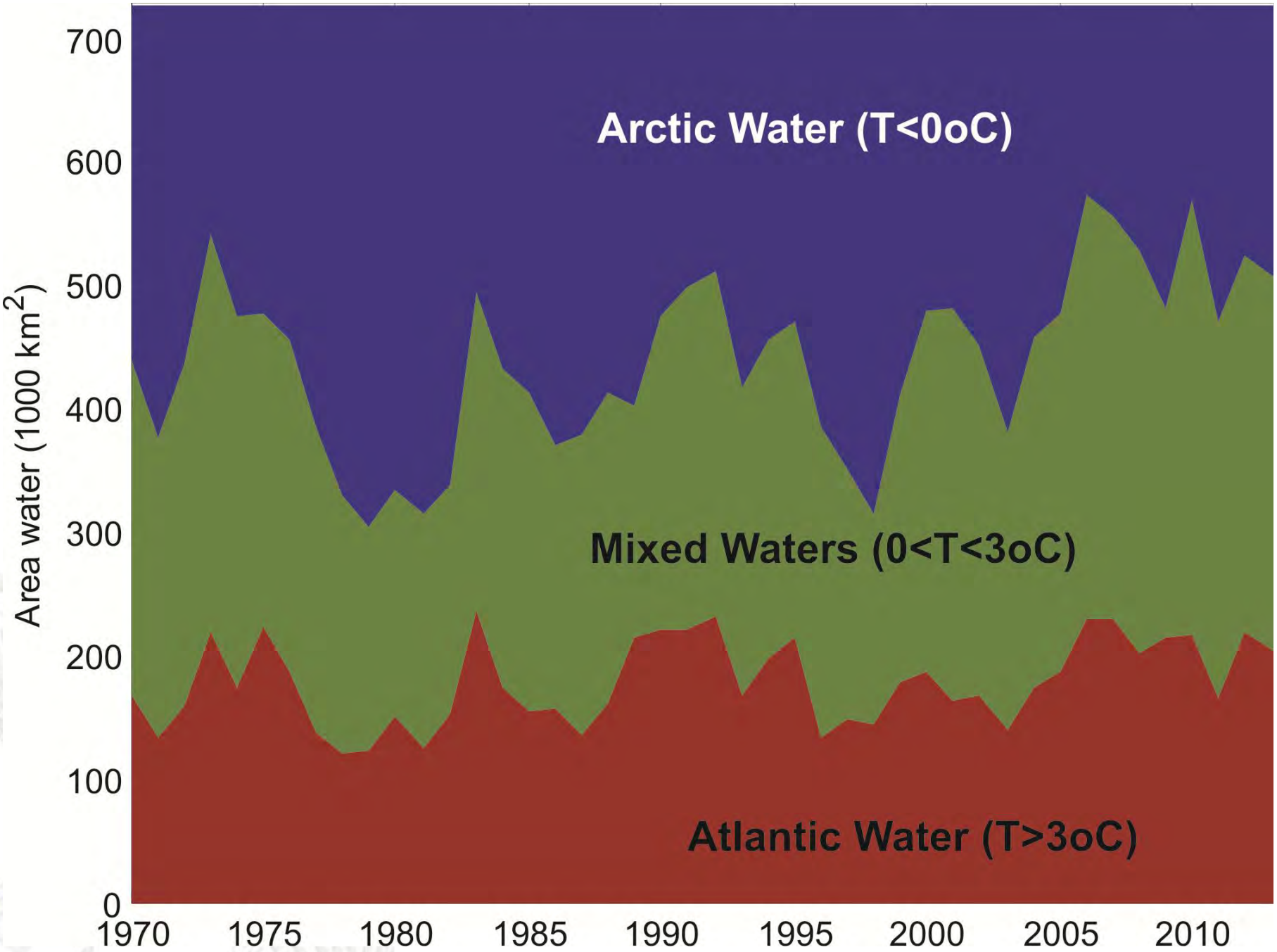


Dalpadado et al. (2014) Productivity in the Barents Sea - Response to Recent Climate Variability. PLoS ONE 9(5)

Bottom temperature-Polar Front

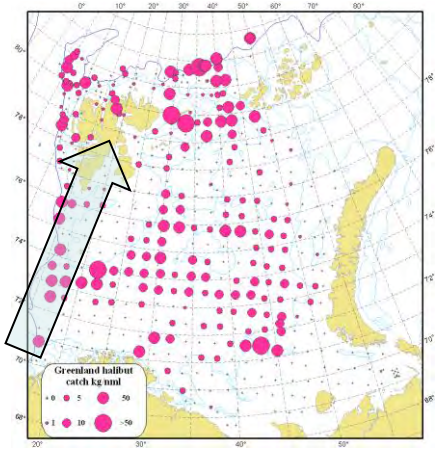


Jørgensen et al 2014. Distribution of benthic megafauna in the Barents Sea: baseline for an ecosystem approach to management. ICES Jour of Mar Scien

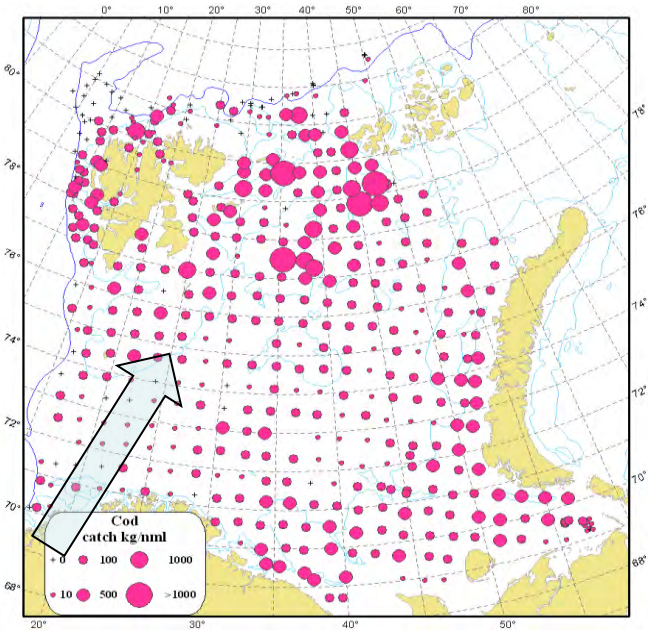

Arctic Water (T<0oC)
Mixed Waters (0<T<3oC)
Atlantic Water (T>3oC)
Area water (1000 km2)
0
100
200
300
400
500
600
700
1970
1975
1980
1985
1990
1995
2000
2005
2010

Commercial fish species migrate northward

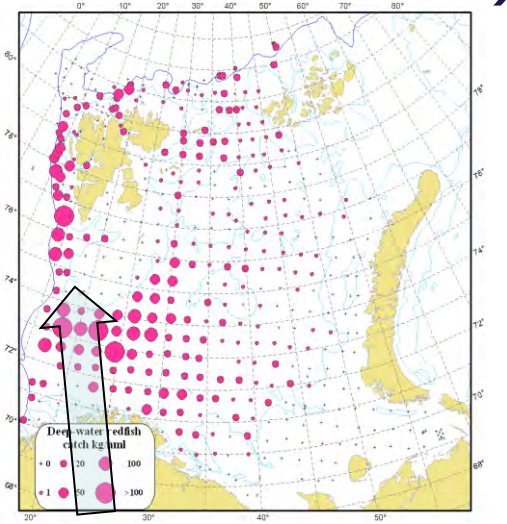
Greenland halibut
(*Reinhardtius hippoglossoides)*



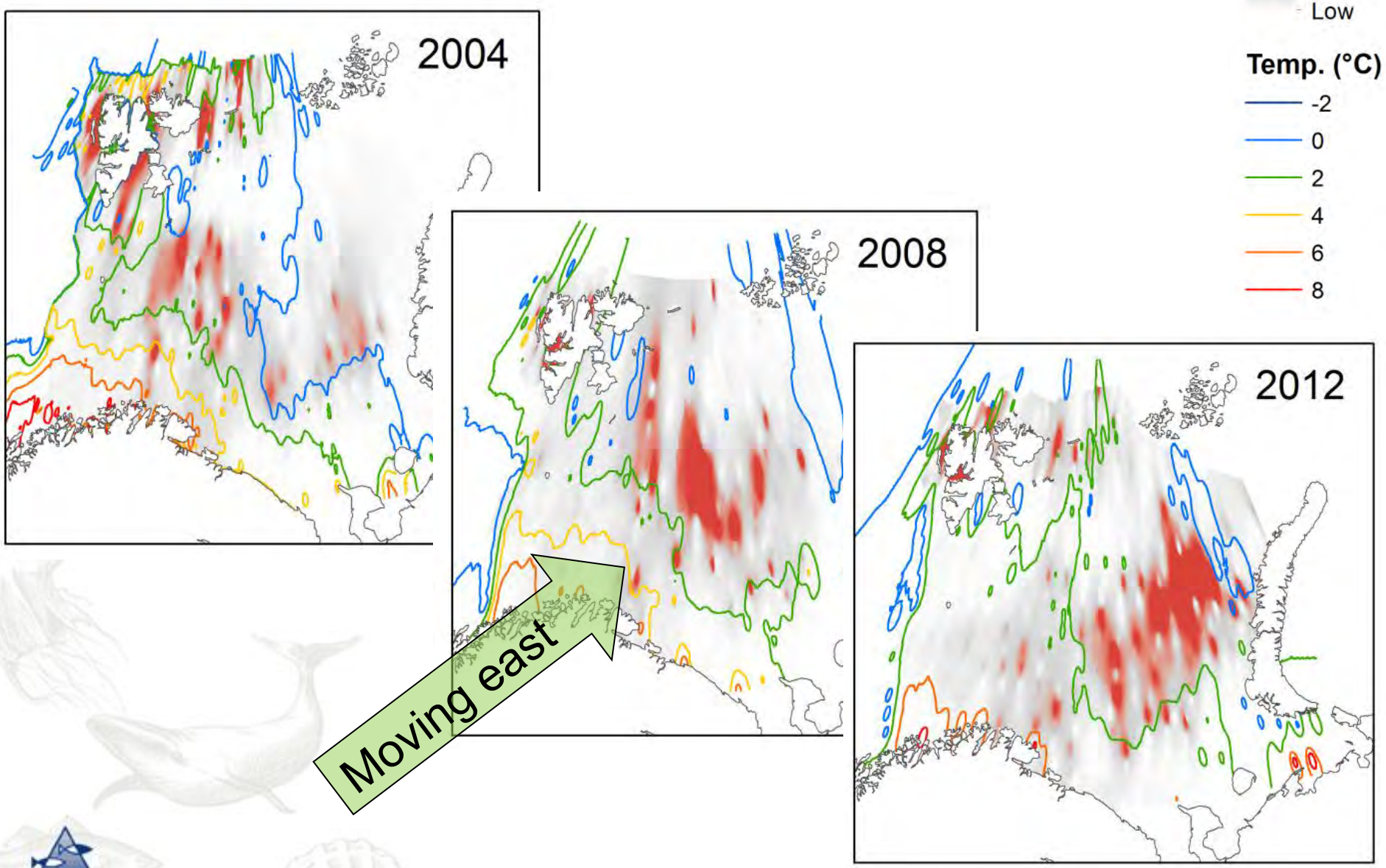
Cod
(Gadus morhua)



Deep-water redfish
(*Sebastes mentella)*



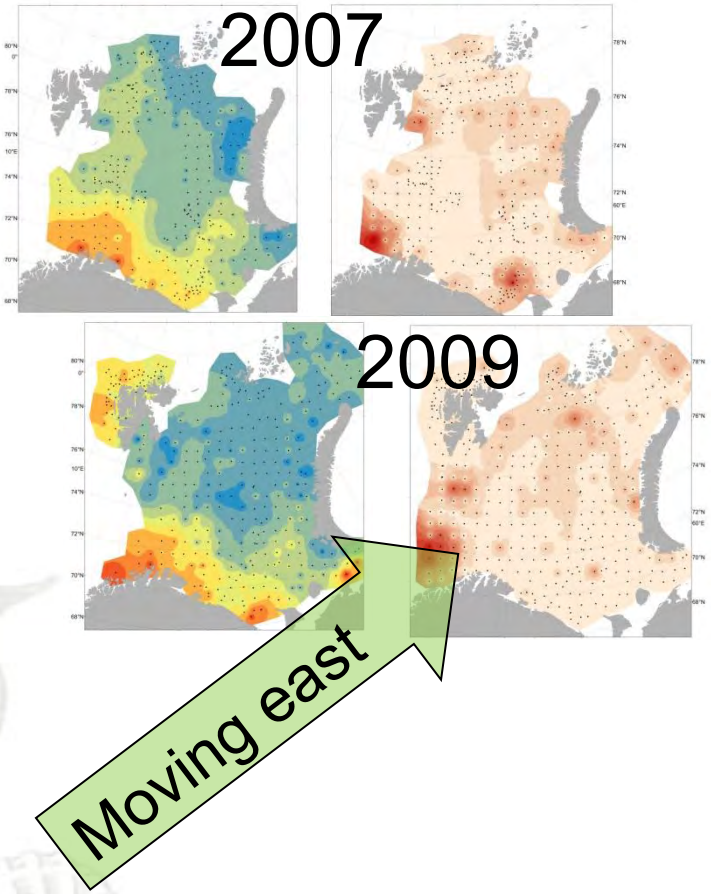
Commercial shrimps *Pandalus borealis*



Benthos Biomass

Temperature (°C)

- -1,86 - -0,42
- -0,41 - 0,41
- 0,42 - 1,34
- 1,35 - 2,36
- 2,37 - 3,34
- 3,35 - 4,26
- 4,27 - 5,38
- 5,39 - 6,58
- 6,59 - 7,79
- 7,8 - 9,97

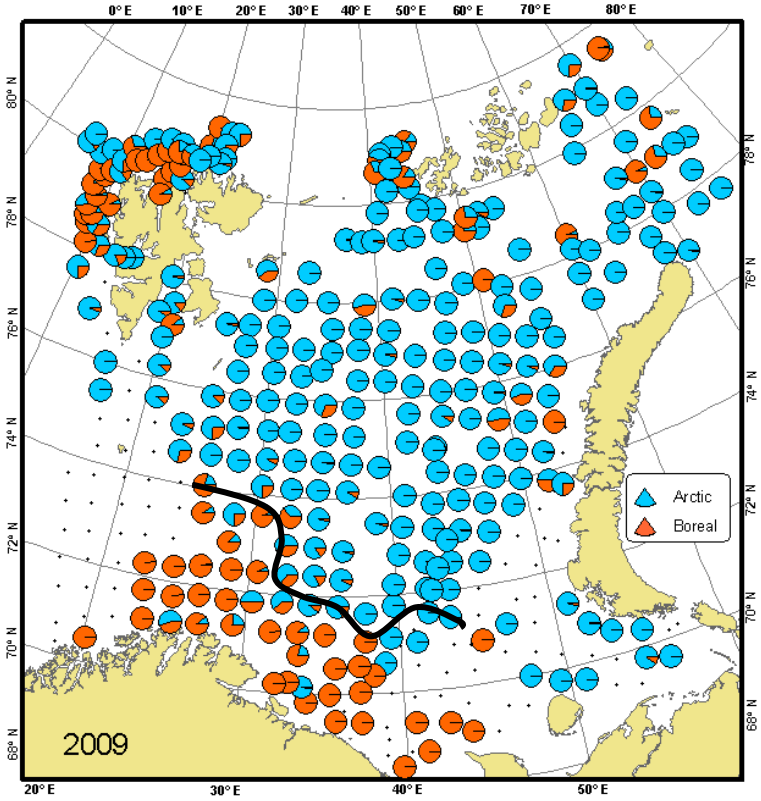


Biomass (g WM/m²)

- 0 - 0,6
- 0,61 - 1,7
- 1,71 - 3,7
- 3,71 - 7,34
- 7,35 - 13,97
- 13,98 - 26,05
- 26,06 - 48,05
- 48,06 - 88,12
- 88,13 - 161,1
- 161,11 - 294,04

Warm and cold water “indicator” species

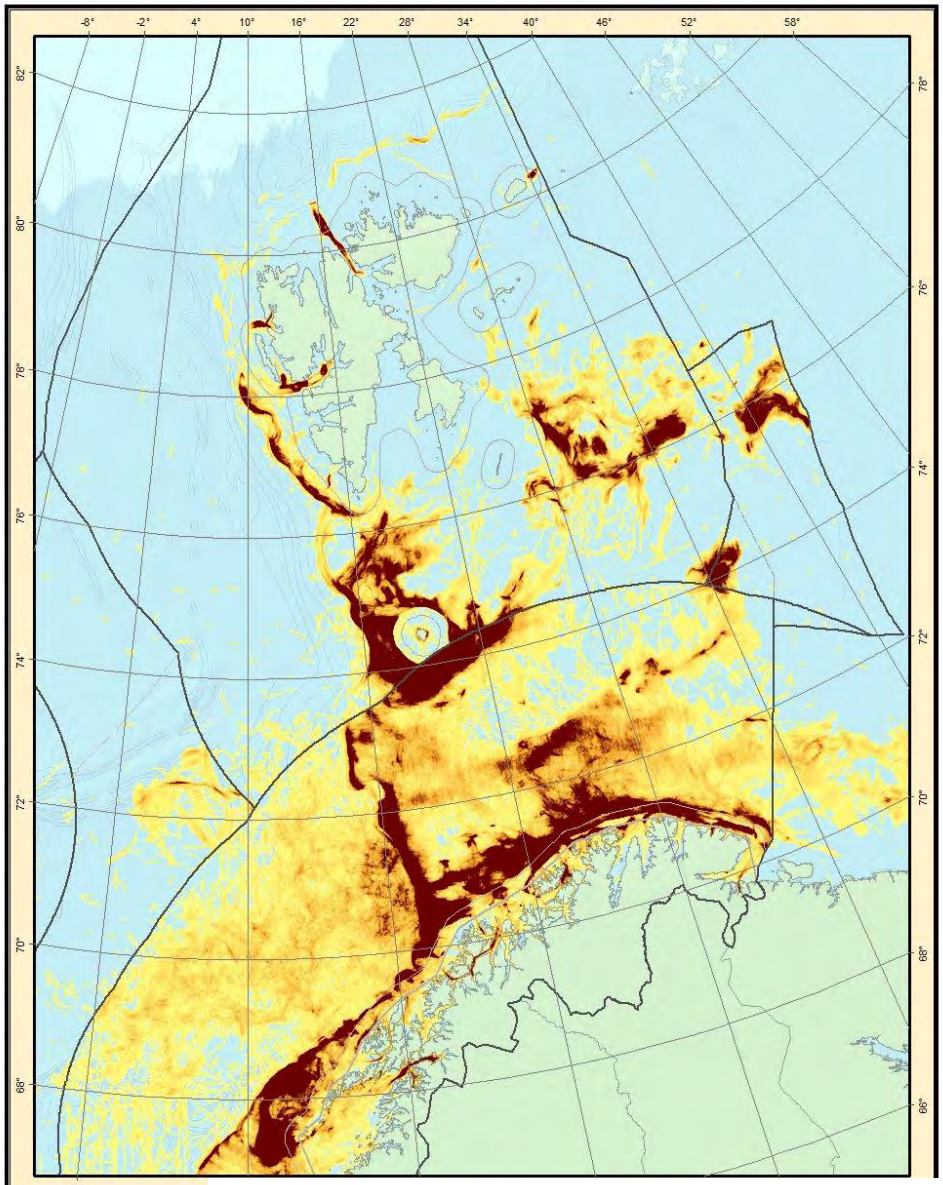
2009

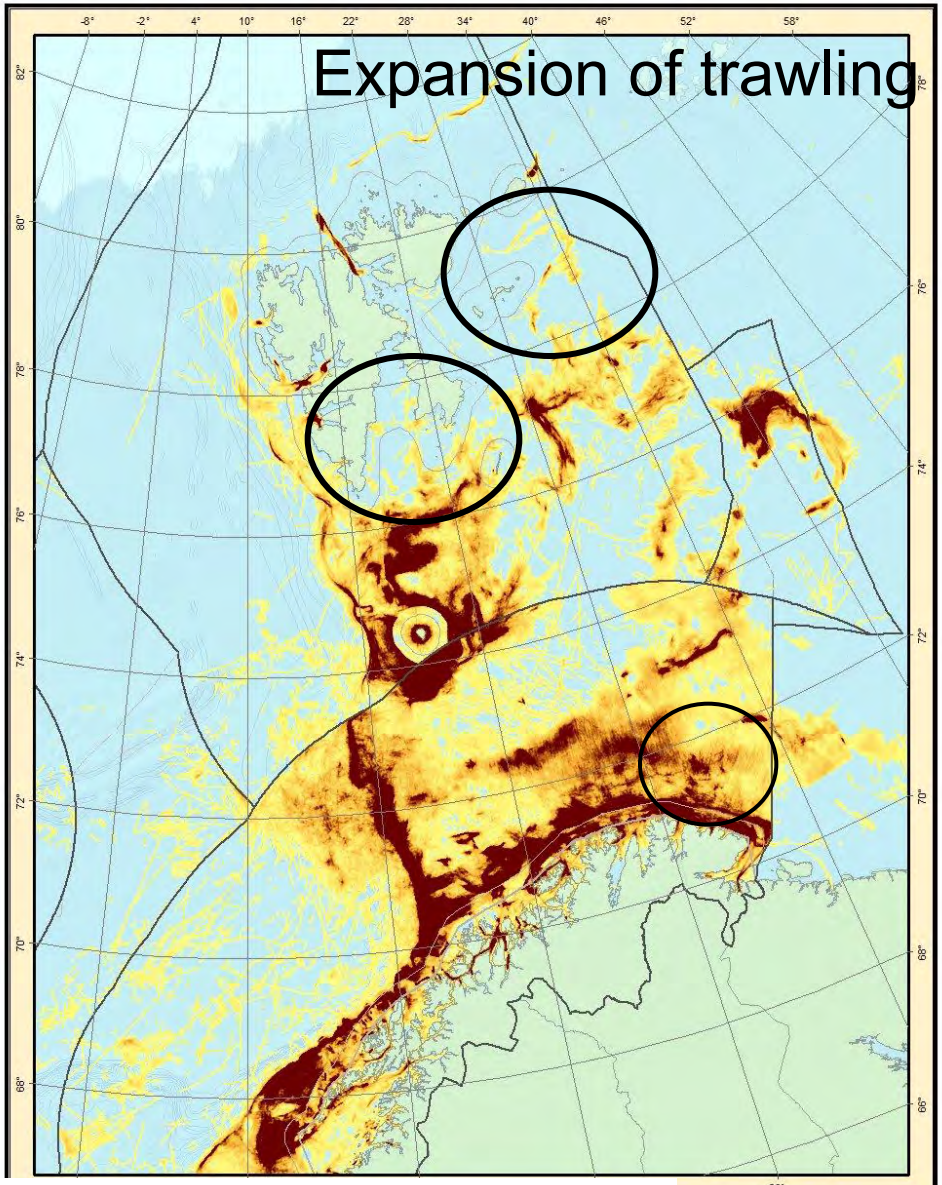


Demanding need of species knowledge !!

2006-2008

2010-2012





Intensitet
Høy
Lav

Trawling

FISKERIDIREKTORATET
Statistikkavdelingen
- Norsk FMC -

Vulnerable species

Gorgonocephalus
basket stars (40cm)

Heliometra glacialis
feather stars (20 cm arms)

Geodia
sponges (15 kg)

Umbellula
sea pens (2.3m)

Survive? Regenerate? Reestablish?

New species: Snow crab

Prey: crustacea, bivalves, brittle-stars, worms

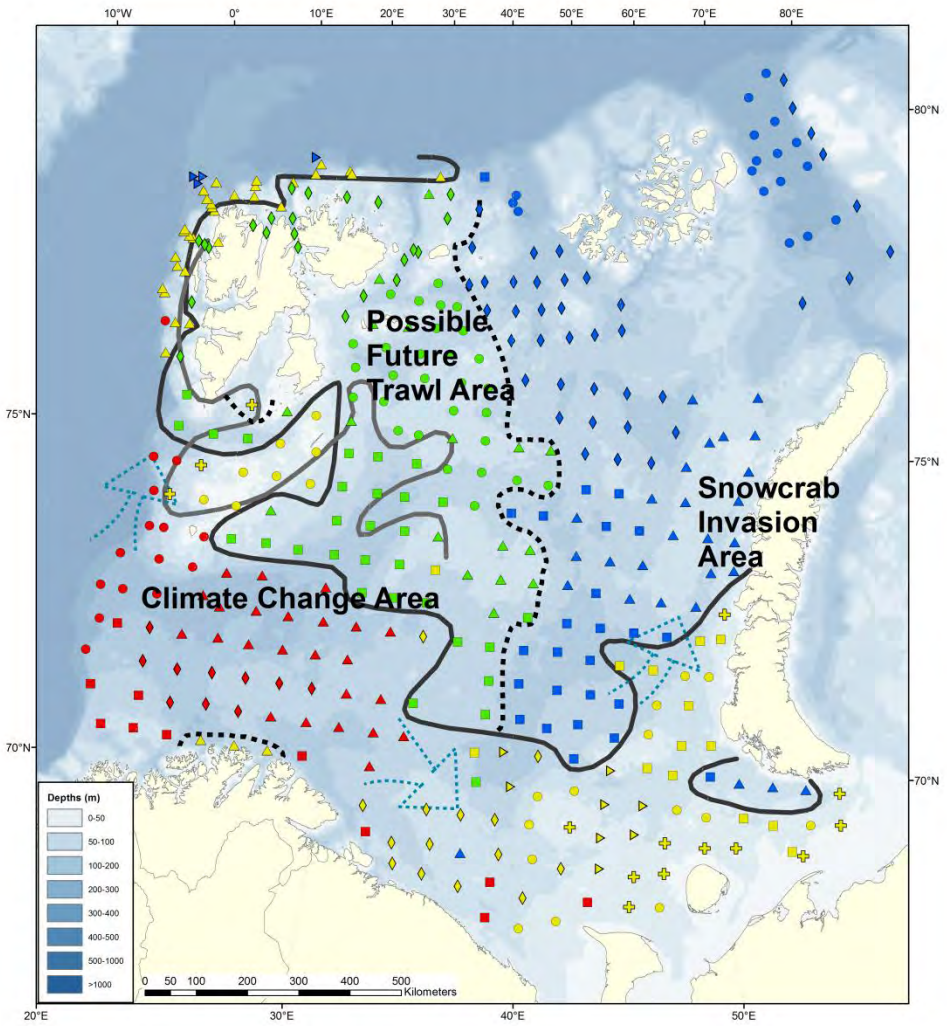
Juvenile crabs: crustacean amphipods and brittle-stars

Adult crabs: annelids, crustacean decapods and fish

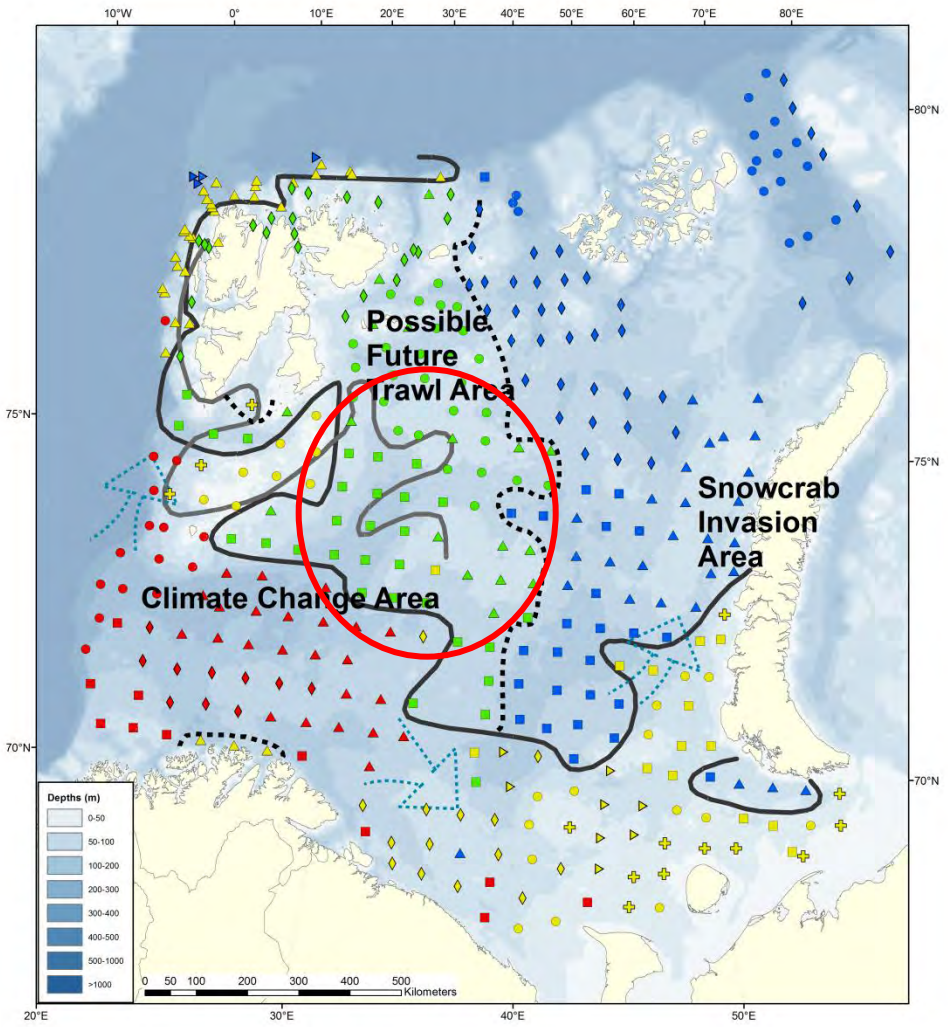
Chionoecetes opilio

Conclusion

Area specific sett of “multiple stressors” on different mega-benthic “communities”



Multiple stressors on *one* megabenthic communities need robust indicators



How to give fast, robust and precise advise

Need to know "what type of signal " !

Are there stressors that are expected to have rapid and significant impacts on benthos where knowledge is lacking? YES

Annually updated GIS maps showing **species range changes**

Annually updated GIS maps showing **stressor range changes**

Study **cumulative effects** on benthos
Secure high quality **species identification**

On a backdrop of a map showing the "benthic state", -> develop a "click" system showing ***vulnerable areas*** based on robust semi-quantitative mapped **benthic species** showing signal toward particular **stressors**

Need to

Monitor the status and changes

Species identification on a high quality level

Species sensitivity to particular pressures

Trait-based analyses to be developed

Advisory product to be developed

MONITORING ARCTIC BENTHIC LIFE

The Circumpolar Biodiversity Monitoring Program's Benthos Expert Network

Jørgensen L.L.[1], Ljubin, P.[2] Guðmundsson G.[3], Ólafsdóttir, S.H.[4], Blicher M.[5], Hammeken, N.[5] Archambault P.[6], Iken K.[7], Bluhm, B. [7,8], Sørensen J.[9], Denisenko N. and S.[10]

[1] Institute of Marine Research, Norway; [2] Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Russia; [3] Icelandic Institute of Natural History, Iceland; [4] Marine Research Institute, Iceland; [5] Greenland Institute of Natural Resources, Greenland; [6] Université du Québec à Rimouski, Canada; [7] University of Alaska Fairbanks, USA; [8] University of Tromsø, Norway; [9] Natural History Museum, Faroe Islands; [10] Zoological Institute, Russian Academy of Sciences, Russia

A proposal to coordinate current Arctic benthic monitoring efforts

- A circumpolar benthic biodiversity monitoring program is proposed across Arctic coastal nations
- The current effort focuses on megafauna as the ecosystem component most regularly sampled in most of the regions.
- The efforts include using annual ground fish trawl surveys as a cost- and time-effective method to analyze benthic bycatch in regions where such surveys exist (e.g., Atlantic Arctic). In other regions, such as the Pacific Arctic, efforts are based on individual projects.
- This program will identify and track changes in benthic life and allow scientists to better understand the effects of natural and anthropogenic pressures from localized to pan-Arctic perspectives.
- Reporting biological change to stakeholders will facilitate informed policy decisions.
- These efforts will create information of pan-Arctic benthic communities that can be updated annually. This information will be publicly accessible through the Arctic Biodiversity Data Service (ABDS).

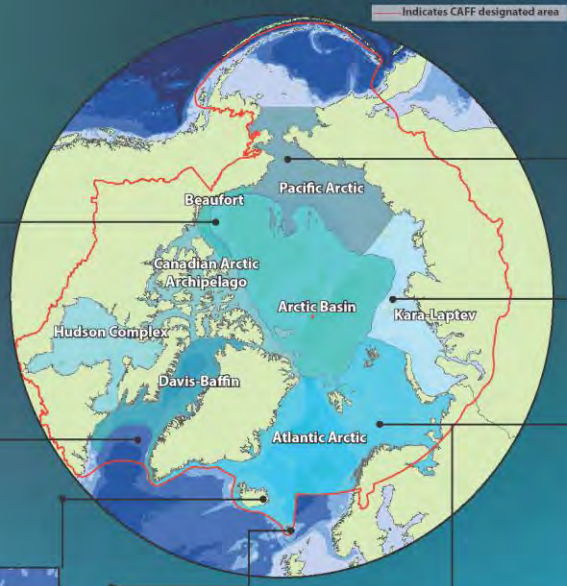
What is the Benthos Expert Network (BEN) of the CBMP?

- The Benthos Expert Network (BEN) is a group of international scientists under the Circumpolar Biodiversity Monitoring Program's (CBMP) Marine component.
- The BEN focusses on implementing the Arctic Marine Biodiversity Monitoring Plan in relation to benthic Focal Ecosystem Components.
- The BEN is identifying existing data for integration and coordinating circumpolar benthic monitoring efforts.

What is the CBMP?

- The Circumpolar Biodiversity Monitoring Programme (CBMP) is an international network of scientists, government agencies, Indigenous organizations and conservation groups working together to harmonize and integrate efforts to monitor the Arctic's living resources. It is the cornerstone program of the Arctic Council's Conservation of Arctic Flora and Fauna (CAFF) working group.
- The CBMP has been endorsed by the Arctic Council. It is the biodiversity monitoring component of the Sustaining Arctic Observing Networks (SAON), the official Arctic Biodiversity Observing Network (Arctic BON) of the Group on Earth Observations (GEO BON), and an information provider to the United Nations Convention on Biological Diversity (CBD).

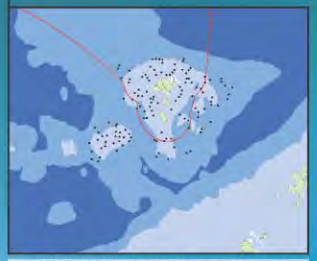
Trawl stations showing existing or possible long-term monitoring areas



Canada: Locations of long-term scientific trawl stations in the Canadian Arctic sampled by the ArcticNet and Beaufort Regional Ecosystem Assessment (Fisheries and Oceans Canada) programs.

Greenland: Location of existing long-term bottom trawl stations in Southeast Greenland, Davis Strait and Baffin Bay conducted by GINR.

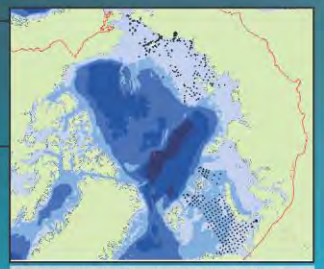
Iceland: Locations of annual fish-survey trawl stations with potential to include benthos monitoring.



Faroe Islands: Locations of Faroe Island annual fish-survey monitoring with potential to include benthos.

Norway: Location of scientific trawl sites with ongoing annual monitoring since 2007 in the Barents Sea.

USA: Locations of scietific trawl stations (black) that have been sampled repeatedly and can contribute to long-term time series. Stations in the Bering Sea (red) are part of the federal annual groundfish trawl survey. Epibenthic invertebrates are identified during these surveys but the region is technically outside of the CBMP definition of the Arctic (see large map).



Russia: Location of long-term trawl stations in the Barents, Chukchi and East Siberian seas that have the potential to include benthos monitoring.

More information: www.caff.is/marine